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# Development of Activity Based Costing (ABC) Optimization Tool for an Environmental Organization

Anthony J. Gutterman


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THESIS

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AFIT/GEE/ENV/97D-08



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THESIS

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Presented to the Faculty of the Graduate School of Engineering

of the Air Force Institute of Technology

In Partial Fulfillment of the

Requirements for the Degree of

Master of Science in Engineering and Environmental Management

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Anthony Gutterman

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## Abstract

The purpose of this thesis was to develop a tool that would allow the user the ability to determine the activities an organization should track using Activity Based Costing (ABC). This was accomplished through the assignment of costs to the maintenance of ABC data and the determination of the benefit received as a result of using ABC. While obtaining the information pertinent to the cost of ABC was relatively straightforward and well documented, the information regarding the value of the benefit of ABC was not available. Therefore, using information provided in the literature concerning savings resulting from making the polluter pay for the amount of pollution generated, a benefit ratio was established based on the idea that when an organization is given both the financial ability and responsibility to pay for its actions, savings will immediately occur.

Current tools and techniques available in the ABC literature concerning the cost and benefit of ABC focus on the development of cost drivers. Nothing is available which focuses on the activities that should be used by an ABC system. This thesis expands the body of knowledge on ABC by developing such a tool. In addition, nothing currently is available which allows an ABC practitioner the ability to know what value of benefit must be received from ABC in order to recoup the financial investment involved in using such a system. Success stories have been written citing 10 to 100 times the investment gained as a result of using ABC, but this may or not be the case for every organization. This thesis fills the gap between hoping to receive a 10 or 100 times payback and knowing what the expected payback must be in order to use ABC beneficially (in terms of dollars invested).

# DEVELOPMENT OF AN ACTIVITY-BASED COSTING OPTIMIZATION TOOL FOR ENVIRONMENTAL FUNCTIONS

## I. Introduction

### Background

A private sector company determines profits by subtracting its' expenses from its' revenues: Revenue-Expense = Profit. In today's competitive market, every company must continuously improve its' operations in order to reduce their expenses. Reducing expenses either gives a company greater profits (holding revenue constant) or it allows a company to reduce the price of their product or service in hopes of gaining market share. In either situation, the company benefits from reducing its expenses. One way companies attempt to reduce their expenses is by reducing or eliminating scrap and rework. In the environmental arena, reducing scrap and rework is equal to reducing or eliminating pollution/waste from being generated. When a company generates less pollution, environmental requirements for permits, treatment, disposal, storage, reporting, etc., are reduced. Reducing these requirements reduces the expenses of the organization and profits are increased.

In the Air Force (AF), or any non-profit organization, the desire to make a profit does not exist. This is due to the fact that revenues (the approved budget) equal the projected expenses of the organization and profit is zero. This does not mean that an AF

organization does not have a desire to reduce expenses. Every year an AF organization is appropriated funding for a specified budget based on projected expenses. If the organization can reduce its expenses, then, holding profits at zero, revenues, in essence, will increase. This means that the organization will have more money to spend for other requirements as a result of reducing its' expenses.

Currently, the Air Force is structured so that one organization is funded to provide another organization with a service at no charge. The money required to pay for this service is routed through the providing organization. Meaning, the Environmental Management (ENV) organization provides, at no charge to the customer, the trained personnel that provide the services required to ensure the installation complies with environmental laws and regulations. In addition, the ENV organization pays the direct costs associated with the disposal of hazardous and solid wastes, the fees associated with required permits, and a variety of other direct costs. In this type of scenario, the only organization which gains or loses financially as a result of the quantity of pollution generated is the ENV organization. Thus, when a process or procedure is changed at an installation and less waste is produced, the 'gained' revenue generated as a result of less waste being produced benefits the ENV organization.

If the Air Force were to change and allow those generating the pollution, or those causing the cost, to be financially accountable for their actions, then the benefit of less pollution would be received by the generators. If this change occurred, the AF environmental organizations would have to determine the cost of providing the service to the other organizations so that they could be charged accordingly. Using the traditional accounting standards applied by the majority of Air Force organizations, the cost of

providing the service would be determined using the cost of labor, materials and overhead. Determining how much labor or material that would be required for a service is relatively easy, but determining what portion of the overhead to place on which service is difficult.

The method used by most AF organizations to cost the overhead to a product or service is to use a direct percentage of money spent. For example, if the cost of a service to the ENV organization was $1,000 in direct labor and $200 in direct materials, then the overhead would be determined by multiplying the sum ($1,200) by a certain percentage (typically 10% to 15%). In this instance, the cost of the service would be:

| *Direct labor* | *Direct material* | *Overhead* | *Total* |
|---|---|---|---|
| $1,000 | $200 | $1,200 * 0.1 = $120 | 1000+200+120 = $1320 |

While using this accounting method would make the customer aware of the costs of its actions (the cost of consuming environmental services), it could be an inaccurate cost due to the method used in applying the overhead charges. As shown in the next chapter, the traditional cost accounting schemes are no longer an accurate portrayal of an organizations costs. Today, Activity Based Costing, or ABC, is the accounting system in use by private industry (Baseman, 1997). ABC is the means to creating an accounting method which directs the costs of an organization to the products and services which required those costs to be incurred (Institute of Management Accountants, 1993).

Accounting Allocations

In the days before automation, labor and material costs were the main costs associated with delivery of a service or production of a product. Overhead was a small portion of the overall cost and therefore was not a major concern. The typical methods for tracing the overhead costs to a product were to use a formula based on required labor or number of products produced. The more labor intensive a product, the more overhead assigned to that product or the greater the number of products, the less overhead applied per product. As technology increased and automation became more efficient, the labor required to produce a product became a smaller percentage of the total cost compared to overhead. For example, if a special machine was purchased to replace a worker or several workers, the direct labor required would decrease while tooling, engineering, programming, and required maintenance support (all overhead costs in a traditional accounting scheme) would increase (O'Guin, 1991: 7). A labor based formula would allocate less overhead to the product using this machine while a product based formula would not change the amount of overhead allocated to this product, assuming the number of products produced remained constant. In either case, the overhead allocated to the product should increase because using the machine caused more overhead resources to be consumed.

Over the years, the traditional accounting methods have remained the same while the major cost distributions have changed. The result is improper assignment of costs to products and services which in turn could effect decision making regarding the cost of a product or service. In the AF, the decision makers usually have to decide a project or contracts fate based on this inaccurate cost information. Some tools typically used by the AF to decide a projects fate are payback periods or cost-benefit ratios. Regardless of the

tools used, the cost information required is not accurate because of the current cost accounting methods used. Therefore, a different method, one that accurately traces all the costs of production (labor, material and all the categories of overhead) back to the product, should be implemented throughout the Air Force.

Activity Based Costing

A cost method currently in use by many private manufacturing and service industries is Activity Based Costing (ABC). In ABC, "the cost of a product is the sum of the costs of all activities required to manufacture and deliver the product" (Cooper, 1988). More simply, "ABC is a technique to accurately assign the direct and indirect costs of an organization to the activities and customers or products which consume the organization's resources." (Callahan, et al., 1996). An activity is defined as a unit of work performed by one or more persons whom belong to the same office or other small group. Examples include daily business activities such as paying bills, taking messages, administering X-rays, etc. (Kehoe, Dodson, Reeve, and Plato, 1995:72). Since activities consume an organizations resources, it is important to determine those activities that add value and those that are non-value adding, so that they can be identified, costed, and earmarked for possible changes (Kobell, 1997). Thus, ABC can be used by the Air Force as a method of providing the accurate cost information needed to those making the decisions facing an organization.

General Issue

If an AF organization decreases pollution generation it does not realize any of the benefit (money saved). Instead, the organizations are given credit and praise for reaching established reduction goals. If an organization could reap the benefits from the money saved as a result of generating less pollution, then reducing pollution would be higher on their list of objectives. For example, when asked why they have their doors open and air conditioner on at their base house on a cool autumn evening, one couple responded, 'we don't pay the electric bill!' If the installation were to give that couple 'X' amount of dollars to pay for the electric bill and told them what they saved was theirs to keep, one could hardly refute that they would take actions to reduce their electric bill. Amplify this scenario across all AF organizations, and the possibilities are astounding. Yet, given the traditional cost accounting standards currently used within the AF, the amount of compensation to assess to each customer cannot be accurately determined.

Problem Statement

Using ABC, an ENV organization can accurately place the cost of activities to the consumers of the activities. Then the correct compensation can be given to AF organizations allowing these organizations to be charged for the ENV activities they consume. Attempting to apply this type of compensation to every organization would undoubtedly be difficult and, in certain circumstances, not beneficial due to the cost of tracking all the required data. Currently, there are no tools available which predict the benefits and costs of making AF organizations financially responsible for the ENV activities they consume. To determine which organizations should be compensated and

then charged for ENV activities, an optimization tool based on ABC concepts should be developed.

## Objective

The objective of this research was to develop a tool which determines the ENV activities that should be charged back to the consumer of those ENV activities. To achieve this objective, an ABC optimization tool was developed (Chapter III) and an analysis conducted of Wright-Patterson Air Force Base (WPAFB) ENV, Dyess AFB ENV, and Cheyenne Mountain AFB ENV functions to validate the tool.

To achieve this objective, three main areas were focused upon. One area focused upon was the identification of the activities performed by an ENV organization. Another area focused upon was the identification of the customers of an ENV organization. The final area focused upon was the determination of the benefits and costs of making the customer aware of the ENV resources they consume (e.g. the costs of obtaining and maintaining the required ABC data and the benefits received from that data).

## Scope of Research Effort

Air Force ENV organizations use neither ABC nor traditional accounting concepts in determining the cost of providing a service. This is due to the fact that funding for such services comes from outside the installation and the true cost of doing business is not a measure ENV organizations track. This research was aimed at developing a tool based on ABC concepts that will allow an ENV organization the ability to determine which services

should be charged to the consumer. The tool may be developed for the environmental organizations of the Air Force, but it can be used by any organization contemplating ABC implementation.

The data that is currently available to support such a tool is quite limited at best. If ABC becomes more accepted by AF organizations, the data required by this tool will become obtainable. What this tool defines for the user is the number of activities that can be beneficially tracked using ABC. This way, when it is time to gather all the information required for ABC implementation, the user knows exactly for which activities additional information is required. As will be defined in the next chapter, ABC relies on cost drivers to tie the activities which consume the organizational resources to the product or service. This thesis effort does not look at the cost driver part of ABC. Instead, it is argued that the cost of ABC is driven in part by the number of cost drivers tracked and the number of cost drivers is a direct consequence of the number of activities. Thus, if one limits the number of activities tracked by ABC, the number of cost drivers will also be reduced thereby reducing the cost of the entire ABC system.

In addition, the scope of this research effort was based on the idea that the expense of the environmental service is what causes the savings to occur. If an organization received additional operating funds every year to pay for environmental services, the only difference would be that the burden to pay for the service has changed. Instead, it was assumed the funds typically directed to the environmental organization to pay for the actions of their customers are now directed to the customers. The customers then use these additional funds how they use all their funds, to pay for their requirements (of which one is now to pay for environmental services as part of their everyday operations). It was

also assumed that when the organizations witness exactly how much of their funds go to pay for the pollution they generate that they will do whatever they can to reduce the amount of pollution and hence, save themselves money.

## Thesis Organization

This chapter presented the background of why traditional cost accounting methods are no longer as accurate as ABC as well as providing a research objective, research questions, scope and limitations and a need for research effort. Chapter Two provides a literature search on the legislative background requiring environmental and financial accountability within the Government, it also describes in detail the problems with the traditional accounting method currently used throughout the Air Force, and it illustrates why ABC is a better accounting method. Chapter Three explains the approach used to address the research question. This is where the activities, costs, and benefits used by the ABC optimization tool are explained. Chapter Four contains the findings and analysis of the results obtained from the data collection. Chapter Five contains the conclusions drawn from this research effort and suggestions for future research.. The appendices an ABC activities dictionary and example calculations used in the development of the ABC optimization tool.

# II. Literature Review

## Overview

This chapter provides a literature search on the topics addressed by this thesis effort. The chapter begins by briefly explaining the legislation that drives the need for accurate cost information. Next, traditional accounting, similar to the system currently used by the Air Force, is contrasted with activity based costing and an example is provided. Finally, the chapter is completed with a brief description of current tools available to ABC practitioners.

## Background

The public began to voice their opinions about how businesses should be regulated in terms of environmental legislation in the 1970's after environmental disasters like Lake Erie being pronounced dead and the Cuyahoga River being so polluted that it caught fire (Masters, 1991). Such incidents ushered in a new environmental era for the United States. Although several pieces of legislation were passed before 1970 which can be considered Acts passed to protect the environment (like the Refuse Act of 1899), none had as profound effect on the way the citizens of the United States conduct their daily operations as those passed since the beginning of 1970. Milestones occurring during that decade included the creation of the Environmental Protection Agency (EPA), the passing of the National Environmental Policy Act, and the passing of the first Clean Air and Clean Water Acts to name a few.

Other regulations and laws passed since that time, like Executive Order (EO) 12856 and the Government Performance and Results Act (GPRA) of 1993, have had big effects on business as usual for Government organizations. EO 12856 required each Federal

facility to comply with the provisions of the 1990 Pollution Prevention Act, which established pollution prevention (P2) as a "national objective" and the most important component of the environmental risk reduction hierarchy (EPA Federal Facility Pollution Prevention, Tools for Compliance, 1994:iii). Some P2 initiatives can be accomplished without the organization incurring a cost (such as simply changing from using a hazardous substance to a non-hazardous substance), yet many require a financial investment. This is where the GPRA has a dramatic effect. The GPRA requires the Federal Government to show results for the money it spends (Bowsher, 1996). Thus, when the Government undertakes a P2 initiative, results must be shown for the money spent. However, the current accounting system used by most of the Government does not provide the proper information required to show accurate results (Kobell, 1994). This is because the current accounting system resembles a traditional costing system where the cost elements are broken down into only three categories: direct labor, direct materials and overhead (Grieco and Pilachowski, 1995:4).

Traditional Costing System

At the turn of the 20th century, only three categories were needed to accurately to assign organizational costs. This was because the majority of the costs of production were related to labor or materials. The total price of a product was determined by adding the cost of direct labor, direct material and a portion of overhead. It is easy to see that the amount of direct labor and materials were easily and accurately assigned to specific products. However, assigning overhead costs equally to all the products was not as

accurate. Nonetheless, the traditional cost accounting system was good enough for the times because overhead was such a small portion of overall product costs.

The problems associated with the traditional accounting method are unique to organizations that produce a variety of products or perform a number of different services. If this were not the case, it would not matter how the overhead was assigned because the one product or one service would be the only output of the organization and all costs would be assigned to the one product/service. For example, assume a company produces only plastic green lawn chairs. It doesn't matter how the different costs are separated in this instance, because in the end, all are related to the lawn chair product. If the company produced 1,000 lawn chairs and the total cost of labor ($12,000), materials ($7,000) and all the different sources of overhead ($1,000) equaled $20,000, then the cost to the company of one chair would be $20 [$20,000/1,000] = $20].

Now suppose the company produces roller-coaster seats in the same factory as the lawn chairs. The roller coaster seats will most certainly require more overhead (from research and development, safety inspections, stricter standards, etc.) than the lawn chairs, but this would not be recognized by traditional cost accounting. For the purposes of this example assume the roller coaster seats require the same amount of labor and material, but the company's overhead increased to $6,000. (Total cost to company is $24,000 labor, $14,000 in materials, and $6,000 overhead). Because the company uses traditional accounting, it does not recognize that the roller seats cause $5,000 in overhead and the lawn chairs $1,000, only that the overhead is $6,000. To determine the price of each of their products, the company sums the costs of labor and materials required for each and then adds a portion of the overhead cost. For the lawn chairs, the cost would be:

$12,000 labor + $7,000 materials + (1,000 lawn chairs * $6,000/2,000 total lawn chairs produced by the company) = $22,000; which equals $22 per chair. Because the roller coaster seats require the same amount of labor and materials, the cost per roller coaster seat would also be $22. Clearly the roller coaster seats should require more overhead for the research and development, inspections (higher standards), etc., but traditional costing doesn't account for the variations in overhead costs.

As illustrated in the above example, the overhead costs of the organization were typically spread across the products based on a formula which was based on some product related measure (Grieco, et. al, 1995:4). Because the ratio of overhead to labor or materials was relatively low, the proper allocation of the overhead costs was not a major issue (Harr, 1991). Having a small ratio between labor or materials and overhead meant the overhead could be assigned to the products in just about any fashion and the bottom line of the company would not be affected. Because the profit margins during this time were high, the company wasn't concerned with properly assigning a few percentage of the overall costs. They just cared that it was divided up in some fashion that seemed logical. The overhead costs could even be grossly mis-assigned and the company would still make money so why worry about properly assigning these costs when the way it was being done resulted in a profit to the company (Rao, 1995).

Today, the world is much more competitive and profit margins are not as high. Moreover, automation and reengineering have reduced the amount of labor required to between 5 and 10 percent of the total expenses while the costs associated with overhead have risen to represent over 50% of the total expenses (Rao, 1995; O'Guin, 1991:6). The idea that labor is the major cost of product is no longer accurate. The overhead costs such

as long distance calls, e-mail systems, wheelchair ramps, trade association memberships, lawsuits, management consulting, fax machines, ergonomic furniture, etc., are now the major costs to an organization (Rao, 1997).

The exact changes in percentages between labor, material and overhead quoted by the different sources available in the literature may differ slightly, however, most agree the portion of labor required will continue to decrease as the overhead portion increases (Harr, 1991). To continue erroneously allocate the increased overhead rates in today's competitive market will most certainly be financially disastrous to most organizations. Therefore, Activity Based Costing (ABC), an accounting method which provides a far more accurate portrayal of costs than traditional accounting, should be used to determine how costs are distributed within an organization (Dean, 1996).

Activity Based Costing

Activity Based Costing, ABC, is an accounting method which provides a far more accurate portrayal of cost than traditional accounting (Dean, 1996). It is currently used by private industry as a way to assign costs to the different activities that are performed in providing a product or service (Cooper and Kaplan, 1991:269). An activity will be defined as an operation conducted by one or more persons such as setting up a machine, receiving raw material, changing the oil in the company car, fulfilling a customer request for use of an aircraft, or administering X-rays (O'Guin, 1991:31; Kehoe et. al., 1995:72; Spinner (a)).

In ABC, the total cost of a product or service is the sum of the costs of all activities required to manufacture and deliver the product or provide the service (Cooper, 1988).

More simply, ABC is a tool that allows an accurate assignment of the costs of an organization to the activities and customers or products which consume the organization's resources (Callahan, Marion, Pohlen and Shishoff, 1996). David Harr (1991) puts it in the most basic terms, ABC presumes that:

- All activities in an organization cause costs
- All activities are incurred to create products or to deliver services, therefore
- All costs are product or service costs.

ABC recognizes that activities are performed at different speeds for different products or customers. It allows for the overhead of a company to be assigned to a product or customer based on the demand that product or company places on the activity. It is in this sense that ABC recognizes the different consumption rates or quantities products or customers require per overhead activity. This way the overhead is not arbitrarily assigned to a product or customer based on an established formula from the past which could lead to faulty decisions about the fate of a product or service (Rao, 1997). Instead, the accurate costs of the current activities performed in the delivery of a product or service are determined based on the demands the current activities place on the current resources of the organization.

Consider the following example from Philip Brooks, Laura Davidson, and Jodi Palamides', "Environmental Compliance: You Better Know Your ABC's," Occupational Hazards, February 1993. This example illustrates the differences between traditional costing and ABC, as well as illustrating the application of ABC methods in a product cost application, and it points out the flaws of traditional cost systems:

A Furniture Manufacture (FM) produces two types of wood chairs, finished (FIN) and unfinished (UNFIN). 500,000 of each type of chair are produced per year. FM is contemplating dropping the UNFIN line due to lack of profits for that product. The waste from the UNFIN line is composed of sawdust and residual glue, both with little environmental consequences. The waste from the FIN line includes paints, stains, solvents, and other toxic adhesives, as well as sawdust and residual glue. In determining whether the UNFIN should be dropped or retained, the company used traditional accounting concepts to determine the profits from each product.

Traditional Accounting Analysis

The Overhead for the previous year was $30 million, distributed as shown below in Figure 1.

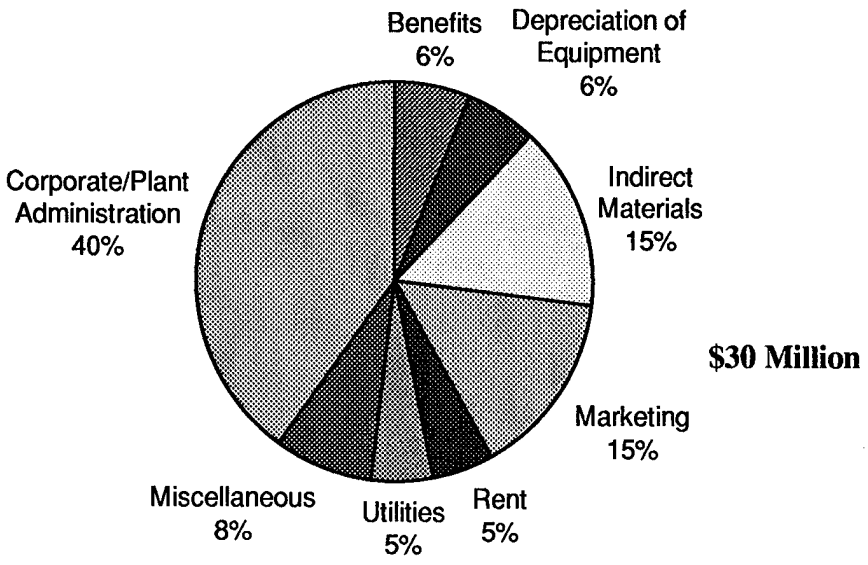


Figure 1. FM's Total Overhead

The traditional cost accounting method requires three inputs: labor cost, material cost and overhead cost. In this example, the cost of labor is $10 per UNFIN chair and $10.50 per FIN chair equaling a labor charge of $10.25 million per year [($10*500,000 UNFIN) + ($10.5*500,000 FIN)]. The material cost for UNFIN is $10 and $15 for FIN. The overhead of the company is charged to each product based on a labor cost required factor ($10.25 Million labor required to make the chairs).

For UNFIN:

$10 direct labor/UNFIN * $30 Million Overhead / $10.25 Million = $29.27/UNFIN

For FIN:

$10.5 direct labor/UNFIN * $30 Million Overhead / $10.25 Million = $30.73/FIN

The price of each product is the $30 million in overhead is then divided between the two products as shown in Table 1.

Table 1. FM's Product Costs

| UNFIN | $/chair | FIN | $/chair |
|---|---|---|---|
| Direct Labor | 10.00 | Direct Labor | 10.50 |
| Direct Material | 10.00 | Direct Material | 15.00 |
| Overhead | 29.27 | Overhead | 30.73 |
| Total | 49.27 | Total | 56.23 |

In order to be competitive, FM must set the price of each chair at comparable market values which are $50.00 and $60.00, for UNFIN and FIN respectively. The apparent profit shown from traditional accounting is $0.73 for UNFIN ($50.00-$49.27) and $3.77 for FIN ($60.00-$56.23).

Based on the information given from traditional accounting, the UNFIN chairs are not as profitable as the FIN chairs. FM's yearly profits from the two chairs are $365,000 for UNFIN and $1.89 Million for FIN. However, before the fate of UNFIN could be decided, someone within FM asks why the environmental costs are lumped into the overhead and then almost equally divided between the two products when environmental costs are mainly the consequence of the FIN chairs. This caused the company to look at the activities it performed for each product. This process of analyzing the activities performed is also known as activity based costing.

ABC Analysis

A review of FM's records resulted in the determination of distinct environmental activities, Solid Waste (SW) Disposal, Environmental (ENV) Audits, Storage Permits for Hazardous Substances (HS), and Hazardous Waste (HW) Disposal, as shown in Figure 2. Specifically, the review determined that of the $5.4 million of the total $30 million overhead was attributable environmental costs. The remaining activities were indistinguishable between the two products and therefore were calculated as before.

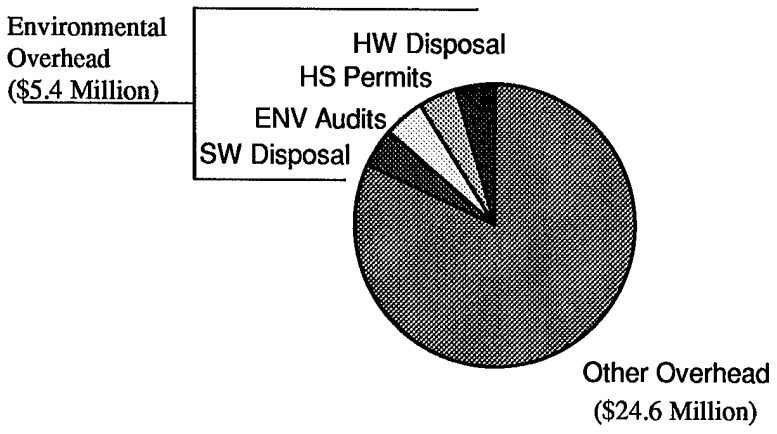


Figure 2. ABC Environmental Overhead for FM

FM was able to determine the total spent on SW Disposal as a result of producing both UNFIN and FIN chairs to be $60,000. The other environmental activities resulted from the production of the FIN chairs. Their costs were found to be $1.67 Million for ENV Audits, $1.0 Million for Storage Permits for HS, and $2.67 Million for HW disposal. Using this information, the ABC pricing of the two FM products is shown in Table 2.

Table 2. ABC for FM

| UNFIN | $/chair | FIN | $/chair |
|---|---|---|---|
| Direct Labor | 10.00 | Direct Labor | 10.50 |
| Direct Material | 10.00 | Direct Material | 15.00 |
| SW Disposal | 0.06[a] | SW Disposal | 0.06[a] |
| ENV Audits | 0 | ENV Audits | 3.34[b] |
| Storage Permit HS | 0 | Storage Permit HS | 2.00[c] |
| HW Disposal | 0 | HW Disposal | 5.34[d] |
| Other Overhead | 24.00 | Overhead | 25.20 |
| Total Overhead (Environmental Overhead + Other Overhead) | 24.06 | Total Overhead (Environmental Overhead + Other Overhead) | 35.94 |
| Total | 44.06 | Total | 61.44 |

a - $60,000 for SW Disposal/1,000,000 chairs = $0.06/ chair.
b - $1.67 Million ENV Audits/500,000 FIN chairs = $3.34/FIN chair
c - $1.0 Million Storage Permits HS/500,000 FIN chairs = $2.00/FIN chair
d - $2.67 Million HW Disposal/500,000 FIN chairs = $5.34/FIN chair

The established price based on traditional costing for the UNFIN and FIN chairs were $50 and $60, respectively. The result of setting the prices at these levels as revealed by ABC is a profit of $5.94 ($50.00 - $44.06) for the UNFIN chair and a loss of $1.44 for the FIN chair ($60 - $61.44).

A comparison between the two accounting methods is shown below:

| | Cost Per Unit | |
|---|---|---|
| | UNFIN Chair | FIN Chair |
| Traditional | $49.27 | $56.23 |
| Activity based costing | 44.06 | 61.44 |
| Profits Resulting From Traditional per chair | 0.73 | 3.77 |
| Profits Resulting From ABC per chair | 5.94 | -1.44 |

Based on the ABC analysis, FM can now see that the true cost of doing business for both chairs is not as previously thought. In fact, FM can see the UNFIN chair is the only profitable product produced. This insight could lead to a variety of consequences. For instance, FM could decide to entirely discontinue the FIN chairs. FM could also see that changing the substances used in the process of making FIN chairs from a hazardous substance to non-hazardous substance would greatly decrease, if not eliminate, the need for audits, permitted storage space, and HW disposal. Doing this could increase FM's profit on FIN chairs to $9.24 a chair (eliminating the need for environmental issues reduces the cost per chair to the company by $10.68; $61.44 - 10.68 = $50.76; $60.00 - $50.76 = $9.24). The issue that is being explained through this example is that ABC provides a far more accurate portrayal of product costs than the traditional accounting systems.

In addition, the benefit of ABC can be seen by comparing the results of the comparison. Thinking that losing $1.44 per FIN chair is unacceptable to FM, the company could either change its processes and procedures to make the FIN chair

profitable, or they could decide to drop the FIN chair from their product line. If FM decides to drop the FIN chair products, then their net profit for their products will increase from $4.50 ($5.94-$1.44) to $5.94 a chair. This represents a gain of 32% to the companies bottom line. Yet, a 32% benefit represents FM's 'worst case' scenario as a result of using ABC. If the company decides to change its processes and procedures to such an extent as to make the FIN chair profitable, the net gain to the company will be higher than 32% because the net profit will be $5.94 per UNFIN + the profit per FIN chair. Thus, the benefit that FM receives from knowing the true cost of their two products $0.32 on the dollar , or 32%.

Current ABC Tools

The available literature on ABC provides numerous techniques as to the method or style to use in establishing ABC for an organization (O'Guin, 1991; Miller, 1996; Ness and Cucazza, 1995; Haedicke and Feil, 1991; Kobell, 1994). While many practitioners provide different methods or styles to establishing ABC, there exists two common steps among all: first, identify the activities performed by the organization and place the costs of the organization into these activities; second, identify the drivers of those activities so that the costs of the activities can be related to the product or service. A cost driver is anything that changes the cost of an activity (Miller, 1996:9). Examples of a cost driver are square footage, number of set-ups, or number of work orders. The more square footage a product requires, the more an activity such as 'store product' costs. Figure 3 illustrates the basic premise common to the methods of ABC as found in the literature. The arrows in Figure 3 show the relationship each part of ABC has on the other. For

example, working from the cost of the service provided upwards, the cost of the service is determined by the amount of cost drivers 'triggered' or consumed in delivering the service. The cost drivers are used to tie the consumption patterns of the service to the actual activities performed by the organization. Performing the activities is what causes the resources of an organization to be consumed.

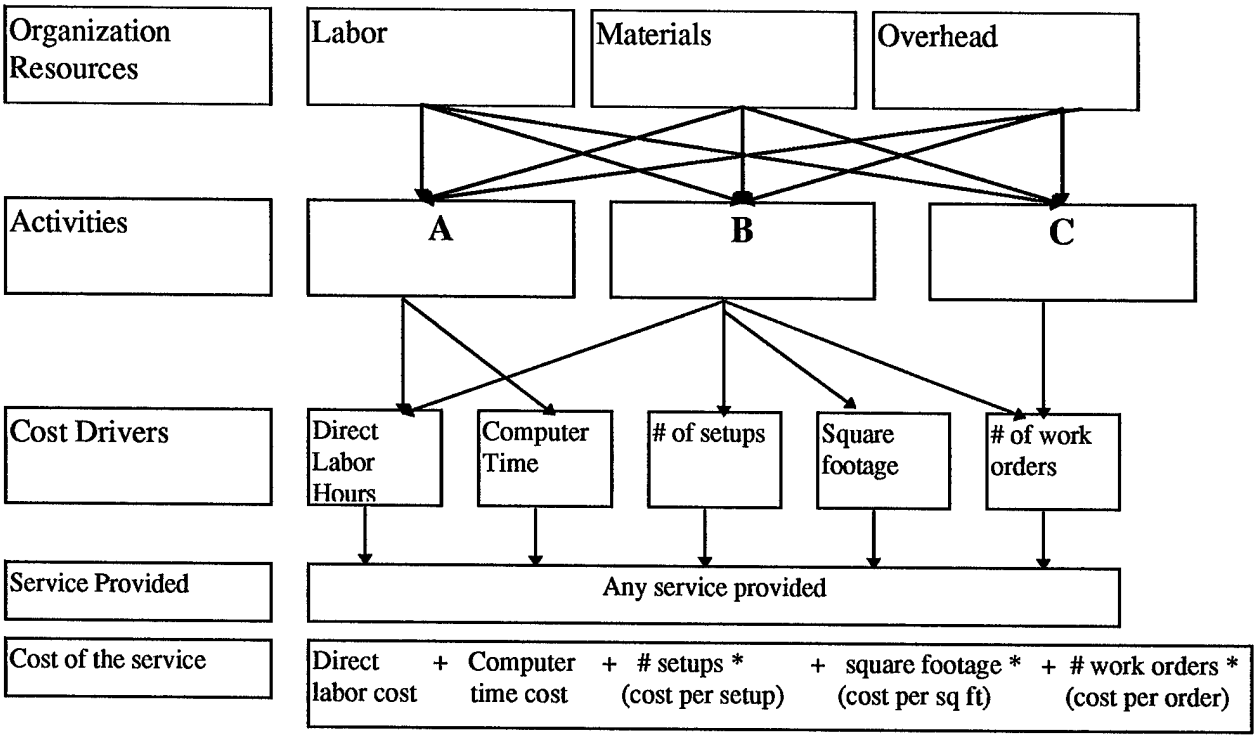


Figure 3. ABC Approach

Figure 3 represents an activity as having multiple cost drivers, which may or may not be the case. In most situations, multiple cost drivers will be required, but that is left to the user of ABC to determine (Miller, 1996:9). The important point to remember in developing ABC for an organization is that more activities and associated cost drivers

equal a higher operating cost for the accounting system (O'Guin, 1991:80). The inverse of this statement may also be true in that tracking more cost drivers may equate to better informed decisions being made. However, most organizations are in business to make money and should not track the activities where the cost is greater than the benefit.

The overall benefits of ABC are viewed to outweigh the costs in the literature (Rao, 1995; Miller, 1996; O'Guin, 1991; Rao, 1997; Haedicke and Feil, 1991; Ness and Cucuzza, 1995). The benefits of ABC are in the form of increased accuracy of product cost information which will allow better informed decision making to take place. The costs of ABC are the real dollars required to establish, operate, and maintain the information system to track the cost drivers. Increasing the number of activities to track increases the number of cost drivers required to track the required ABC information. As shown in Figure 3, the number of cost drivers per activity are typically greater than one. Hence, increasing the ABC complexity by one activity will result in the creation of at least one, if not several, additional cost drivers which equate to higher ABC system costs.

Currently there are tools available which help the ABC practitioner determine what types and how many cost drivers an organization should utilize in an ABC system (Babad and Balachandran, 1993; Cooper, 1988 (a), Cooper, 1988 (b), Cooper, 1989). However, there are no techniques which show the specific activities that should be tracked based on a cost-benefit analysis. Specifically, no tool exists which illustrates for an organization the activities that should be used in an ABC system on a benefit - cost analysis. This thesis develops such a tool.

# III. ABC Optimization Tool Development

This chapter describes the development of the generic activity based costing optimization tool and answers the investigative questions set forth in the first chapter. The purpose of the tool is to provide users with an idea of the expected level, or the number of activities, their ABC system should track based on a cost and benefit analysis. The first section of this chapter develops an activity list applicable to most environmental functions. The second section describes how the costs and benefits of ABC were developed. The third section describes the ABC optimization tool.

## Section 1. Environmental Activities.

The activities described in this section were derived from a literature search to make it applicable to a wide range of environmental functions. An environmental law book, journal articles, and the Department of Defense's The Environmental Assessment and Management (TEAM) Guide were utilized. This section is concluded with a description of how to relate specific activities listed for this model to those performed by individual environmental functions.

Why develop an Activity List? Kobell (1994) explains the first phase of ABC as establishing the department's activities and outputs. Other advocates of ABC concur that identifying the activities performed by an organization as the first and most important step in the development of ABC (Harr, 1991; Lewis, 1995:120; Brimson, 1991:82). That is why the development of the activity list was the first step in the ABC optimization tool.

What is an activity? As previously defined, an activity is a unit of work performed by one or more persons whom belong to the same office or other small group. Determining the specific activities performed by an organization is not extremely difficult. Observation, archival analysis, brainstorming, interviewing, and surveying are all methods currently used to determine the activities of organizations (Cooper, 1990; Kehoe et. al. 1995; Brimson, 1991:79). The method of obtaining the activity information is unimportant. What is important is that the information depicts the workings of the organization.

How were the activities identified for the ABC optimization tool? The ABC optimization tool was developed so the user could easily identify which activities performed by their organization should be tracked using ABC. This was accomplished by first identifying what the most likely activities are that typical environmental organizations (similar to Air Force environmental organizations) perform. The best way to accomplish this would have been to survey several environmental organizations and ask them the activities they perform in providing different services. The problem with attempting such a feat was most organizations do not know how to define the specific activities they perform in delivering a service (unless they are using ABC). They know they provide pollution prevention services, natural and cultural resources services, or hazardous waste compliance services, but they do not know all the specific activities involved in providing that service (manhours, computer time, office supplies, consulting support, office space, etc.). In addition, because environmental protection is required by state and local law as well as Federal law, the services performed may be different from one state to the next. Because each organization would define the activities they perform differently, the surveying of different organizations to find the common activities was not considered a

viable method for developing an activity list. Instead a literature search for applicable Federal laws and regulations was used. States may develop their own standards based on Federal law, however, the standards they develop must be at least as stringent as Federal law. Thus, there was a logic to basing the activities developed for the ABC optimization tool on Federal law.

Thomas F. P. Sullivan edited the Environmental Law Handbook, 13th edition (1995) in which the environmental laws and issues that effect an environmental function were covered in full detail. These include the: Resource Conservation and Recovery Act; Clean Air Act; Clean Water Act; Oil Pollution Act; Safe Drinking Water Act; Emergency Planning and Right-to-Know Act; Comprehensive Environmental Response, Compensation, and Liability Act; National Environmental Policy Act; Federal Facilities Compliance Act; Toxic Substances Control Act; Underground Storage Tanks; and Pesticides. The acts and issues were described in enough detail to allow the research to be related to activities which must be accomplished to satisfy the requirement.

In order to define these regulatory requirements in terms of actual activities performed by a military environmental function, the Department of Defense's TEAM Guide was used to tie a DoD's actions to a regulatory requirement. In addition, an article by Burt Hamner and Christopher Stinson (1995) entitled *Managerial Accounting and Environmental Compliance Costs*, was used to relate regulatory requirements to specific activities performed. Figure 4 illustrates the activities which resulted from the literature search. It is important to mention that the activities listed in Figure 4 do not comprise a complete list of every activity performed by an ENV organization. The level of detail which could be added to every activity is nearly endless. For instance, the activity 'Obtaining and

Maintaining Permits' could be broken down further into obtaining a Title V permit. Taking it further, the activities which are accomplished to obtain the permit, such as take out form, put form in typewriter, fill-out form, place form in envelope, address form, mail form, etc., could all be tracked. However, the more activities one tracks, the more costly it is to utilize an ABC model. If the designer of an ABC model is given a choice about making the model more or less complex, he should err on the side of less (O'Guin, 1991:80). Thus, when first setting up ABC for an organization it is important to lay a foundation that is easy for the entire organization to work with, and from there details can be added or deleted. The activities listed in Figure 4 lay this foundation for any environmental organization implementing ABC. An activity dictionary is provided at Appendix A to clarify what is meant by each broad based activity listed in Figure 4.

Figure 4. Environmental Activities

| Service | Activity |
|---|---|
| Air Management | -Obtaining and Maintaining Permits[a]<br>-- Title V<br>-- Incinerators<br>-- Engine Test Cells<br>-New Source Performance Review<br>-CFC and Halon Management<br>-- Class I and Class II Ozone Depleting Chemical Management<br>-Air Emissions Inventory<br>-Air Emission Monitoring[b] |

Figure 4. Environmental Activities

| | |
|---|---|
| Air Management (cont) | -- Testing and Sampling<br>-Operate air emission treatment equipment<br>-Audits<br>-Record-keeping |
| Hazardous Material Management | -Purchasing Hazardous Materials<br>-- Placing and processing orders<br>-- Receiving and storing materials<br>-Obtaining and maintaining Material Data Safety Sheets<br>-- Maintaining a hazardous communications program<br>-Oversee industrial hygiene audits<br>-Prepare Toxic Release Inventory<br>-Preparing Emergency Planning and Community Right-to-Know reports<br>-Prepare emergency plan (Spill Prevention Control and Countermeasures Plan)<br>-Prepare Tier one/Tier Two reports<br>-Responding to spills<br>-- Fire department actions<br>-- Spill equipment required<br>-- Training<br>-- Environmental reporting<br>-Procurement of hazardous material facility<br>-- obtaining and maintaining permit<br>-Labeling requirements<br>--Drums, Facilities, Transportation<br>-Purchase and maintain personal protection equipment<br>-Purchase and maintain secondary containment equipment<br>-Filing and record-keeping<br>-Perform Audits |
| Hazardous Waste Management | -Hazardous waste identification<br>-- testing and sampling<br>-Resource Conservation Recovery Act reporting of identified hazardous waste activities<br>-Obtaining Environmental Protection Agency hazardous waste generator number<br>-Obtaining and maintaining Treatment, Storage, and Disposal Facility permits[a]<br>-Treatment, Storage, and Disposal Facility operations<br>--Security, communications, safety, fire, |

Figure 4. Environmental Activities

| | |
|---|---|
| Hazardous Waste Management (cont) | and decontamination equipment<br>-Preparation and maintenance of hazardous waste manifest<br>-Preparing wastes for transport<br>--Preparing container labels<br>-Paying hazardous waste transportation and disposal fees<br>-Procurement of hazardous waste storage containers<br>-Oversee (training and inspection) hazardous waste satellite accumulation point management<br>-Treatment of hazardous waste[c]<br>-Disposal of hazardous waste[c]<br>-Preparing Spill Prevention Control and Countermeasures Plan[d]<br>-Test and maintain hazardous waste equipment<br>-Biennial 'Waste Activities' Report preparation<br>-Preparation of Closure and post-closure plans for Treatment, Storage, and Disposal Facilities<br>-Training<br>- Handling of hazardous wastes other than satellite accumulation points |
| Petroleum, Oil and Lubricant (POL) Management | -Preparation of Spill, Control, and Countermeasures Plan<br>-Obtaining and Maintaining POL permits[a]<br>-Monitoring and Permitting of used oil collection/recycling areas |
| Wastewater/Drinking Water Management | -Obtaining and Maintaining National Pollution Discharge Elimination System Permit[a]<br>-Operating wastewater treatment plant<br>-- Permitting<br>-- Record-keeping<br>-- Operator certification<br>-- Sludge treatment and disposal<br>-- Monitoring, sampling, testing<br>-- Equipment and facility depreciation<br>-- Equipment and facility maintenance<br>-- Reporting<br>-- Treatment<br>or |

Figure 4. Environmental Activities

| | |
|---|---|
| Wastewater/Drinking Water Management (cont) | -Paying wastewater treatment fees<br>-Operating industrial wastewater pretreatment plants<br>-Obtaining and Maintaining[a] permits such as:<br>-- Storm water<br>-- Non-point sources<br>-- Sludge disposal<br>-- Dredge and fill<br>-- Septic tanks<br>-- NPDES<br>-Spill Prevention, Control, and Countermeasures plan<br>- Maintaining drinking water standards |
| Solid Waste Management | -Collection of solid wastes<br>-- Separating and storing recyclables<br>-Obtaining and maintain[a] landfill permits<br>-- Includes closure plans, monitoring and record-keeping |
| Other | -Above and underground storage tank management<br>-- Resource Conservation Recovery Act Subtitle I reporting and record-keeping<br>--Upgrading or removal of existing underground storage tanks<br>-- Monitoring underground storage tank corrosion control systems<br>-- Maintaining leak detection equipment<br>-- Release reporting, investigation and response actions<br>-Preparing Environmental Compliance Assessment and Management Program Audits (ECAMP)<br>- Performing activities associated with Toxic substances (asbestos, PCBs)<br>-Performing ECAMPs<br>-Follow-up actions after ECAMPs |

[a] Operating and Maintaining permits involves the paperwork preparation, reporting, testing, sampling, and monitoring required under the associated permits

[b] Monitoring is required per permit and for Volatile Organic Compounds.

[c] Treatment and Disposal of hazardous wastes on site

[d] Spill Prevention Control and Countermeasures Plan is also called a Contingency Response Plan or Spill Response Plan

Section 2. Costs and Benefits of ABC.

Costs of ABC. There are three main costs associated with ABC. First, training is required in order to ensure those personnel involved with ABC understand what it is they are doing and why. Second, time (labor hours) must be spent collecting the ABC data. Third, an information system (or some other similar system) must be developed to process the ABC data. Because the true cost of a system is not fully realized until it is developed, costs were estimated based on comparing systems currently in use by organizations (similar to any organization comparable to ENV) utilizing ABC and then choosing the most expensive option. Choosing the most expensive option can be considered a conservative approach. For example, consider an employee conducting a cost estimate for the delivery of the latest edition of an item hot off the production line. Upon consulting different sources, the employee determines the cost of the delivering the item in question could be as low as $100 and as high as $500 depending on the day of the week the item is delivered. The employee does not know when the item will be finished, s/he only knows the boss wants it delivered the day it comes of the production line. In addition, the employee knows personnel are fired for estimating costs to be lower than the actual costs. Therefore, the employee will be conservative and estimate that the cost to deliver the item will be $500. This way the most expensive option is chosen and when the cost is less, the employee is rewarded (not fired) for obtaining the service below cost.

Training. For ABC to be successful, everyone needs to be familiar with ABC and its concepts (O'Guin, 1991:125; Norkiewicz, 1994; Player and Keys, 1995). Initial and recurring training are required to ensure that everyone involved with ABC knows their responsibilities and why they are doing the job they are doing. This training can be conducted by any of several methods. A consultant may be hired to teach the organization ABC or an organization may appoint someone to become an ABC 'Champion' with the intentions that person will train the rest of the organization. Because the exact training methods used by the users of this tool are unknown, the costs of the training involved with ABC were estimated.

It was assumed that an organization will choose someone to champion the ABC effort for the organization. The cost of this training was estimated to be only the costs associated with the time (labor hours) spent receiving the training. The length of such training was estimated at 3.5 days based on the length of ABC training course currently offered by Mrs. Paula Spinner, Senior Cost Analyst, SAF/FMCE (Spinner (c)). By taking 3.5 days, or 28 hours, the cost of ABC training can readily be estimated for the employees of an organization.

Record-Keeping/Data Collection. The cost of record-keeping or data collection will be defined as the time (labor) needed to record an activities duration as well as the time required to record the direct costs (service contracts, credit card purchases). This means that for every activity, there are two pieces of information that must be documented: the labor and the direct cost to the organization for the activity (permit fees, disposal costs, recycling costs, etc.).

The labor costs were determined for a military organization by referencing the 1996 Uniformed Services Almanac (pp. 15-62) and the 1996 general schedule annual salary for Dayton, Ohio (Defense Finance and Accounting Service, 1996). The hourly wages listed in Table 3 were determined based on between 2 and 20 years in the service, with additions for basic allowances for quarters and substances for military employees.

Table 3. Hourly Wage Averages[a] for 1996 for Military and Civilian

| Rank[b] | Average Hourly Wage($/hr)[c] | Rank[b] | Average Hourly Wage($/hr)[c] |
|---|---|---|---|
| O1 | 14 | E9 | 22 |
| O2 | 18 | GS7 | 14 |
| O3 | 23 | GS8 | 15 |
| O4 | 26 | GS9 | 17 |
| O5 | 30 | GS10 | 20 |
| E3 | 10 | GS11 | 21 |
| E4 | 11 | GS12 | 25 |
| E5 | 13 | GS13 | 30 |
| E6 | 15 | GS14 | 35 |
| E7 | 17 | GS15 | 41 |
| E8 | 20 | | |

a- averages were taken for the pay of all grades for different years in service and step-increases.
b- O-1 through O-5 were used because it is not expected that an O-6 or higher is a part of a normal ENV organization. It is expected that no lower than E-3 or GS-7 is a part of an ENV organization.
c- averages were based on monthly salaries, an 8 hour work day and 4.33 weeks worked a month.
See appendix B for the computation of Table 3.

The numbers given in Table 3 were further simplified to obtain four different categories as shown in Table 4. The categories were determined based on grouping similar salaries.

Table 4. Pay Grade Categories to be Used in the ABC Optimization Tool

| Pay Grade Categories | | Hourly Wage[a] ($/hr) |
|---|---|---|
| A | E3-E4 | 11 |
| B | E5-E8, O1, O2, GS7 - GS11 | 17 |
| C | GS12, GS13, O3 - O4,E9 | 24 |
| D | GS14 - GS 15,05 | 34 |

a- determined based on a 40 hour work week, 4.33 weeks per month, 12 months per year

The categories were separated based on the average pay grade of employees found at most Air Force environmental organizations. In fact, the majority of the people working for an Air Force environmental organization are in categories B and C (Cheyenne Mountain AFB had two Category (Cat) B employees, and Dyess AFB had 8 Cat B, 1 Cat C and 1 Cat D employees). As a result, the above categories should mirror the typical organization to cover a range of employees found in the organization. [Most Air Force environmental organizations are staffed with officers below the O-4 level, enlisted below the E-9 level, and general schedule civil employees below the 12 level.] By first categorizing the employees and second averaging the hourly wages representative to the categories, the ABC optimization tool is greatly simplified. If the user of the tool disagrees with the break down of employees into categories, the user may keep every worker's pay grade separate.

Once the pay grades are determined, all that is required is to determine the cost of record-keeping per employee. The time required to enter the ABC data was estimated to be 10% of the total time spent on the activity by the employee. For example, suppose a worker spends 1 hour a week on activity A, then it can be estimated that the time required to record ABC data for the activity would be no more than 10% of that hour, or 6 minutes.

It could be argued the time required to enter the data per activity could be considered constant. The only thing an employee must do for ABC is to document the proper information required and that should be the same every time. Yet, as stated before, the ABC optimization tool only provides the activities which should be tracked. It doesn't provide the actual drivers which will be used in ABC. The information concerning these drivers is the actual data required by ABC. Because the exact drivers that will be used by an organization which utilizes this tool was unknown, an estimate had to be made as to the amount of time that would be spent per ABC data entry. Thus, the 10% rate which varies according to the time devoted to the activity by the employee was chosen because it was a conservative approach (Spinner, 15 Oct 1997, stated that ABC maintenance is about 15 to 25 hours a quarter [or just over 5% of a workers time], depending on the data required).

A problem that may be encountered when attempting to use the 10% rate in practice is when the duration of the activity is short. For example, if the activity only requires 2 minutes of a persons time, then, according to this estimate, 12 seconds will be required to enter ABC data. While it is easy to see that 6 minutes out of an hour is a conservative estimate, it is not as easy to see that someone could spend just 12 seconds entering data. That is why this estimate was developed only for the use of this optimization tool. Once the activities that should be tracked by an environmental organization are identified (result of this thesis), the exact measures (cost drivers as well as time needed to input the data for that driver) will have to be developed. If the 10% estimation used in this thesis proves incorrect, it can easily be changed.

ABC System Software (or other comparable information system): Private companies specializing in ABC were contacted and requested to provide information about the cost of ABC software and associated training. The results are shown in Table 5.

Table 5. Cost of ABC Software

| Company | Software | Cost of ABC Software[a] and software training[b] |
|---|---|---|
| ICMS Software, Inc. 1-800-955-2233 | CMS-PC™ | $11,000 |
| ABC Technologies (503)-626-4895 | EasyABC Plus* | $7,000 |

* This software is currently used at Air Staff on projects of limited duration or having quick prototype potential (Spinner(b))
a - per organization (multiple users, networking license)
b- the cost of training is for one individual. Time required for entire organization is included in the 3.5 days of ABC training required per personnel

In order to remain conservative, the cost of ABC software to be used by an organization utilizing the ABC optimization tool was estimated at $11,000. This $11,000 includes the cost of an ABC software system that has networking capabilities as well as networking licensing rights. In addition, the cost of training one individual (e.g. the ABC champion to use the system is included in the $11,000.

Once the ABC software is in place, the ABC information required must be obtained and entered into the program. The cost associated with this undertaking is the time (labor) associated with the ABC champion determining the required information. This could range anywhere from 50 to 200 hours depending on the complexity of the organization (Spinner, 15 Oct 1997). It was assumed the person to be designated as the ABC champion will be in pay grade category B. For Cheyenne Mountain AFB, due to nature of the environmental organization (contracted organization) it was determined that

50 hours would be needed to start the ABC system. It was assumed that for both Dyess AFB, and Wright-Patterson AFB 150 hours would be required to obtain the information needed to start an ABC system. The reason the maximum times were not used is because it was assumed that an ABC system built as a result of the ABC optimization tool would not be as complex as an ABC system built without using the tool. In addition, because the time required to identify the activities of the organization will not be required (listed in Figure 4), the time required to establish an ABC system was assumed to be less than the maximum.

Benefits of ABC. Consider an example (Rao, 1997) where four co-workers have lunch together at an expensive restaurant (one where the prices aren't listed on the menu) to celebrate a job well done. One of the four workers is health conscious and orders only a house salad and a glass of water. The others however, order appetizers and a seven course T-bone steak feast, all the while downing glasses of the best champagne. When the bill comes, only the total amount is listed for the four meals. Because they have no idea how much each item was, they decide to separate the bill equally four ways. The result for the health conscious worker is an expensive salad. This is similar to the division of organizational costs under traditional accounting.

Now consider they do know how much each persons portion of the bill was because the prices are on the menus and they were given separate checks. This allows for the correct portions to be assigned correctly and accurately to each individual similar to ABC for services and products. How much benefit would the people involved receive knowing how much they spent? The answer to this questions lies in the actions taken by the

individuals in response to knowing the cost of their actions. If they chose a cheaper restaurant with the same quality of food then the benefit would be the difference in the amount expected to be spent at the expensive restaurant and the actual amount spent at the cheaper restaurant. In this scenario it is easy to place a dollar value on the benefit. This is not the case for environmental organizations because many of the benefits that result are avoidance of fines, decreased potential for liability, increased health, better public image, etc.

Some of the benefits of ABC itself are that it provides: the information needed for the ability to make improved decisions; the information to decide on which continuous improvement activities to pursue; and it gives the user the ability to easily determine relevant costs concerning a product or service (Cooper and Kaplan, 1991:277). These benefits are only received by the organization after the ABC fueled actions are taken to reduce expenses or improve the organization. (O'Guin, 1991:76; Miller, 1996:28). What this means is that an organization will only know if ABC is beneficial to them when (if), after it is implemented, the quality of the product is improved, the cost of the product is decreased, or money is saved by the organization as a result of the information provided by ABC. The result of such an understanding is that many organizations undertake ABC initiatives without knowing what to expect in terms of a benefit as a result. They only see that it works for other companies and that maybe it will work for them.

In order to determine the activities that should be costed using ABC techniques on a benefit - cost analysis, some type of benefit expected from ABC must be established for the organization. This will allow the organization to determine for which activities it

should develop cost drivers and related ABC information in the beginning stages of ABC development.

To determine the benefit that will be entered into the ABC optimization tool, assumptions were made. The first assumption was that once both the true cost of an activity and the customers of that activity are determined, the customers will be held financially liable for causing those costs. If the four co-workers at the restaurant didn't have to pay the bill because the company was picking up the tab, they wouldn't care if it came with or without each persons portion identified accurately and correctly. In this instance, the information provided by separate checks, or ABC, would not result in any benefit to the users. This type of scenario is the practice currently used within Air Force environmental organizations. Money is appropriated to the Department of Defense by Congress and then it is passed through different channels until an environmental organization receives a budget and the responsibility to 'pick up the environmental tab' for the installation. For example, the money to pay for the disposal of the hazardous waste generated as the result of the repairing of a jet engine is not paid for by the maintenance shop that worked on the engine nor is it paid for by the flying squadron that operates the plane which utilizes the engine. Instead, ENV, who has no say in how that engine was fixed, pays for the disposal. If the engine shop or flying squadron were given the financial ability and responsibility to pay for the services rendered in the disposal of the hazardous waste then there may be an incentive to those organizations to reduce the amount of hazardous waste generated.

Consider another example where person X, who lives in a residential area, has all the household bills paid for by a wealthy friend. X finds out the residential area has changed

its policy concerning solid waste disposal. The city will now weigh all the material in the non-recyclable bin and charge the residents based on that weight. In addition, the city decided to give reduced charges to the residents that consistently separate their trash from the recyclables and fill the recycled bins on a weekly basis. Because X never pays the solid waste bill, there is no incentive to reduce the amount of waste in the trash bin and increase the amount in the recycled bin. Suppose the wealthy friend decided to give X the amount of money that used to be spent on X's solid waste disposal making X responsible for the disposal bill. Any savings resulting from X lowering the disposal fees would go directly into X's pocket. It is evident that X now has an incentive to decrease the amount of wastes placed into the non-recyclable bin. The end result is less trash goes to the landfill and X benefits by gaining spending money.

The above examples provide an illustration of how a dollar value will be placed on the benefits received from ABC in this thesis. It was assumed that when an organization is given the financial ability to pay for environmental services and the ability to reap the benefits of reduced expenses, that they will reduce the amount of pollution they generate thus saving themselves money and producing less waste. The rest of this section details how the dollar values were determined and how they will be assigned.

A literature search was accomplished to determine the dollar amount expected to be saved as a result of reducing pollution (which will occur by changing to ABC). Haynes C. Goddard (1995) stated in his article *The Benefits and Costs of Alternative Solid Waste Management Policies,* that the price elasticity of demand for waste management services (measured as waste generation) was found to be about 0.20. This means that an increase in price results in a decrease in waste generation (for every 10% increase in price there is a

2% drop in waste generated). When a person, or an organizational unit, goes from paying nothing for waste disposal to suddenly being charged for waste disposal services, it can be safely assumed that they will see the price as being increased. Therefore, the organizational unit will take some type of action to reduce the amount of wastes being generated. Actions such as turning off the water when not in use, re-using red rags more times than normal, using more 'elbow grease' to clean parts instead of a hazardous substance, etc., are all no-cost actions which can easily be accomplished by any unit.

Goddard (1995) also stated that a system such as making one pay for the waste they generate, results in a 17% to 25% net economic savings. Using these figures, supported by the price elasticity of demand of 0.20, it was assumed that a 20% savings could be expected as a result of making the polluter aware of the costs of their actions. This means that for every dollar charged back to an organizational unit for environmental activities listed in Figure 4, $0.20 will be saved as a result.

The $0.20 on the dollar saved is the possible savings as a result of the efforts taken by the unit after being made aware of its actions. Yet, the potential of the savings based on ABC goes further than the $0.20. Current analysis of pollution prevention projects shows that the payback of a pollution prevention project is 3 to 1. For every dollar invested in pollution prevention, three are returned to the organization (Ogden, 1996; Friend 1994; U.S. Federal Energy Management Program, 1995). Thus, if the organization takes the $0.20 saved as a result of ABC and invests in a pollution prevention effort then the potential benefits of ABC to the organization is $0.40 (invest $0.20 at a 3 to 1 payback = 3*(.2) - .2 [← Initial investment] = 0.40).

In summary, if an organization is held financially accountable for the environmental costs it incurs then the quantity of pollution (waste) generated will decrease. Less pollution generated equals a drop in expense. Holding the profit at zero and revenues constant in the profit equation, a decrease in expenses for one requirement equals the ability to take on additional expenses. If the additional expenses are caused as a result of investment in a pollution prevention project, than the payback of the investment can be expected to be 3 to 1, or 300%. Subtracting the investment yields a net gain of over 200%.

The 40 % payback is considered to be a conservative estimate for the benefits received from ABC systems. After the fact assessments of ABC have resulted in benefits of 10, 20 even 100 times the investment (Ness and Cucuzza, 1995). However, such a statement may be misleading to an ABC practitioner due to the fact that they refer to an average benefit. If an ABC system had been developed based only on the activities which resulted in a gain (based on a cost - benefit analysis), then the true benefit could be even greater than cited above. This thesis fills that gap between hoping to receive a 10 or 100 times payback and knowing what the expected payback must be for a given investment.

Section 3. Activity Based Costing Optimization Tool.

The ABC optimization tool described in this section was developed to give environmental organizations a tool that optimally determines the activities which should be tracked using ABC. This optimum point has been defined as the point when the benefits outweigh the costs. To determine what activities should be tracked to the customer, the following five step process was developed.

STEP ONE

The purpose of step one is to identify the activities completed by the ENV organization and the customers of those activities.

Step One is to be completed by personnel familiar with the activities performed by the organization. The first part of this step is to determine which activities listed in Figure 4 are actually performed by the ENV organization. This is accomplished by the user simply marking yes if the activity is performed. If an answer for an activity is yes, then the user must identify the customers of that activity. A customer was defined at the squadron level (or comparable structured units in organizations outside the Air Force) to minimize the complexity.

A sample matrix for Step One is below in Table 6.

Table 6. Sample Matrix for Step One of the ABC Optimization Tool.

| Activity | Does your organization perform this activity? | If the activity is performed by your organization, who are the customers?[a] |
|---|---|---|
| **Provide Air Management Service:** | | |
| Obtaining and Maintaining Permits<br>-- Title V<br>-- Incinerators(classifieds, medical)<br>-- Engine Test Cells | | |
| -New Source Performance Review | | |
| -Ozone Depleting<br>Chemical Management | | |
| -CFC and Halon Management<br>-- Class I and Class II | | |
| -Air Emissions Inventory | | |
| -Air Emission Monitoring<br>-- Testing and Sampling | | |

a - The customer level must be defined by the user.

The result of step one will be the creation of a matrix which provides the ENV organization with an easy to read table of the ABC activities performed and for who they are performed. This will allow for the employees to simply insert the percentage of time they spend on the activity per customer listed (Step Three)

Consider an example where all the activities in Table 6 except for 'New Source Performance Review' and 'Ozone Depleting Chemical Management' were marked as completed by the organization. For 'Obtain and maintain permits,' the customers were identified as A, B, and C, for 'CFC and Halon Management' the customers were C and D, for Air Emissions Inventory the customers were A, B, C, D, E and F, and the customers for 'Air Emissions Monitoring' the customers were A, B, and C. The resultant matrix is shown below in Table 7. Table 7 simply lists all the activities that were marked as completed and all (cumulative) the different customers.

Table 7. Example of Resultant Matrix Completed After Step One.

| ACTIVITY | CUSTOMER | | | | | | |
|---|---|---|---|---|---|---|---|
| Air Management Service | A | B | C | D | E | F | TOTAL |
| Obtain and maintain Air permit | X | X | X | | | | |
| CFC and Halon Management | | | X | X | | | |
| Air Emission Inventory | X | X | X | X | X | X | |
| Air Emission Monitoring | X | X | X | | | | |

STEP TWO

The purpose of step two is to determine the different pay grade categories of the organization that will be used in the ABC optimization tool.

The different wage grades within the organization must be determined. This allows for a distribution of the labor hours which are performed in the accomplishment of each activity to simplify the optimization tool. For an Air Force ENV function, the pay grade categories and associated hourly wage were listed in Table 4 and are summarized below:

| PAY GRADE CATEGORY | HOURLY WAGE ($/HR) |
|---|---|
| A | 11 |
| B | 17 |
| C | 24 |
| D | 34 |

STEP THREE (must be completed for each pay grade)

The purpose of step three is to determine the time spent on the activities per customer. This allows the labor charges to be calculated that will be charged back to the customer. In addition, once the time spent per activity is determined, the cost of ABC data entry (record-keeping/data collection) can be calculated using the estimation that 10% of an employees time spent performing an activity will be spent tracking the required ABC data. This step is divided into three parts. Part A determines the amount of time spent on the activities per customer. Part B determines the cost of labor as a result of the listed activities and customers. Part C determines the cost of keeping track of the ABC data required.

Part A. Determination of the time spent on activities per customer by every employee.

Using the matrix developed in step one (Table 7), the time spent on the activity for each customer per employee must be determined. Each employee in the organization that is even remotely involved with the listed activities must fill in the percentage of their time that is spent in a given year performing or supporting the listed activities per customer. Considering some months require some activities to take more time (such as the months that a TRI report is due or that an audit is performed), thus allowing an accurate reflection of how the ENV personnel spend their time.

ENV organizations often hire personnel for a specific purpose such as POL management or AST/UST management. Some personnel may have additional duties to include other activities, but for the majority of installations, specific activities are the responsibility of specific employees. In the instances where more than one employee performs work for an activity and customer, an average must be taken to determine the percentage of time spent. This must be accomplished for each pay grade. Accomplishing this task for each pay grade reduces the amount of ABC data maintenance required.

It is important to note that the matrix developed in step one will not include all the activities which consume an organizations time. This is because tracking activities such as coffee breaks, telephone conversations, and staff meetings, etc., represent costs within an organization which remain lumped together in traditional overhead costs and are nearly impossible to trace to an activity or customer. This time and associated labor cost will remain a consequence of the ENV organizational activities and will continue to paid for by the ENV organization. This means the total amount of time spent by an employee on the listed activities for the given customers will rarely, if ever, be equal to 100%.

Continuing the example started in Step One, assume there are 3 Category B employees and 1 Category C employee who spend their time on these activities and customers. The result of the time spent by the employees per pay grade category is shown in Table 8. The first value are the total percentages spent by the Category B employees while the percentages in parenthesis represent the total spent by Category C employees (e.g. 15(5) equals 15% total time for the three Category B employees and 5% total time for the Category C employee. Note: 15% for the Category B employees is the total time spent by the three employees. It could mean 15% spent by one employee and 0% by the other two or one employee could spend 7% of their time, one could spend 5% of their time and the third could spend 3% of their time on this activity. This number is the total spent by all three Category B employees).

Table 8. Example of Percentage of Time Spent on Activities and Customers.

| ACTIVITY | CUSTOMER | | | | | | |
|---|---|---|---|---|---|---|---|
| Air Management Service | A | B | C | D | E | F | TOTAL |
| Obtain and maintain Air permit | 15(5) | 15(5) | 5(1) | 0(0) | 0(0) | 0(0) | 35(11) |
| CFC and Halon Management | 0(0) | 0(0) | 20(15) | 20(10) | 0(0) | 0(0) | 40(25) |
| Air Emission Inventory | 20(10) | 20(10) | 10(5) | 5(1) | 5(1) | 5(1) | 65(28) |
| Air Emission Monitoring | 20(2) | 20(2) | 20(2) | 0(0) | 0(0) | 0(0) | 60(6) |
| Total | 55(17) | 55(17) | 55(23) | 25(11) | 5(1) | 5(1) | 200(70) |

Table 8 does not suggest the employees put forth 200% effort for these activities and customers. What Table 8 shows is that of the 3 Category B employees, the average time spent on these activities and customers is 66.7% (200%/3 employees). The 70% total shown for the Category C employee in Table 8 is the amount of time the employee spends on these activities and customers.

Part B. Determination of the cost of labor as a result of the listed activities and customers.

Based on the information given by the employee as to the time spent, the labor costs to an organization can be calculated. For the organization with the time percentages listed in Table 8, the cost of labor was determined as follows for the activity 'Obtain and Maintain Air Permits' for customer A.

3 Category B employees earn $17 / hr each and the Category C employee earns $24 / hr and both category employees work an average of 50 weeks a year. [50 weeks a year is used because each employee is assumed to take two weeks off a year]. Therefore, the labor costs to the organization as a result of this activity and customer were determined.

For Category B employees:

15% of the employees time * 40 hrs/week * 50 weeks a year * $17/hr = $5,100/year.

For the Category C employee:

5% of the employees time * 40 hrs/week * 50 weeks a year * $24/hr = $2,400/year.

The total labor cost to the organization as a result of this activity and customer were then determined to be $7,500 ($5,100 + $2,400). This type of calculation was repeated for every pay grade category in order to determine the total cost consumed by the activities per customer per year. The results for this example are shown in Table 9.

Table 9. Example of Labor Costs.

| ACTIVITY | CUSTOMER | | | | | | |
|---|---|---|---|---|---|---|---|
| Air Management Service | A | B | C | D | E | F | TOTAL |
| Obtain and maintain Air permit | $7500 | $7500 | $2180 | 0 | 0 | 0 | $17,180 |
| CFC and Halon Management | 0 | 0 | $14000 | $11600 | 0 | 0 | $25,600 |
| Air Emission Inventory | $11600 | $11600 | $5800 | $2180 | $2180 | $2180 | $35,540 |
| Air Emission Monitoring | $7760 | $7760 | $7760 | 0 | 0 | 0 | $23,280 |
| Total | $26,860 | $26,860 | $29,740 | $13,780 | $2,180 | $2,180 | $101,600 |

To ensure the calculations were completed correctly, all that is needed is a quick check of the total percentages given in Table 8 compared to the overall total of Table 9. 200% (total) of the three Category B employees time and 70 % of the Category C employees time equates to:

(2.0*$17/hr*40 hrs/wk*50 wks/yr) + (0.70*$24/hr*40 hrs/wk*50 wks/ yr) = $101,600/yr.

Part C Determination of the costs associated with ABC data maintenance.

Using the assumption that 10% of time spent on an activity is spent recording the ABC data as outlined in section 2 of this chapter, the costs associated with record-keeping and data collection can be determined. Continuing the above example, Table 10 lists the results of taking 10% of an employees time spent per activity per customer as the time required for ABC data maintenance. An example of how to obtain the cost of recordkeeping for customer A and the activity 'Obtain and Maintain Permits' is illustrated below.

For Category B employees:

10% * (15% employees time * 40 hrs/wk * 50 wks a year * $17/hr) = $510/year.

For the Category C employee:

10% * (5% employees time * 40 hrs/wk * 50 wks a year * $24/hr) = $240/year.

Total cost to organization of ABC = time needed by Cat B & Cat C employees to record the data or $510 + $240 = $710. This type of calculation was repeated for all the customers and activities listed in Table 9 and the results are shown in Table 10.

Table10 . Example of ABC Data Maintenance Costs.

| ACTIVITY | CUSTOMER | | | | | | |
|---|---|---|---|---|---|---|---|
| Air Management Service | A | B | C | D | E | F | TOTAL |
| Obtain and maintain Air permit | $750 | $750 | $218 | 0 | 0 | 0 | $1,718 |
| CFC and Halon Management | 0 | 0 | $1400 | $1160 | 0 | 0 | $2,560 |
| Air Emission Inventory | $1160 | $1160 | $580 | $218 | $218 | $218 | $3,554 |
| Air Emission Monitoring | $776 | $776 | $776 | 0 | 0 | 0 | $2,328 |
| Total | $2,686 | $2,686 | $2,974 | $1,378 | $218 | $218 | $10,160 |

STEP FOUR

The purpose of step four is to identify the direct non-labor costs which will be charged back to the customers of the activities. The direct costs associated with service contracts and other direct costs associated with the performance of an activity must be determined per customer. If the costs can not be traced back to a specific customer (due to information not being available), than an assumption must be made as to how these costs are to be distributed. The assumption made was basted on the time spent on the activity per customer by all the employees. The best method for explaining this assumption is to continue with the example.

Assume the direct non-labor costs associated with these activities was determined but that each customers portion could not be identified. Thus, the non-labor direct costs were divided among the customers based on the time spent on the activities by the employees. The total costs were $25,000 for Obtain and Maintain Air Permits, $2,000 for CFC and Halon Management, $10,000 for Air Emission Inventory, and $5,000 for Air Emission Monitoring. Using the values listed in Table 8, an example of how to divide the non-labor

direct costs for customer A and the activity 'Obtain and Maintain Permits' is illustrated below.

The amount of time spent by Category B employees was 15% for this customer on this activity. The total amount of time spent on this activity by Category B employees was 35%. The total amount of time spent by the Category C employee was 5% for this customer and 11% for the entire activity. Using these values, the percentage of non-labor direct costs attributable to customer A for this activity can be determined.

$25,000 *[(15% + 5%)/(35% + 11%)] = $10,870.

This type of calculation was repeated for all customers and activities and the results are shown in Table 11.

Table 11 . Example of Division of Non-Labor Costs.

| ACTIVITY | CUSTOMER | | | | | | |
|---|---|---|---|---|---|---|---|
| Air Management Service | A | B | C | D | E | F | TOTAL |
| Obtain and maintain Air permit | $10870 | $10870 | $3260 | 0 | 0 | 0 | $25,000 |
| CFC and Halon Management | 0 | 0 | $1077 | $923 | 0 | 0 | $2,000 |
| Air Emission Inventory | $3871 | $3871 | $1936 | $774 | $774 | $774 | $12,000 |
| Air Emission Monitoring | $1667 | $1667 | $1666 | 0 | 0 | 0 | $5,000 |

STEP FIVE

Using all the identified items from steps one through four, as well as the costs and benefits as defined in section 2, determine which activities should be tracked back to each customer. Section 2 defined the costs of ABC to be the cost of training, record-keeping, and ABC system software. The cost of record-keeping was assumed to be the labor charges associated with 10% of the time spent performing an activity would be required for record-keeping/data collection (Table 10). The cost for training and ABC system

software will be distributed among the customers in a method similar to the one described in step four for direct non-labor costs as illustrated below.

Using $11,000 as the cost of the ABC system software, 3.5 days as the length of training ENV personnel received, and 100 hours as the time required by the ABC champion to obtain the required information for ABC, the costs associated with the ABC system software were determined for the example started in Step One. For the activity Obtain and Maintain Air Permits for customer A, the following calculation explains the process for dividing the ABC system software and training costs up among the activities and customers.

Training Costs for Category B employees = 3*(3.5 days*8 hrs a day*$17/hr) = $1,428. For the Category C employee = 1 * (3.5 days * 8 hrs a day * $24/hr) = $672.

The cost to obtain ABC data information as gathered by one Category B employee = 100 hours * $17/hr = $1,700.

Total cost of ABC system software and set-up =

$11,000 + $1,428 + $672 + $1,700 = $14,800.

The portion of this cost attributable to customer A for the activity Obtain and Maintain Air Permits was determined by taking the percentage of time spent by the employees for this activity and customer compared to the total percentages spent for all activities and customers.

$14,800 * [(0.15 + 0.15) / (2.00 + 0.70)] = $1,096

This type of calculation was completed for all activities and customers and is shown in Table 12.

Table 12 . Example of Division of ABC System Software and Set-up Costs.

| ACTIVITY | CUSTOMER | | | | | | |
|---|---|---|---|---|---|---|---|
| Air Management Service | A | B | C | D | E | F | TOTAL |
| Obtain and maintain Air permit | $1096 | $1096 | $329 | 0 | 0 | 0 | $2,521 |
| CFC and Halon Management | 0 | 0 | $1919 | $1644 | 0 | 0 | $3,563 |
| Air Emission Inventory | $1644 | $1644 | $823 | $329 | $329 | $329 | $5,098 |
| Air Emission Monitoring | $1206 | $1206 | $1206 | 0 | 0 | 0 | $3,618 |
| Total | $3,946 | $3,946 | $4,277 | $1,973 | $329 | $329 | $14,800 |

The benefits resulting from ABC are equal to 40% of the value charged back to the customers. The value that will be charged back to the customers is equal to sum of labor charges (Table 9) and non-labor direct costs (Table 11) associated with the activities. The total to charge back for this example is shown in Table 13.

Table 13. Example of Total Value to Charge Back.

| ACTIVITY | CUSTOMER | | | | | | |
|---|---|---|---|---|---|---|---|
| Air Management Service | A | B | C | D | E | F | TOTAL |
| Obtain and maintain Air permit | $18370 | $18370 | $5440 | 0 | 0 | 0 | $42,180 |
| CFC and Halon Management | 0 | 0 | $15077 | $12523 | 0 | 0 | $27,600 |
| Air Emission Inventory | $15471 | $15471 | $7736 | $2954 | $2954 | $2954 | $47,540 |
| Air Emission Monitoring | $9427 | $9427 | $9426 | 0 | 0 | 0 | $28,280 |
| Total | $43,268 | $43,268 | $37,679 | $15,477 | $2,954 | $2,954 | $145,600 |

The benefit received as a result of charging back the costs in Table 13 equal 0.40 of the value charged back as shown in Table 14 for all activities and customers.

Table 14. Example of Benefit Received

| ACTIVITY | CUSTOMER | | | | | | |
|---|---|---|---|---|---|---|---|
| Air Management Service | A | B | C | D | E | F | TOTAL |
| Obtain and maintain Air permit | $7348 | $7348 | $2176 | 0 | 0 | 0 | $16,872 |
| CFC and Halon Management | 0 | 0 | $6031 | $5009 | 0 | 0 | $11,040 |
| Air Emission Inventory | $6188 | $6188 | $3094 | $1182 | $1182 | $1182 | $19,016 |
| Air Emission Monitoring | $3771 | $3771 | $3770 | 0 | 0 | 0 | $11,312 |
| Total | $17,307 | $17,307 | $15,071 | $6,191 | $1,182 | $1,182 | $58,240 |

The activities which should be tracked using ABC as a result of using the ABC optimization tool are then determined by subtracting the costs associated with ABC from the benefits for each activity and every customer. The costs associated with the model are a summation of the ABC data maintenance costs (Table 10) and the ABC system software and set-up costs (Table 12). The total cost of ABC is shown in Table 15.

Table 15. Example of Total Costs of ABC.

| ACTIVITY | CUSTOMER | | | | | | |
|---|---|---|---|---|---|---|---|
| Air Management Service | A | B | C | D | E | F | TOTAL |
| Obtain and maintain Air permit | $1846 | $1846 | $547 | 0 | 0 | 0 | $4,239 |
| CFC and Halon Management | 0 | 0 | $3319 | $2804 | 0 | 0 | $6,123 |
| Air Emission Inventory | $2804 | $2804 | $1403 | $547 | $547 | $547 | $8,652 |
| Air Emission Monitoring | $1982 | $1982 | $1982 | 0 | 0 | 0 | $5,946 |
| Total | $6,632 | $6,632 | $7,251 | $3,351 | $547 | $547 | $24,960 |

The final step of the ABC optimization tool is to subtract Table 15 from Table 14. The activities and customers which result in a positive value (greater than zero) are the activities and customers which should be investigated further using ABC so the cost drivers can be identified and a full ABC accounting system established. The result of subtracting Table 15 from Table 14 is shown below in Table 16.

Table 16. Example Output of ABC Optimization Tool.

| ACTIVITY | CUSTOMER | | | | | |
|---|---|---|---|---|---|---|
| Air Management Service | A | B | C | D | E | F |
| Obtain and maintain Air permit | $5502 | $5502 | $1629 | 0 | 0 | 0 |
| CFC and Halon Management | 0 | 0 | $2712 | $2205 | 0 | 0 |
| Air Emission Inventory | $3384 | $3384 | $1691 | $635 | $635 | $635 |
| Air Emission Monitoring | $1789 | $1789 | $1788 | 0 | 0 | 0 |

If the values in Table 16 had not all been positive then the above procedure would have to be iterated until only positive values remain in Table 16. The iterative process would be accomplished by noting which activities and customers resulted in a negative value in Table 16. Then the user would have to go back to Step Three (Table 8) and place a 0 for percentage of time spent in any cell (activity and customer intersections) where ever there had been a negative value in Table 16. The reason this needs to be accomplished is because the costs associated with ABC system software and set-up must only be divided amongst the activities that are finally chosen to track with ABC. If this procedure is not followed, then the cost of the ABC software and set-up will be spread across all the activities and customers in a similar manner to the way traditional accounting tracked overhead costs. An example of how to accomplish this iterative process is illustrated in Section 1, Finding 3 of Chapter IV.

# IV. Results/Data Analysis

## Overview

This section of the research effort reports the results of the data analysis from the ABC optimization tool that was summarized in Chapter III. The first section details the results for Cheyenne Mountain AFB. The second section details the results of the tool for Dyess AFB. The third section details the results for Wright-Patterson AFB.

## Section 1. Results for Cheyenne Mountain

Using the 0.4 benefit ratio ($0.40 benefit for every $1.00 charged back to the customers) and 10% of time spent on the activity as the labor required for maintaining the ABC data, the tool was utilized for Cheyenne Mountain AFB (CMAFB). The personnel at the ENV organization were given a table with all activities listed in Figure 4 and asked to respond to whether the activities were performed and who the customers are for the activities performed. The other information required from CMAFB ENV personnel was how much non-labor direct costs was spent per identified activity and customer. This information was then entered into the ABC optimization tool and the output shown in Table 18 was obtained.

Finding 1. The personnel spend approximately 90% of their times on these activities for these customers as shown in Table 17 (there are 2 category B employees at CMAFB ENV).

Finding 2. Holding the benefit at 40% of the charged back dollar amount and the time required to collect ABC data at 10%, it was determined that every activity identified by

CMAFB ENV was beneficial to track to all customers of the associated activity via ABC. As is shown in Table 18, all activities and customers have a positive value (greater than 0) resulting from benefit - cost, which means that the benefit to the organization is larger than the cost of ABC.

Table 17. Percentages of Employees Time Spent on Activities per Customer for CMAFB.

| Employee Percentages per activity per customer | | # Cat B employees = | 2 | | wage ($/hr) = | 17 | |
|---|---|---|---|---|---|---|---|
| * assume costs incurred at beginning of year | | | | | | | |
| **Activities** | CES | CS(COMM) | SPS | Med | SVS | CMOC | |
| **Air Management** | | | | | | | |
| 1. Obtain and Maintain Air Permits | 0.07 | 0 | 0 | 0 | 0 | 0 | 0.07 |
| 2. Air Emission Inventory | 0.05 | 0 | 0 | 0 | 0 | 0 | 0.05 |
| 3. Air Emission (Monitoring, testing and sampling | 0.018 | 0.002 | 0 | 0 | 0 | 0 | 0.02 |
| 4. Audits | 0.02 | 0 | 0 | 0 | 0 | 0 | 0.02 |
| 5. Record-Keeping | 0.081 | 0.009 | 0 | 0 | 0 | 0 | 0.09 |
| **Hazardous Material Management** | | | | | | | |
| 6. Purchase Hazardous Materials | 0.056 | 0.007 | 0.0035 | 0.0021 | 0.0007 | 0.0007 | 0.07 |
| 7. Obtain and Maintain MSDS (hazcom) | 0.027 | 0.0015 | 0.0006 | 0.0003 | 0.0003 | 0.0003 | 0.03 |
| 8. Oversee industrial hygiene audits | 0.027 | 0.0009 | 0.0009 | 0.0006 | 0.0003 | 0.0003 | 0.03 |
| 9. Prepare Toxic Release Inventory | 0.04 | 0 | 0 | 0 | 0 | 0 | 0.04 |
| 10. Prepare Emergency Planning and Community Right to Know Reports | 0.02 | 0 | 0 | 0 | 0 | 0 | 0.02 |
| 11. Prepare Emergency Plan (SPCC) | 0.016 | 0.002 | 0.001 | 0.0006 | 0.0002 | 0.0002 | 0.02 |
| 12. Prepare Tier One/Tier Two reports | 0.04 | 0 | 0 | 0 | 0 | 0 | 0.04 |
| 13. Respond to spills | 0.027 | 0.0015 | 0.0006 | 0.0003 | 0.0003 | 0.0003 | 0.03 |
| 14. Procurement of hazardous material facility (obtaining and maintaing permit) | 0.019 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.0002 | 0.02 |
| 15. Labeling requirements | 0.018 | 0.002 | 0 | 0 | 0 | 0 | 0.02 |
| 16. Purchase and maintain PPE | 0.01 | 0 | 0 | 0 | 0 | 0 | 0.01 |
| 17. Purchase secondary containment equip | 0.0092 | 0 | 0.0008 | 0 | 0 | 0 | 0.01 |
| 18. Perform audits | 0.024 | 0.0015 | 0.0015 | 0.0015 | 0.0009 | 0.0006 | 0.03 |
| **Hazardous Waste Management** | | | | | | | |
| 19. Hazardous waste identification | 0.035 | 0.005 | 0.005 | 0.0025 | 0.0015 | 0.001 | 0.05 |
| 20. RCRA reporting of waste activities | 0.024 | 0.0024 | 0.0018 | 0.0012 | 0.0003 | 0.0003 | 0.03 |
| 21. Obtaining EPA hazardous waste generator number | 0.018 | 0.001 | 0.0004 | 0.0002 | 0.0002 | 0.0002 | 0.02 |
| 22. Preparation of hazardous waste manifest | 0.0665 | 0.0014 | 0.0014 | 0.0007 | 0 | 0 | 0.07 |
| 23. Preparation of wastes for transport | 0.0384 | 0.0008 | 0.0004 | 0.0004 | 0 | 0 | 0.04 |
| 24. Paying hazardous waste transportation and disposal fees | 0.1235 | 0.0026 | 0.0013 | 0.0013 | 0.0013 | 0 | 0.13 |
| 25. Procurement of hazardous waste storage containers | 0.027 | 0.0015 | 0.0006 | 0.0003 | 0.0003 | 0.0003 | 0.03 |
| 26. Prepare SPCC Plan | 0.0186 | 0.0006 | 0.0006 | 0.0002 | 0 | 0 | 0.02 |
| 27. Test and maintain hazardous waste equipment | 0.04 | 0 | 0 | 0 | 0 | 0 | 0.04 |
| 28. Prepare Biennial 'Waste Activities' report | 0.016 | 0.002 | 0.0014 | 0.0002 | 0.0002 | 0.0002 | 0.02 |
| 29. Preparation of closure and post-closure plans for TSDF | 0.027 | 0.0015 | 0.0006 | 0.0003 | 0.0003 | 0.0003 | 0.03 |
| 30. Training accomplished for Hazardous Waste purposes other than SAP training | 0.05 | 0 | 0 | 0 | 0 | 0 | 0.05 |
| **POL Management** | | | | | | | |
| 31. Prepare SPCC Plan | 0.02 | 0 | 0 | 0 | 0 | 0 | 0.02 |
| 32. Obtain and Maintain POL Permits | 0.07 | 0 | 0 | 0 | 0 | 0 | 0.07 |
| 33. Monitoring and Permitting of used oil collection/recycling areas | 0.07 | 0 | 0 | 0 | 0 | 0 | 0.07 |
| Wastewater Management | | | | | | | |
| 34. Obtain and Maintain NPDES permit | 0.063 | 0.0021 | 0.0021 | 0.0014 | 0.0007 | 0.0007 | 0.07 |
| 35. Paying wastewater treatment fees | 0.038 | 0.0004 | 0.0004 | 0.0004 | 0.0004 | 0.0004 | 0.04 |
| 36. Obtain and Maintain Storm Water permit | 0.0665 | 0.0007 | 0.0007 | 0.0007 | 0.0007 | 0.0007 | 0.07 |
| **Solid Waste Management** | | | | | | | |
| 37. Collection of solid wastes | 0.1275 | 0.0135 | 0.003 | 0.003 | 0.0015 | 0.0015 | 0.15 |
| 38. Obtaining and Maintaining Landfill permits | 0.072 | 0.004 | 0.0016 | 0.0008 | 0.0008 | 0.0008 | 0.08 |
| **OTHER** | | | | | | | |
| 39. Managing AST and UST | 0.05 | 0 | 0 | 0 | 0 | 0 | 0.05 |
| 40. Performing ECAMP (to include pre-audit and post-audit activities) | 0.027 | 0.0015 | 0.0006 | 0.0003 | 0.0003 | 0.0003 | 0.03 |
| Total | | | | | | | 1.80 |

The average amount of time spent by these two workers for these activities and customers is 0.90, or 90% (1.80/2 = 0.90)

Table 18. Result of ABC Optimization Tool CMAFB (benefit =0.4, %time spent for ABC data=0.1).

| BENEFIT-COST | | OUTPUT | | for percentage of benefit = | | | 0.4 |
|---|---|---|---|---|---|---|---|
| * assume costs incurred at beginning of year | | | | & % overall cost as recordkeeping = | | | 0.1 |
| Activities | CES | CS(COMM) | SPS | Med | SVS | CMOC | |
| **Air Management** | | | | | | | |
| 1. Obtain and Maintain Air Permits | 1816.14 | 0 | 0 | 0 | 0 | 0 | |
| 2. Air Emission Inventory | 954.39 | 0 | 0 | 0 | 0 | 0 | |
| 3. Air Emission (Monitoring, testing and sampling | 415.58 | 46.18 | 0 | 0 | 0 | 0 | |
| 4. Audits | 461.76 | 0 | 0 | 0 | 0 | 0 | |
| 5. Record-Keeping | 250.11 | 27.79 | 0 | 0 | 0 | 0 | |
| Hazardous Material Management | | | | | | | |
| 6. Purchase Hazardous Materials | 3372.92 | 421.61 | 210.81 | 126.48 | 42.16 | 42.16 | |
| 7. Obtain and Maintain MSDS (hazcom) | 407.37 | 22.63 | 9.05 | 4.53 | 4.53 | 4.53 | |
| 8. Oversee industrial hygiene audits | 119.37 | 3.98 | 3.98 | 2.65 | 1.33 | 1.33 | |
| 9. Prepare Toxic Release Inventory | 523.51 | 0 | 0 | 0 | 0 | 0 | |
| 10. Prepare Emergency Planning and Community Right to Know Reports | 261.76 | 0 | 0 | 0 | 0 | 0 | |
| 11. Prepare Emergency Plan (SPCC) | 209.4 | 26.18 | 13.09 | 7.85 | 2.62 | 2.62 | |
| 12. Prepare Tier One/Tier Two reports | 523.51 | 0 | 0 | 0 | 0 | 0 | |
| 13. Respond to spills | 803.37 | 44.63 | 17.85 | 8.93 | 8.93 | 8.93 | |
| 14. Procurement of hazardous material facility (obtaining and maintaining permit) | 438.67 | 4.62 | 4.62 | 4.62 | 4.62 | 4.62 | |
| 15. Labeling requirements | 91.58 | 10.18 | 0 | 0 | 0 | 0 | |
| 16. Purchase and maintain PPE | 3590.88 | 0 | 0 | 0 | 0 | 0 | |
| 17. Purchase secondary containment equip | 764.41 | 0 | 66.47 | 0 | 0 | 0 | |
| 18. Perform audits | 1034.11 | 64.63 | 64.63 | 64.63 | 38.78 | 25.85 | |
| **Hazardous Waste Management** | | | | | | | |
| 19. Hazardous waste identification | 248.07 | 35.44 | 35.44 | 17.72 | 10.63 | 7.09 | |
| 20. RCRA reporting of waste activities | 554.11 | 55.41 | 41.56 | 27.71 | 6.93 | 6.93 | |
| 21. Obtaining EPA hazardous waste generator number | 775.58 | 43.09 | 17.24 | 8.62 | 8.62 | 8.62 | |
| 22. Preparation of hazardous waste manifest | 585.34 | 12.32 | 12.32 | 6.16 | 0 | 0 | |
| 23. Preparation of wastes for transport | 502.57 | 10.47 | 5.24 | 5.24 | 0 | 0 | |
| 24. Paying hazardous waste transportation and disposal fees | 6461.34 | 136.03 | 68.01 | 68.01 | 68.01 | 0 | |
| 25. Procurement of hazardous waste storage containers | 1163.37 | 64.63 | 25.85 | 12.93 | 12.93 | 12.93 | |
| 26. Prepare SPCC Plan | 429.43 | 13.85 | 13.85 | 4.62 | 0 | 0 | |
| 27. Test and maintain hazardous waste equipment | 923.51 | 0 | 0 | 0 | 0 | 0 | |
| 28. Prepare Biennial 'Waste Activities' report | 369.4 | 46.18 | 32.32 | 4.62 | 4.62 | 4.62 | |
| 29. Preparation of closure and post-closure plans for TSDF | 83.37 | 4.63 | 1.85 | 0.93 | 0.93 | 0.93 | |
| 30. Training accomplished for Hazardous Waste purposes other than SAP training | 554.39 | 0 | 0 | 0 | 0 | 0 | |
| **POL Management** | | | | | | | |
| 31. Prepare SPCC Plan | 861.76 | 0 | 0 | 0 | 0 | 0 | |
| 32. Obtain and Maintain POL Permits | 616.14 | 0 | 0 | 0 | 0 | 0 | |
| 33. Monitoring and Permitting of used oil collection/recycling areas | 616.14 | 0 | 0 | 0 | 0 | 0 | |
| **Wastewater Management** | | | | | | | |
| 34. Obtain and Maintain NPDES permit | 1274.53 | 42.48 | 42.48 | 28.32 | 14.16 | 14.16 | |
| 35. Paying wastewater treatment fees | 877.34 | 9.24 | 9.24 | 9.24 | 9.24 | 9.24 | |
| 36. Obtain and Maintain Storm Water permit | 585.34 | 6.16 | 6.16 | 6.16 | 6.16 | 6.16 | |
| **Solid Waste Management** | | | | | | | |
| 37. Collection of solid wastes | 2093.69 | 221.68 | 49.26 | 49.26 | 24.63 | 24.63 | |
| 38. Obtaining and Maintaining Landfill permits | 942.32 | 52.35 | 20.94 | 10.47 | 10.47 | 10.47 | |
| **OTHER** | | | | | | | |
| 39. Managing AST and UST | 954.39 | 0 | 0 | 0 | 0 | 0 | |
| 40. Performing ECAMP (to include pre-audit and post-audit activities) | 12683.37 | 704.63 | 281.85 | 140.93 | 140.93 | 140.93 | |

Refer to Appendix C, pages 102-104 for a complete description of how to obtain the values in Table 18 given the percentages in Table 17 and the non-labor costs associated with the ENV organizations. The values listed in Tables 18, 24, and 26 are the real dollar values. A value of 0.93 in these tables equals $0.93.

Table 18 shows which activities should be charged to which customers on a benefit - cost basis. This however, is not the value charged to the customers, this is only the value of the benefit CMAFB will receive given a 0.4 benefit ratio ($0.40 payback on money invested). The amount each customer should be charged is the sum of total labor costs and service contract costs. The funds that should be transferred from the ENV organization to the customer to give the customer the financial ability and responsibility to pay for the environmental activities listed in Table 18 is shown below for year 1: (for amount per activity per customer, see Appendix C)

| *Activities* | *CES* | *CS(COMM)* | *SPS* | *Med* | *SVS* | *CMOC* |
|---|---|---|---|---|---|---|
| **Sum to charge back per customer** | **169100** | **7130** | **3450** | **2064** | **13506** | **1090** |

Finding 3. Sensitivity Analysis on the Estimations. Because the values associated with the time required to track the ABC data and the benefit received from charging the money back to the customers are only estimates, a sensitivity analysis was conducted for these values. This sensitivity analysis consisted of setting one of the estimations (either benefit or % time required for ABC data maintenance) at a certain value and then the other estimation was either raised or lowered until a change occurred in the output of the ABC optimization tool. This change in the output is defined as the point when at least one of the values in the output (similar to Table 18) began to show a negative value. That is, the change is when the output values begin to show that the cost of tracking the data outweighs the benefit.

For CMAFB, the sensitivity analysis was conducted by first setting the % time required for ABC data maintenance at 5% and then lowering the benefit ratio from 0.40 until a value was reached where at least one negative value existed in the output. What was

determined was that the benefit ratio could be lowered until it was set at 0.26. If it was set any lower, then some of the activities and customers began to show negative results in the output. This type of analysis was conducted for a % time required for ABC data maintenance of 5%, 10%, 15%, 20%, 25%, 30%, 40%, and 50%. The results of this analysis are shown in Figure 5. The area above the line represents the region where any combination of benefit ratio and % time required for ABC data maintenance would result in it being financially beneficial to track all activities listed in Table 17. The area below the line represents the region where it may be beneficial to track some activities with ABC but only after iterations of the ABC optimization tool with the appropriate values for the estimations will the user know which activities and customers to track.

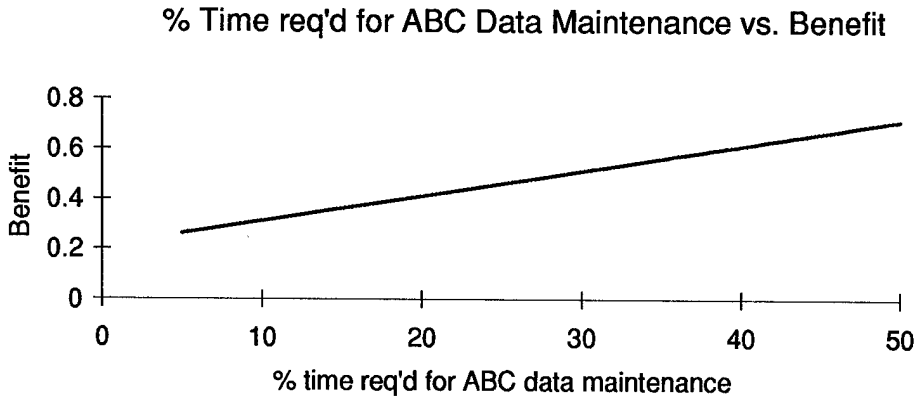


Figure 5. Sensitivity Analysis for ABC Optimization Tool Estimations

What Figure 5 does for CMAFB is that if the decision maker decides the estimations used for the purposes of this thesis are incorrect, then they can use this graph to see what will be required if new values are chosen. Analyzing Figure 5 based on the estimations established for this thesis, at a benefit of 0.4, the time spent maintaining ABC data can be as high as 19% (almost twice as high as estimated) and not change the outcome of tracing

all the activities. Also, at 10% time spent maintaining ABC data, the benefit can be as low as 0.31 (less than 25% drop) and not change the outcome. This shows that the sensitivity of the benefit estimation is almost twice that of the percent time required.

If CMAFB decided that the intersection of the two estimations fell below the line in Figure 5, then the ABC optimization tool would need to iterated to determine which activities and customers cannot be tracked beneficially (which means until only positive values remain in the output). Such an analysis was conducted for CMAFB holding the % time required for ABC data maintenance at 10%. The results of this analysis are described in Table 19.

Table 19. Sensitivity Analysis for Benefit Estimation for Time 0*

| When Benefit = | CMAFB can track all activities in Table 18 except: |
|---|---|
| 0.31-1 | can track all activities in Table 18 |
| 0.30 | 5) Recordkeeping and 29) Preparation of closure and post-closure plans for TSDF |
| 0.29 | same as above plus 8) Oversee Industrial Hygiene Audits |
| 0.28 | same as above plus 15) Labeling Requirements |
| 0.26-0.27 | same as above |
| 0.25 | same as above plus 19) Hazardous Waste Identification |
| 0.24 | same as above |
| 0.23 | cannot track any of the activities listed in Table 18 |

* all costs for year one are incurred at the beginning of the year, or at time = 0

As is shown in Table 19, as the benefit ratio is set at 0.29, the cost to track the activity using ABC begins to outweigh the benefits for the activity Oversee Industrial Hygiene Audits. This prompts the user to complete iterations by replacing the percentages listed in Table 17 for this activity with 0's for all customers and then the output once again analyzed to make sure no additional activities became negative as a result. In this

instance, no additional activities took on a negative value in the input and the benefit could be lowered until 0.28 before activity 15) Labeling Requirements resulted in a negative value. Once again, the user must replace the percentages in Table 17 for this activity with 0's and the output analyzed to make sure no additional activities have a negative value. This process was continued until the benefit was set at 0.23.

What occurred when the benefit was set at 0.23 is the reason the iterative process must be followed. At first, only activities 22, 32, 33, and 36 resulted in negative values in the output. After the percentages in Table 17 for these activities are replaced with 0's (which is in essence prior to Step Three of the ABC optimization tool process) then negative values resulted in the output for activity 30. Repeating this process results in the removal of first activities 9, 10, 11, 12, 23, and 38, which cause 7 and 37 to be removed and so on until there were no activities with a higher benefit than cost.

Thus, Table 19 shows that if the benefit is set at 0.23 and the time required to maintain ABC data remains at 10%, no activities identified by CMAFB should be tracked with ABC due to the fact that it is not financially beneficial. Similar analysis was conducted to determine the minimum value at which the benefit could be set as the time percentages required for ABC data maintenance were varied as shown in Table 20.

Table 20. Effects on Benefit by Changing Time Spent on ABC Data Maintenance.

| When time spent maintaining ABC data = | Can track at least one activity listed in Table 18 until benefit is set below* (*using set benefit, cannot track these activities to any customer*): |
|---|---|
| 5% | 0.20 (*5, 8, 15, 19, 29*) |
| 10% | 0.24 (*5, 8, 15, 19, 29*) |
| 15% | 0.28 (*5, 8, 15, 19, 29*) |
| 20% | 0.31 (*5, 8, 15, 19, 29*) |
| 25% | 0.35 (*5, 8, 15, 19, 29*) |
| 30% | 0.38 (*5, 8, 15, 19, 29*) |
| 35% | 0.42 (*5, 8, 15, 19, 29*) |
| 40% | 0.45 (*5, 8, 15, 19, 29*) |
| 50% | 0.52 (*5, 8, 15, 19, 29*) |

* any lower than listed benefit then cannot track any activities

A graphical representation of Table 4.20 is shown below in Figure 6. Figure 6 depicts the minimum the benefit can be set for different % time required for ABC data maintenance.

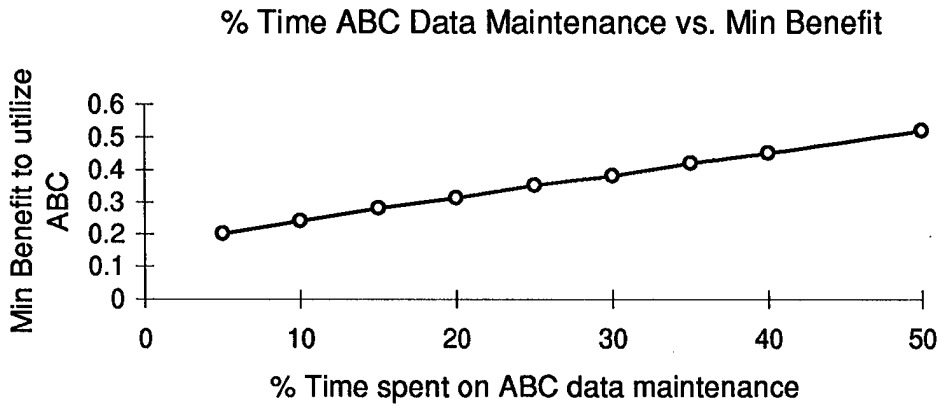


Figure 6. Graphical Representation of Table 20.

Figure 6 differs from Figure 5 in that Figure 5 represents the areas (above the line) where it is financially beneficial to track all the activities to every customer while Figure 6 represents the region where, if the values are set below the line, it is not financially beneficial to track any of the activities. Placing the figures together yields Figure 7. The region in-between the two lines represents the values where the ABC optimization tool will be useful to show which activities should be tracked to which customer. If the values for the estimations are set above the GO line, then all activities can be tracked because it is financially beneficial. If the values are set below the NO-GO line, then no activities can be tracked.

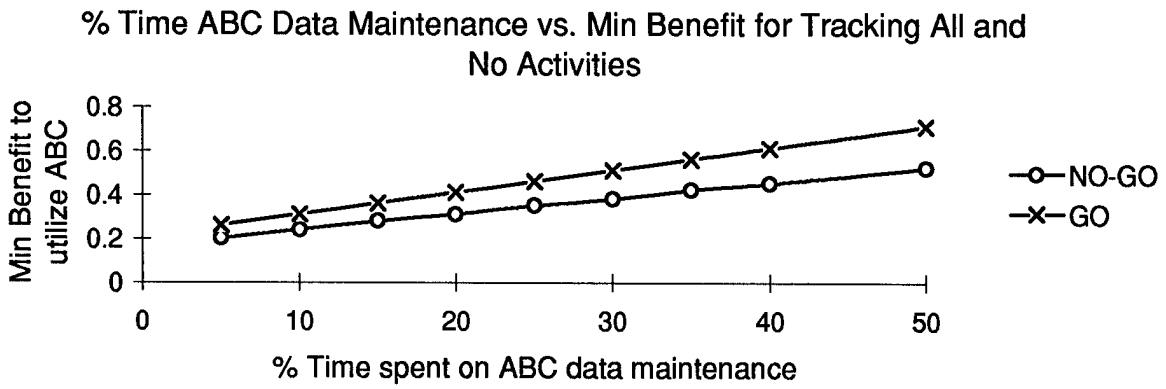


Figure 7. Graph of Regions for Tracking All, Some, and No Activities

Finding 4. Outyears. The analysis completed above was accomplished with the assumption that all costs and benefits are incurred only for the first year. If one were to assume the life of a software product such as the one used by ABC to be 3 years (typical life of current software), then the benefit received as a result of ABC could be determined for the subsequent years after implementation as well as the costs of record-keeping using an inflation rate of 2.5% and a discount rate of 6.3% recommended by the FY 1997 Revised Inflation Guidance. In addition to the software becoming outdated within three years, the data required by the ABC optimization tool will most certainly change significantly as well. Therefore, the assumption that the results from the ABC optimization tool will be good for two to three years is a conservative assumption.

For this thesis, it was assumed that all costs would be incurred at the beginning of the year. This means that at the beginning of Year 1 or Time = 0, the costs and benefits for the first 12 months of implementation are in today's dollars. All the costs and benefits for the second year are incurred at the beginning of Year 2 or Time = 1, and so on for Year 3. In order to accurately assess the costs and benefits in the future, equations 1 and 2 were

utilized. Equation 1 was used to determine the power of money in the future based on expected inflation, while Equation 2 was used to equate that future power of money to today's values (to account for the time value of money).

$$F = P(1+i)^n \quad (1)$$

$$P = \frac{F}{(1+dr)^n} \quad (2)$$

Where F = the future value, P = the present value, n = the number of time periods (years), i = the inflation rate, and dr = the discount rate. If equations 1 and 2 are combined, the result is what was called the present value factor or PV factor in equation 3. This factor was then used to determine the outyear costs and benefits by simply multiply the PV factor and the costs and benefits at the beginning of Year 1 (Time = 0).

$$\text{PV Factor} = \frac{(1+i)^n}{(1+dr)^n} \quad (3)$$

Using i = 2.5% and dr = 6.3%, and n = 0, 1 and 2, the PV factors for the first year and the two outyears were determined as shown in Table 21.

Table 21. PV Factor for the Outyears

| Year (Time from beginning, n) | inflation (i) | discount rate (dr) | PV factor |
|---|---|---|---|
| 1 (0) | 0.025 | 0.063 | 1 |
| 2 (1) | 0.025 | 0.063 | 0.96425 |
| 3 (2) | 0.025 | 0.063 | 0.92978 |

The results of completing the analysis for the different life spans of the software is shown below in Figure 8, Table 22 and Figure 9. It is important to note, the cost of the software was not depreciated over the life span of the software. Instead, all costs associated with the software were assumed to be incurred in the first year. Not depreciating the software maintains the conservative approach used throughout this thesis.

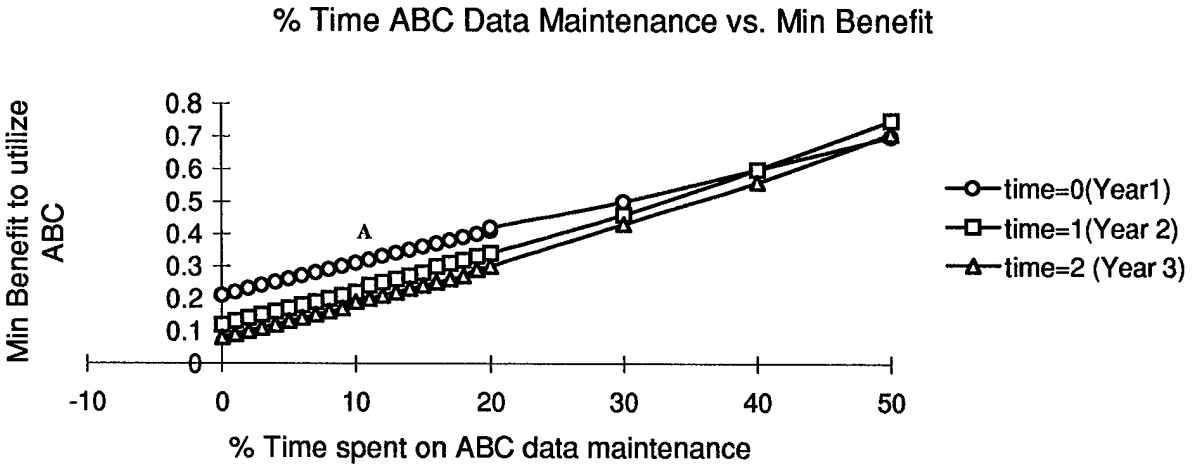


Figure 8. Graph of the "Go" Line Over Different Software Life Spans

Figure 8 is similar to Figure 5 in that the area below each line represents the area where the ABC optimization tool needs to be iterated in order to determine which activities in Table 18 cannot be tracked beneficially while above each line represents the area where all the activities in Table 18 can be tracked beneficially. For instance, if CMAFB determines the time required to maintain the required ABC data is 10%, while the benefit expected is $0.40 per dollar charged back to the customer, and the life to be 2 years (time = 1), then, using Figure 8 they can determine that ABC is beneficial for all activities (A). If A was set below the Year 2 (time =1) line then the ABC optimization tool would need to be iterated to determine which activities to track with ABC.

Table 22 establishes the minimum benefits that must be accepted by CMAFB given the percentage of time spent maintaining ABC data. The minimum benefit that must be established for the first year of the ABC software (at 10% time required for ABC data maintenance) was 0.24 (Table 19). When the second and third years were analyzed, it was determined the benefit could be set as low as 0.20 and 0.18, respectively. This shows, that the minimum benefit that CMAFB must accept from ABC in order to beneficially track the activities and customers ABC data is 0.18, or $0.18 per dollar (given a three year life span) or that the organization must save $0.09 on the dollar and invest it in a pollution prevention project with a pay off of 3:1.

Table 22. Establishment of Minimum Benefit Given Software Life span

| If life of software is: | Benefit can be as low as: | When time spent maintaining ABC data is (%): |
|---|---|---|
| 2 years | 0.15 | 5 |
| | 0.20 | 10 |
| | 0.26 | 15 |
| | 0.32 | 20 |
| | 0.39 | 25 |
| | 0.45 | 30 |
| | 0.52 | 35 |
| | 0.59 | 40 |
| | 0.74 | 50 |
| 3 years | 0.10 | 5 |
| | 0.14 | 10 |
| | 0.18 | 15 |
| | 0.22 | 20 |
| | 0.26 | 25 |
| | 0.30 | 30 |
| | 0.34 | 35 |
| | 0.38 | 40 |
| | 0.48 | 50 |

Graphical representation of Table 22 for all three years of the software life span is shown in Figure 9.

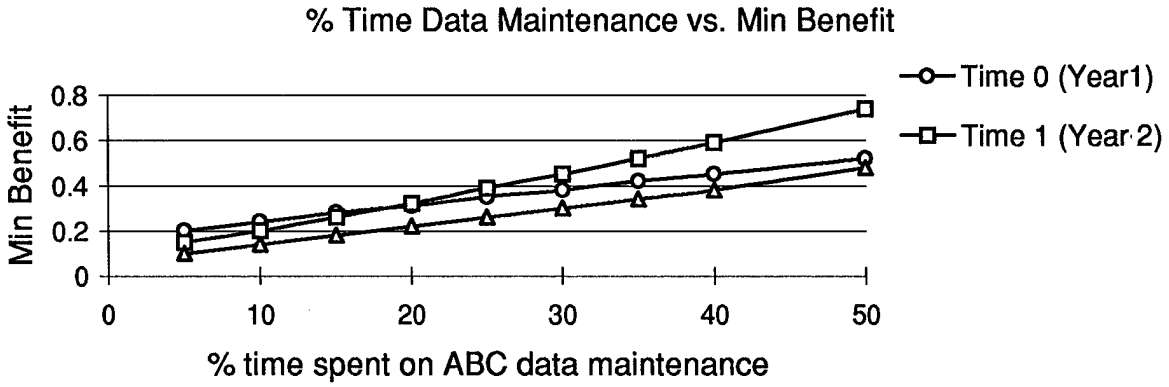


Figure 9. Graph of the "No-Go" Line Over Different Software Life Spans

Notice in Figure 9 that the lines intersect showing that an increased time for data maintenance requires more benefit in the second year than the first (at approximately 18%). The reason the lines intersect is because the amount actually received as benefit is incrementally reduced every year while the costs of ABC data maintenance (the only costs that are incurred in the outyears) are not reduced. When a customer is charged a certain amount for a specific activity, it was assumed that 20% will be saved initially. If a customer is given $200 for a certain activity and saves 20% the first year then only $160 will be given the second (and only $128 the third). Thus, the benefit received from charging the customers for the activities gets incrementally smaller over the years while the costs to maintain the data does not decrease incrementally.

Interpreting the results in Table 22 and Figure 9, it is shown for CMAFB, that if the project is assumed to extend for three years, (or the life of the software and data is good for only three years) the benefit received as a result of tracking money back to the

customer per activity must be at least $0.14 for every dollar charged back holding the % time required for ABC data maintenance at 10. If the benefit is set or perceived to be lower, then ABC cannot optimally be utilized given a time required for data maintenance of 10%. The figures and charts are provided for CMAFB to apply 'What if' scenarios such as 'what if the life span is 2 years, the benefit is only 0.20 and the time required will be at least 5%?'

If CMAFB decides the value of the estimations to be below the line in Figure 8 but above the line in Figure 9, then the ABC optimization tool needs to be iterated to determine which activities should be tracked to which customers (or until only positive values remain in the output). Instead of attempting to graph the ranges for the outyears as was accomplished with graph in Figure 7 for the first year, a range of the estimations is given in Table 23. If the benefit ratio is set above the higher value in the range, then ABC is financially beneficial for all activities and if it is below the lower value in the range, then ABC is not financially beneficial for any activities. If it is set within the range, then using the ABC optimization tool will be required with the specific values set by the user.

Table 23 shows the sensitivity of ABC to changes in the benefit received. Depending on the year, a slight change in the benefit impacts the results from being beneficial to track all activities to each customer to not tracking any activities to any customers.

Table 23. Range of Values for Benefit Ratio, CMAFB

| | Time required to maintain ABC data | | | | |
|---|---|---|---|---|---|
| | 10% | 20% | 30% | 40% | 50% |
| Time 0 (Year 1) | 0.24-0.31 | 0.31-0.41 | 0.38-0.50 | 0.45-0.60 | 0.52-0.70 |
| Time 1 (Year 2) | 0.20-0.22 | 0.32-0.34 | 0.45-0.46 | 0.59-0.60 | 0.74-0.75 |
| Time 2 (Year 3) | 0.14-0.19 | 0.22-0.30 | 0.30-0.43 | 0.38-0.56 | 0.48-0.71 |

Section 2. Results for Dyess AFB (DAFB)

Using a similar approache to developing the results as listed for CMAFB, the results for DAFB were determined and are reported below for all three years. Results of the ABC optimization tool for DAFB are in Appendix C. The reason Appendix C contains the complete output for DAFB only is because DAFB had the most pay grade categories, thus this output is a representation of the most complex of the three ABC optimization tool outputs (CMAFB had one pay grade category and WPAFB had two).

Finding 1. Category B employees spend approximately 76% of their time for these activities and customers, while Category C employees and the Category D employee spend 65% and 80% of their time for these activities and customers (See Appendix C).

Finding 2. Holding the benefit at 40% of the charged back dollar amount and the time required to collect ABC data at 10%, it was determined that every activity identified by DAFB ENV was beneficial to track to all customers via ABC. As is shown in Table 24, subtracting the total cost from the total benefit yields a positive value for all activities and customers, which means that the benefit to the organization is larger than the cost of ABC (the result was the same when the life span of the software and data was extended over three years).

Table 24. Result of ABC Optimization Tool for DAFB (benefit =0.4, %time spent for ABC data=0.1).

| Activities | CES | SVS | SPS | EMS | CRS | SUPPLY | TRANS | MED | OPS |
|---|---|---|---|---|---|---|---|---|---|
| **Air Management** | | | | | | | | | |
| 1. Obtain and Maintain Air Permits | 295.8 | 3.1 | 0 | 1866 | 1359 | 1 | 309.8 | 1 | 142.2 |
| 2. New Source Performance Rvw | 7.2 | 1 | 0 | 631.4 | 471.2 | 1 | 119.1 | 1 | 1 |
| 3. CFC and Halon Management | 14211.1 | 0 | 0 | 323.1 | 0 | 0 | 1715.8 | 0 | 0 |
| 4. Air Emission Inventory | 1468.8 | 388.9 | 244.7 | 8555.5 | 1713.5 | 316.8 | 1353.2 | 72.1 | 574.5 |
| 5. Record-Keeping | 155.6 | 85.9 | 80.8 | 634 | 237.4 | 82.9 | 226.1 | 2.1 | 55.3 |
| **Hazardous Material Management** | | | | | | | | | |
| 6. Prepare Toxic Release Inventory | 70.6 | 0 | 0 | 0 | 0 | 105.4 | 0 | 0 | 0 |
| 7. Prepare Emergency Planning and Community Right to Know Reports | 720.2 | 0 | 0 | 0 | 34.8 | 0 | 0 | 0 | 0 |
| 8. Prepare Emergency Plan (SPCC) | 158.6 | 0 | 0 | 0 | 0 | 369.4 | 0 | 0 | 0 |
| 9. Respond to spills | 643.5 | 391.3 | 391.3 | 866.7 | 866.7 | 475.4 | 866.7 | | 253.2 |
| 10. Procurement of hazardous material facility | 916.6 | 0 | 0 | 0 | 0 | 4190.4 | 0 | 0 | 0 |
| 11. Labeling requirements | 34.8 | 0 | 0 | 0 | 0 | 105.4 | 0 | 34.8 | 0 |
| 12. Perform audits | 88 | 88 | 88 | 88 | 88 | 176 | 88 | 88 | 88 |
| **Hazardous Waste Management** | | | | | | | | | |
| 13. Hazardous waste identification | 7861.4 | 3888.2 | 3206.8 | 10385.8 | 7179 | 3888.2 | 5533.6 | 5533.6 | 7861.4 |
| 14. RCRA reporting of waste activities | 746.1 | 92.5 | 92.5 | 324.5 | 324.5 | 232.7 | 208.5 | 116 | 464.7 |
| 15. Obtaining EPA hazardous waste generator number | 148 | 129.5 | 129.5 | 158.3 | 129.5 | 129.5 | 129.5 | 129.5 | 99.7 |
| 16. Obtaining and Maintaining TSDF permits | 2833.6 | 48.1 | 72.2 | 206.1 | 168.4 | 1680.9 | 168.4 | 720.7 | 129.7 |
| 17. Preparation of hazardous waste manifest | 213.8 | 185 | 185 | 185 | 185 | 185 | 185 | 192.2 | 185 |
| 18. Paying hazardous waste transporation and disposal fees | 11857 | 10276 | 11857 | 16284.4 | 10276 | 10276 | 10276 | 9801.6 | 10276 |
| 19. Procurement of hazardous waste storage containers | 401.2 | 112.6 | 112.6 | 156.8 | 119.8 | 155.6 | 119.8 | 51.4 | 155.6 |
| 20. Oversee (training and inspections) hazardous waste SAP's | 1273.3 | 216.4 | 111 | 481.3 | 448.4 | 216.4 | 332.4 | 317 | 590.8 |
| 21. Prepare SPCC Plan | 1494.9 | 37 | 55.5 | 143.9 | 106.9 | 106.9 | 106.9 | 92.5 | 177.5 |
| 22. Prepare Biennial 'Waste Activities' report | 634.5 | 37 | 55.5 | 143.9 | 106.9 | 106.9 | 106.9 | 92.5 | 106.9 |
| 23. Preparation of closure and post-closure plans for TSDF | 1591.1 | 73.9 | 73.9 | 73.9 | 73.9 | 243 | 73.9 | 147.7 | 73.9 |
| **POL Management** | | | | | | | | | |
| 24. Prepare SPCC Plan | 2024 | 7.2 | 7.2 | 29.8 | 4.1 | 879 | 1145 | 18.5 | 7.2 |
| 25. Monitoring Used Oil | 7.2 | 7.2 | 4.1 | 37 | 4.1 | 1 | 9.3 | | 4.1 |
| Wastewater Management | | | | | | | | | |
| 26. Obtain and Maintain NPDES permit | 841.9 | 74 | 74 | 74 | 74 | 74 | 74 | 490.5 | 351.4 |
| 27. Prepare SPCC Plan | 200.9 | 51.4 | 51.4 | 206.6 | 206.6 | 25.7 | 25.7 | 25.7 | 78.9 |
| 28. Obtain and Maintain Stormwater permit | 739 | 739 | 369 | 1846 | 0 | 369 | 739 | 0 | 2585 |
| **Solid Waste Management** | | | | | | | | | |
| 29. Collection of Solid Wastes (Separating and storing recyclables, payment of disposal fees) | 60642.4 | 13875.2 | 9379.2 | 18758.3 | 9379.2 | 9379.2 | 9379.2 | 4690.1 | 12376.2 |
| 30. Obtaining and Maintaining landfill permits (closure plans, monitoring, record-keeping, etc.) | 176 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **OTHER** | | | | | | | | | |
| 31. Managing AST and UST (RCRA reporting, maintaining leak detection, monitoring corrosion control systems, etc.) | 3939.8 | 957 | 0 | 957 | 0 | 2005.8 | 957 | 957 | 509.3 |
| 32. Performing ECAMP (to include pre-audit and post-audit activities) | 2781.6 | 930.1 | 575 | 1201 | 1201 | 930.1 | 1201 | 605 | 5142.2 |

Values listed in Tables 18, 24 and 26 are the actual dollar values. A listed value in these tables of 0.93 equals a value of $0.93.

The value each customer should be given to pay for the environmental activities listed in Table 24 is shown below year 1: (for amount per activity per customer, see Appendix C)

| Activities | CES | SVS | SPS | EMS | CRS | SUPPLY | TRANS | MED | OPS |
|---|---|---|---|---|---|---|---|---|---|
| TOTAL | 330331.6 | 88498.93 | 72757.93 | 179731.4 | 96631.71 | 104225.7 | 99388.11 | 66026.75 | 119720.8 |

Finding 3. Sensitivity Analysis on the Estimations. Knowing the values associated with the time required to track the ABC data and the benefit received from charging the money back to the customers are only estimates, a sensitivity analysis was again conducted for these values. The results are shown in Figure 10 for the life span of the software.

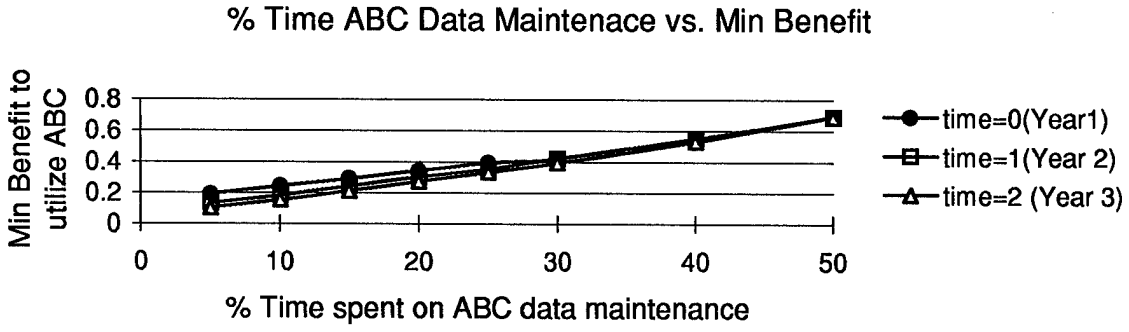


Figure 10. Graph of the "Go" Line Over Different Software Life Spans, DAFB

The area above each line represents the region where ABC can be used beneficially for all activities listed in Table 24 and the area below is where the ABC optimization tool needs to iterated to determine which activities should be tracked with ABC. For Dyess AFB, setting the % time required for ABC data maintenance at 10%, the benefit can be as low as 0.24, 0.18 and 0.15 for the 3 different years, respectively. When the benefit is set at 0.40, the time required for ABC data maintenance can be as high as 27%, 28% and 31% for the 3 different years, respectively.

The minimum values DAFB can set the combination of the estimations is shown in Figure 11.

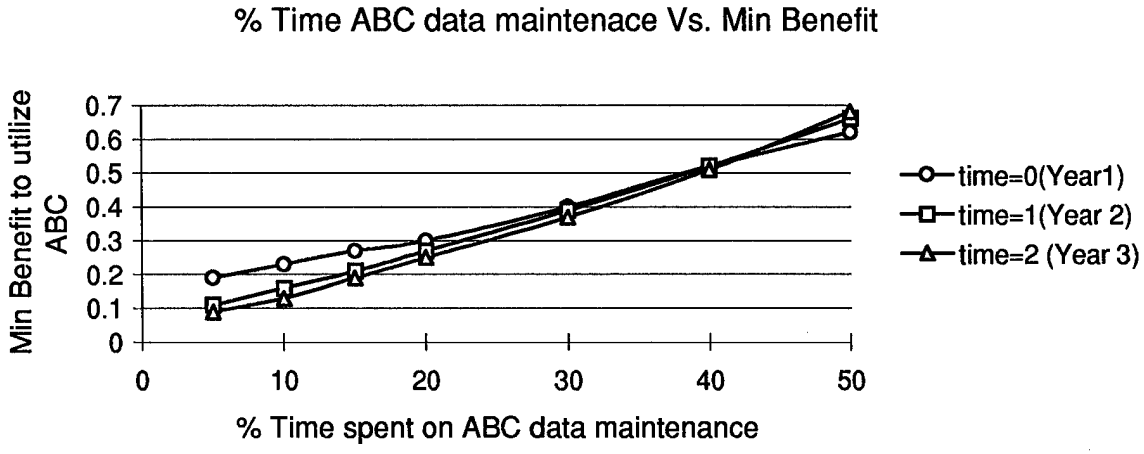


Figure 11. Graph of the "No-Go" Line Over Different Software Life Spans, DAFB

Thus, if DAFB determines the values for the estimations to be set below the appropriate line for the given year, then ABC should not be used because it would not be beneficial.

If DAFB decides the value of the estimations to be below the line in Figure 10 but above the line in Figure 11 for any given year, then the ABC optimization tool needs to be iterated to determine which activities should be tracked to which customers. The range between the two lines in Figures 10 and 11 are shown below in Table 25 for the three year life span.

Table 25. Range of Values for Benefit Ratio, DAFB

| | Time required to maintain ABC data | | | | |
|---|---|---|---|---|---|
| | 10% | 20% | 30% | 40% | 50% |
| Time 0 (Year 1) | 0.23-0.24 | 0.30-0.34 | 0.40-0.42 | 0.52-0.55 | 0.62-0.64 |
| Time 1 (Year 2) | 0.16-0.18 | 0.27-0.30 | 0.39-0.42 | 0.52-0.55 | 0.66-0.69 |
| Time 2 (Year 3) | 0.13-0.15 | 0.25-0.27 | 0.37-0.39 | 0.51-0.53 | 0.68-0.69 |

Section 3. Results for Wright-Patterson AFB.

Using the 0.4 payback ratio and 10% of time spent on the activity as the labor required for maintaining the ABC data, the tool was utilized for Wright-Patterson AFB (WPAFB). The information gathered from WPAFB personnel was entered into the ABC optimization tool and the results shown in Table 26 were obtained.

Finding 1. Category B employees spend approximately 58% of their time for these activities and customers, while Category C employees 94% of their time for these activities and customers.

Finding 2. Holding the benefit at 40% of the charged back dollar amount and the time required to collect ABC data at 10%, it was determined that every activity identified by WPAFB ENV was beneficial to track to all customers of the associated activity via ABC. As is shown in Table 26, all activities and customers have a positive value (greater than 0) resulting from benefit - cost, which means that the benefit to the organization is larger than the cost of ABC.

Table 26. Result of ABC Optimization Tool WPAFB (benefit =0.4, %time spent for ABC data=0.1).

| ACTIVITIES | CE | Avionics | Flight Dynamics | Materials | Propulsion | Armstrong (Human Systems) | LOG | SPTG | 445 Airlift Wing |
|---|---|---|---|---|---|---|---|---|---|
| **Air Management** | | | | | | | | | |
| 1. Obtain and Maintain Air Permits | 33913.61 | 0 | 0 | 0 | 3822.72 | 3822.72 | 3822.72 | 0 | 0 |
| 2. Air Emission Inventory | 4808.01 | 4808.01 | 4808.01 | 4808.01 | 4808.01 | 4808.01 | 4808.01 | 4808.01 | 4808.01 |
| 3. Air Emission (Monitoring, testing and sampling | 62283.61 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4. Record-Keeping | 72.72 | 36.36 | 36.36 | 36.36 | 36.36 | 36.36 | 36.36 | 0 | 72.72 |
| **Hazardous Material Management** | | | | | | | | | |
| 5. Obtain and Maintain MSDS (hazcom) | 57.36 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6. Prepare Toxic Release Inventory | 1147.22 | 344.16 | 344.16 | 344.16 | 344.16 | 344.16 | 458.89 | 344.16 | 573.61 |
| 7. Prepare Emergency Planning and Community Right to Know Reports | 458.89 | 229.44 | 314.64 | 229.44 | 229.44 | 229.44 | 229.44 | 114.72 | 229.44 |
| 8. Prepare Emergency Plan (SPCC) | 6108.74 | 0 | 0 | 1551.36 | 0 | 0 | 1118.24 | 1118.24 | 0 |
| 9. Respond to spills | 9344.33 | 109.87 | 5716.55 | 6537.8 | 5606.68 | 3324.04 | 219.74 | 3324.04 | 1209.39 |
| 10. Purchase and maintain PPE | 1829.44 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11. Purchase secondary containment equip | 1373.61 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12. Perform audits | 0 | 218.16 | 145.44 | 363.61 | 14.54 | 145.44 | 0 | 363.61 | 0 |
| **Hazardous Waste Management** | | | | | | | | | |
| 13. Hazardous waste identification | 5183.54 | 1097.76 | 1097.76 | 4661.3 | 1907.97 | 1907.97 | 647.84 | 1295.69 | 2429.81 |
| 14. RCRA reporting of waste activities | 109.12 | 0 | 0 | 327.36 | 54.36 | 54.36 | 0 | 0 | 54.36 |
| 15. Obtaining and Maintaining TSDF permits | 72.72 | 0 | 0 | 72.72 | 36.36 | 36.36 | 0 | 0 | 36.36 |
| 16. Operating TSDF | 1139.52 | 0 | 0 | 2278.64 | 569.56 | 569.56 | 0 | 0 | 569.56 |
| 17. Preparation of hazardous waste manifest | 22.94 | 11.47 | 11.47 | 11.47 | 11.47 | 11.47 | 11.47 | 11.47 | 11.47 |
| 18. Preparation of wastes for transport | 95.67 | 11.47 | 11.47 | 375.08 | 11.47 | 11.47 | 84.19 | 84.19 | 593.24 |
| 19. Paying hazardous waste transporation and disposal fees | 16543.12 | 0 | 0 | 16543.12 | 82716.41 | 82716.41 | 0 | 0 | 548.81 |
| 20. Procurement of hazardous waste storage containers | 290.89 | 0 | 0 | 0 | 0 | 0 | 72.72 | 72.72 | 145.44 |
| 21. Oversee (training and inspections) hazardous waste SAP's | 436.33 | 0 | 0 | 581.77 | 109.08 | 109.08 | 0 | 363.61 | 399.97 |
| 22. Prepare Biennial 'Waste Activities' report | 573.61 | 573.61 | 286.8 | 573.61 | 286.8 | 286.8 | 286.8 | 0 | 573.61 |
| 23. Preparation of closure and post-closure plans for TSDF | 1720.82 | 229.44 | 229.44 | 1147.22 | 229.44 | 229.44 | 229.44 | 0 | 1720.82 |
| 24. Training accomplished for Hazardous Waste purposes other than SAP training | 4286.64 | 436.94 | 436.94 | 2580.47 | 1508.91 | 1508.91 | 2143.12 | 2143.12 | 3215.08 |
| **POL Management** | | | | | | | | | |
| 25. Obtain and Maintain POL Permits | 72.72 | 0 | 0 | 36.36 | 36.36 | 0 | 0 | 0 | 0 |
| 26. Monitoring and Permitting of used oil collection/recycling areas | 803.05 | 114.72 | 114.72 | 114.72 | 114.72 | 114.72 | 114.72 | 114.72 | 114.72 |
| **Wastewater Management** | | | | | | | | | |
| 27. Obtain and Maintain NPDES permit | 80181.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 28. Paying wastewater treatment fees | 72.72 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 29. Obtain and Maintain Storm Water permit | 30727.22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **OTHER** | | | | | | | | | |
| 30. Managing AST and UST | 10053.24 | 2010.81 | 2010.81 | 2010.81 | 10053.24 | 2010.81 | 2010.81 | 2010.81 | 2010.81 |
| 31. Performing ECAMP (to include pre-audit and post-audit activities) | 1478.73 | 0 | 1395.29 | 3803.14 | 866.69 | 3274.54 | 2534.42 | 5068.83 | 2640.38 |

The values listed in Tables 18, 24, and 26 are the real dollar values. A value of 0.93 in these tables equals $0.93.

The value each customer should be given to pay for the environmental activities listed in Table 26 is shown below for year 1: (for amount per activity per customer, see Appendix C)

| ACTIVITIES | CE | Avionics | Flight Dynamics | Materials | Propulsion | Armstrong (Human Systems) | LOG | SPTG | 445 Airlift Wing |
|---|---|---|---|---|---|---|---|---|---|
| total = | 716459 | 30904 | 49113 | 139173 | 294592 | 273456 | 54300 | 63150 | 69210 |

Finding 3. Sensitivity Analysis on the Estimations. Knowing the values associated with the time required to track the ABC data and the benefit received from charging the money back to the customers are only estimates, a sensitivity analysis was conducted for these values. The results are shown in Figure 4.31 for the life span of the software.

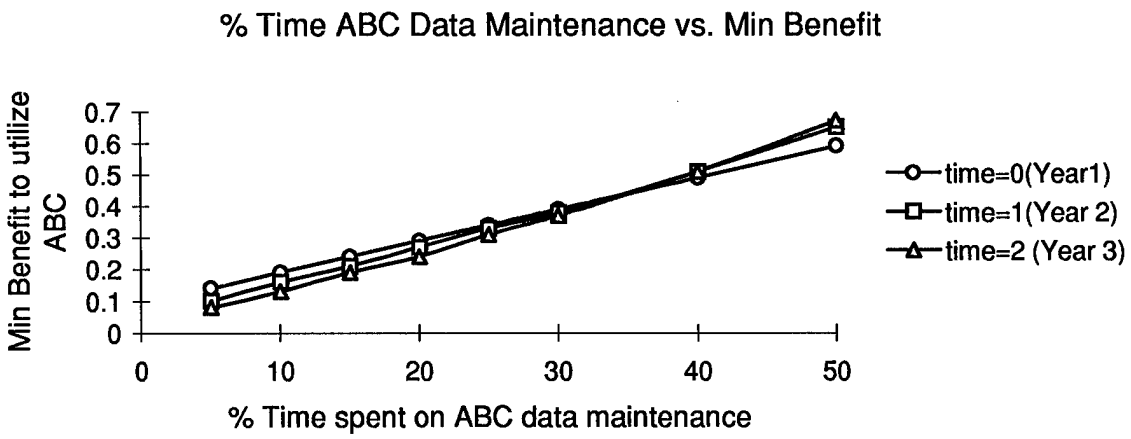


Figure 12. Graph of the "Go" Line Over Different Software Life Spans, WPAFB

The area above each line represents the region where ABC can be used beneficially for all activities listed in Table 26 and the area below is where the ABC optimization tool needs to iterated to determine which activities should be tracked with ABC. For WPAFB, setting the % time required for ABC data maintenance at 10%, the benefit ratio can be as low as 0.19, 0.16 and 0.13 for the 3 different years respectively. When the benefit ratio is

set at 0.40, the time required for ABC data maintenance can be as high as 27%, 28%, and 31% for the 3 different years respectively. The minimum values WPAFB can set the combination of the estimations is shown in Figure 13.

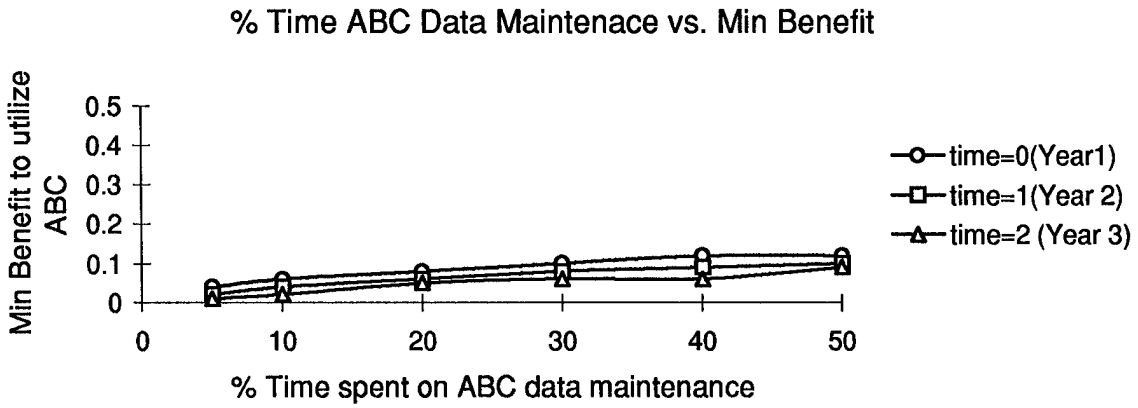


Figure 13. Graph of the "No-Go" Line Over Different Software Life Spans, WPAFB

Thus, if WPAFB determines the values for the estimations to be set below the appropriate line for the given year, then ABC should not be used because it would not be beneficial.

If WPAFB decides the value of the estimations to be below the line in Figure 12 but above the line in Figure 13, then the ABC optimization tool needs to be iterated to determine which activities should be tracked to which customers (or until only positive values remain in the output). The range between the two lines for any year in Figure 12 and 13 are shown below in Table 27 for the three year life span.

Table 27. Range of Values for Benefit Ratio, WPAFB.

| | Time required to maintain ABC data | | | | |
|---|---|---|---|---|---|
| | 10% | 20% | 30% | 40% | 50% |
| Time 0 (Year 1) | 0.06-0.19 | 0.08-0.29 | 0.10-0.39 | 0.12-0.49 | 0.12-0.59 |
| Time 1 (Year 2) | 0.04-0.16 | 0.06-0.27 | 0.08-0.38 | 0.09-0.51 | 0.10-0.65 |
| Time 2 (Year 3) | 0.02-0.13 | 0.05-0.24 | 0.06-0.37 | 0.06-0.51 | 0.09-0.67 |

The value for the benefit for WPAFB is much lower than for either CMAFB or DAFB. The range is also greater for most all the percentages. Thus, if WPAFB chooses a value for the benefit that falls within these ranges, then the ABC optimization tool must be used to determine which activities should be traced to which customers (or which customers to charge for the given activity).

# V. Conclusions and Recommendations

## Overview

This chapter highlights the conclusions drawn by the researcher as a result of this thesis effort. The chapter also contains recommendations for follow on studies.

## Conclusions

The problem stated in the first chapter of this research was to determine the environmental activities that should be charged back to the consumer of those activities. This was to be accomplished by the development of an Activity Based Costing optimization tool which analyzed the cost of maintaining the required ABC data and compared it to an expected benefit resulting from the consumers being given the means and responsibility to pay for those activities. It was concluded that a tool can be developed that shows an environmental organization the activities that it can track beneficially using activity based costing. This conclusion was drawn based on the results shown in Chapter IV of this thesis effort.

Other conclusions drawn as a result of this thesis effort were as follows:

1. The estimation for benefit ratio expected as a result of charging a customer for services rendered using ABC is the important variable to determining the number of activities that can be tracked.

2. The life span of the software and data has a dramatic effect on the how small the required benefit ratio can be and still track all the activities when the % time required for ABC data maintenance is kept low.

3. The formula used for estimating the division of non-labor costs does not allow for separating the costs by individual customers.

Benefit Ratio: The sensitivity analysis conducted in chapter IV showed that slight changes in the value of benefit expected to be received as a result of using ABC to make customers responsible for the costs of their actions greatly effects the output compared to changes in the time required for ABC data maintenance. For example, using the conservative estimate of 10% of the time devoted to any activity by an employee will be required for maintaining ABC data and a one year life span for the ABC software, the benefit ratio could be as low as 0.31 for CMAFB and all the activities could be tracked to each customer. At 0.23 benefit, no activities could be tracked beneficially. This means that if the CMAFB only thinks their organization will save $0.10 on the dollar as a result of charging the activities back to the customers, then ABC can not be used beneficially given a one year life span of the ABC software ($0.10 invested in a pollution prevention project with a 3:1 payback means that the benefit to the organization would be $0.20 or 0.20 per dollar). However, if CMAFB thinks they could save just an additional $0.02 on the dollar, or a total of $0.12, then ABC could be used beneficially because the benefit would be $0.24 on the dollar, or 0.24.

The sensitivity of this value increases (becomes tighter) as the outyears are analyzed. For instance, CMAFB must only accept a savings of $0.10 on the dollar if the life span is assumed to be two years and $0.07 if it is assumed to be three years. Once again, a drop of only 1% (or 1 penny on the dollar) in the amount expected to be saved and CMAFB cannot track any activities beneficially.

Life Span: The life span of the software and data has a dramatic effect on the how small the required benefit ratio can be and still track all the activities when the % time

required for ABC data maintenance is kept low. As shown in Tables 23, 25, and 27, when the life span of the software is considered to extend to two or three years, the benefit ratio can be from 15% to 30% lower than if the life span is only one year.

Formula used to separate service contract costs: As stated in the previous chapters, the organizations knew how much they spent on hazardous waste disposal, but not how much was the cause of a specific customer. Therefore, the researcher developed the formula explained in chapter III to divide the costs among the customers. The problem with using a formula is some of the non-labor costs may then be assigned to customers who did not cause those costs. Doing this is similar to spreading the overhead across product lines like with traditional cost accounting. Only if the information was tracked based on customers and activities could it be properly assigned.

Because this tool used a formula, the results may not be completely accurate. Whenever an activity became not beneficial to track as the benefit was lowered, it became not beneficial for all customers. Intuition says that this shouldn't be the case in all situations. The major customers of specific activities should have a beneficial result when tracking the ABC information to them while other customers should not. This conclusion does not negate any of the findings resulting from this research. It only shows that there is a real need for the data because of the potential benefits using ABC to charge back the cost of providing the service represents.

Recommendation for Future Research

Typically, before a company undertakes an expense, an attempt is made to determine what benefit will come from that expense. In the case of ABC, the expense is the software, training and data maintenance required to operate an ABC accounting system. Assuming the organization will only undertake the ABC effort if the benefit outweighs the cost, the organization using ABC must determine what benefit they expect. In lieu of attempting to determine what benefit to expect, this thesis to developed a tool that will allow its users to see the minimum benefits that ABC must give in order to beneficially track the activities to the customers. However, the data required for this thesis was limited. In most cases, the data used in this thesis effort was a best estimate on the part of the employees of the organization.

Because the data used was estimated, the following information is offered as a recommendation for further research instead of a conclusion drawn from this thesis effort. When 10% was set as the time required for ABC data maintenance and the life of the software was set at 1 year, the minimum benefit required before the organizations could no longer beneficially track all activities was 0.31, 0.24 and 0.19 for CMAFB, DAFB, and WPAFB respectively. The differences in the minimum benefit could be attributable to the make-up and requirements of the three different organizations. Yet, the most significant reason why the benefit ratios vary may be because of the size of the dollar value of the amount charged back to each customer as a result of their consumption of the ENV activities (non-labor costs plus labor costs for the listed activities and customers) of the organizations. [CMAFB would charge just over $196,000 while DAFB and WPAFB would charge over $1.15 and $1.6 million respectively for the activities and customers

listed.] If this is true, then it could be stated the benefit required in order to track all the listed activities accomplished by an organization to the customers is reduced as the size of the budgets of the organizations that use the ABC optimization tool are increased. Figure 14 shows a graphical representation of the budget size for these activities vs. the minimum the benefit ratio can be set and still track all the identified activities to the customers.

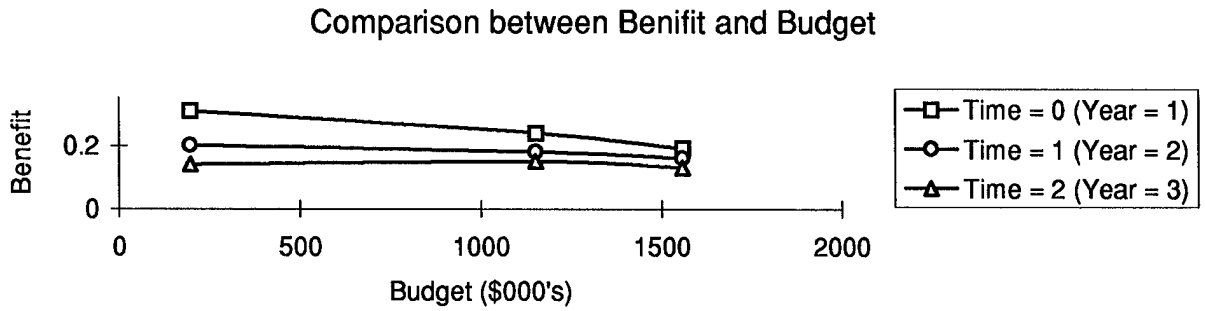


Figure 14. Total Amount to Charge Back vs. Minimum Benefit to Track All Activities

The researcher does not imply that the relationships are linear as only three points are plotted for any year. However, there does appear to be some type of relationship between the two variables. As it is, for approximately every $200,000 increase in amount charged back to the customers and activities for the organizations, there is a 0.01 drop in required benefit for year one. The line for year three is almost straight across (no slope) which might mean the minimum benefit for a life span of three years is constant, or that the minimum benefit is the same regardless how large the sum charged back to a customer.

Thus, what is recommended for future research is for a researcher to survey several ENV organizations to determine common activities performed by all which constitute a

majority of the organizations activities and then collect the cost information available that fits the activities and input this information into an ABC optimization tool built for these organizations. Next, the sensitivity analysis would need to be performed to determine the minimum required benefits given different % times required for ABC data maintenance. Performing this type of analysis for several organizations would allow for more information to be gathered regarding the benefit ratio and budget sizes that could allow a correlation to be drawn between the two. Once such an analysis took place, a simplified tool or equation could be developed which would allow any organization similar to ENV organizations an easy reference for the minimum benefit they would need to receive from ABC in order to use it beneficially.

In addition, since this research effort only completed the first step of ABC by optimizing the number of activities the ABC system should utilize, future research could center on development of the cost drivers associated with the identified activities. This research could utilize one of the available techniques or a new technique could be developed.

Other areas of future research could be devoted to the determination of the actual activities performed at different installations. This thesis developed activities based on a literature search. The results were such that an average of 77% of the employees time was consumed by the activities as defined in Figure 4. Thus, it could be stated the activities listed in Figure 4 were defined at a level which is recognized by different organizations located in different states. This means that the activities as outlined in Figure 4 were ones which appear to be applicable to organizations in different states.

One could argue the significance of this statement from the reverse side saying that the activities are not defined at a level which is recognized by different organizations because an average of 23% of an employees time is not included. However, when one considers the additional activities placed on Department of Defense employees such as military formations (commander's calls), fund raising efforts, readiness inspections, historical preservation and natural/cultural resource management, etc., that consume an employees time, it can be seen that a 77% coverage of an employees time is relatively inclusive of the time a Department of Defense employee contributes to environmental activities.

Therefore, future research could be devoted to determining an activity list that could be developed for any ENV organization that encompasses more of what an organization accomplishes. One possible method of achieving this could be to survey several ENV organizations to determine the specific definitions of activities at each and then global definitions could be developed to be used for all installations.

The final area for recommended research focuses on the availability of data that was needed for this thesis. The specific data required for this thesis effort was limited at best. Each employee gave their best guess as to how much time was spent on each activity for each customer. Since records were not available to track the percentage of an employees time to certain activities and customers, the employees guesses were the best available information. This does not diminish the importance of the results of this thesis because the tool is only an estimation in itself as to the activities and customers that should be charged using ABC techniques. This recommendation was made only to show that there was and is real benefit in finding out better approximations to the real information before

undertaking a full scale ABC effort. The better the information into a model, the better the information out.

Summary

ABC has been shown as a better accounting system than the traditional accounting systems currently in use by many Air Force organizations. As the Air Force attempts to gain control of costs, it is important that accurate information is obtained concerning a product or service cost. ABC has been used by the commercial sector to a variety of different successes. The important point to remember is that all the information any organization could possibly need is probably obtainable. The problem is that collecting this information does not come cheap. Time must be taken to input the data required which consumes portions of the organizational resources. This thesis effort developed a tool that shows the user at what point increasing the complexity of an ABC system becomes non-beneficial. The information presented by this thesis aids in the development of ABC systems for nearly all types of organizations because it relates the costs of ABC to the benefits that must be attained in order for an organization to beneficially use ABC.

## Appendix A. Activity Dictionary

Definitions:

Actions: This word is used throughout the dictionary. This word is intended to be used to cover a variety of verbs such as, reading appropriate literature, reviewing different aspects of the job (plans, drawings, reports, responses, calculations), attending/preparing meetings (for specific purposes such as for air permits, hazardous waste disposal concerns, cross-functional team concerns), filling out reports (any paperwork associated with the activity), filing of records/reports (any thing associated with the activity), attending training for the specific activity (if not mentioned as a separate activity) etc. If the worker accomplishes anything in the course of the day which can be directly related to an activity would be considered an action taken for that activity.

### Air Emissions Management

This section includes activities that are accomplished to comply with regulations, responsibilities, and compliance requirements associated with air pollution emissions from stationary and mobile sources.

Activities associated with Air Management:

Obtain and maintain Permits: Includes the actions taken to obtain and maintain Title V permits, incinerator permits, engine test cells, etc. Any action taken to satisfy the requirements of obtaining or maintaining an air permit per applicable Federal law. Actions may include processing the air emission data, record-keeping, reporting and/or filing.

New Source Performance Review: Includes actions such as pre-construction review and permitting under the Clean Air Act taken to satisfy legal requirements (ensuring Best Available Control Technologies are used etc.)

CFC and Halon Management: Actions taken to prevent the release of CFC's into the atmosphere such as:

- Verifying all applicable laws are followed:
  - -- Labeling, Record-keeping, purchasing, disposal, recovery, etc..
- Verifying no class I or II ODC's are emitted.

Air Emissions Inventory: Actions taken to satisfy the requirements of completing an air emission inventory

Air Emissions Monitoring: The monitoring and record-keeping, report notification, testing, sampling, and other actions taken to ensure the emissions (fugitive, mobile stationary) of the installation do not violate any permits or laws

Audits: Actions taken to ensure the practices of the environmental organization take into consideration all applicable laws (other than ECAMP)

**Hazardous Materials Management**

This section includes activities accomplished to ensure the proper storage and handling of chemicals and the spill contingency and response requirements related to hazardous materials. This section does not address oil, pesticides, radioactive, or asbestos, they will be covered in latter sections.

A hazardous material is any substance which meets the definitions of a hazardous substance as defined by the Resource Conservation and Recovery Act. or 40 CFR 302.3.

Activities associated with the service Hazardous Materials Management

Purchasing hazardous materials: Includes the actions taken to procure the hazardous substance. Includes the actions required to pre-procurement and post-procurement actions (if any). Also includes the actions taken to receive and store the hazardous substance before its use.

Obtaining and maintaining Material Data Safety Sheets: Ensuring the workers who handle hazardous substances have access to a MSDS (ie, maintaining a hazardous communications program)

Oversee industrial hygiene audits: Actions taken to ensure the health of those handling hazardous substances is protected (monitor employee exposure to hazardous materials).

Prepare Toxic Release Inventory: Actions taken to satisfy legal requirement for completing and making public a TRI report.

Preparing Emergency Planning and Community Right-to-know reports: Reports written to satisfy the requirements of EPCRA

Prepare Emergency Plan: Actions taken to ensure the hazardous materials portion of a Spill Response Control and Countermeasures Plan is properly completed.

Prepare Tier one/Tier Two reports: Reports required by Federal law depending on the installations classification.

Responding to spills: Includes actions taken to ensure proper response (ensure training for hazmat contingencies is up-to-date) to a hazardous substance/waste spill. (to include interactions with fire department; reporting to local, regional and Federal regulators, if applicable).

Procurement of hazardous material facility: Includes actions taken to obtain and maintain permit for operating a hazardous material facility as well as actions taken to ensure proper operation of the facility.

Labeling requirements: Actions taken to ensure proper warning labels accompany a hazardous waste. Also, the actions taken to ensure proper labeling requirements are adhered to for the hazardous material facility as well as any containers used for transportation of the hazardous material, if applicable.

Purchase and maintain personal protection equipment: Actions taken to ensure proper PPE is purchased and maintained for those working with, or cleaning up, hazardous materials.

Purchase and maintain secondary equipment: Actions taken to ensure proper secondary containment is used when/where required.

Filing and record-keeping: Keeping records and reports required by law other than MSDS's such as spill reports.

Perform Audits: Audits of hazardous materials facility and other areas handling hazardous materials other than ECAMP.

**Hazardous Waste Management**

This section includes activities accomplished to ensure those that generate, store, transport, treat, or dispose of any type of hazardous waste follow all applicable laws and regulations. (Applicable laws - RCRA, FFCA, EO 12088 Federal Compliance with Pollution Standards). Conditionally exempt small quantity generators, small quantity generators, and generators are subject to different standards. In an attempt to make this activity dictionary as generic as possible, only those activities associated with generators are listed here. A generator is subject to the most stringent laws and therefore is the most applicable to the widest range of installations.
A waste is hazardous if it meets the requirements of RCRA for toxicity, radioactivity, ignitability, or corrosivity. This category also covers medical, pathological, and infectious wastes.

Activities associated with providing a Hazardous Waste service:

The following activities are associated with hazardous waste management for hazardous waste generators. The list encompasses activities which may or may not be accomplished at all installations. The activities performed at an installation for hazardous waste management are based on the installations hazardous waste generator classification. Although there are federal requirements, typically most installations must operate according to the operating permits which are granted by the states. However, due to the fact that the states must set their laws based on Federal law, the following activities were determined based on Federal requirements.

Hazardous waste identification: Actions taken to ensure substances of either known or unknown origin are identified as hazardous or not-hazardous.

RCRA reporting of identified waste activities: Actions taken to ensure the appropriate regulators are notified of any processes or procedures that result in hazardous waste being generated.

Obtaining EPA hazardous waste generator number: Actions taken to ensure the installation obtains and maintains a proper hazardous waste generator identification number.

Obtaining and maintaining treatment, storage, and disposal facility permits: Actions taken to ensure TSDF operations are legal (through permit application and maintenance). Includes completing original permit and subsequent paperwork as well as permit fees.

Procurement of treatment, storage, and disposal facility: Actions taken to ensure the operations conducted at and by the TSDF facility are in accordance with Federal regulations as well as in accordance with the TSDF permit. Ensuring the facility has proper security, communications, safety, fire and decontamination equipment per permit and law.

Preparing and maintaining hazardous waste manifest: Actions taken to track the hazardous waste manifests and then storing the completed manifest on-site for at least three years.

Preparing wastes for transport: Actions taken to ensure the wastes leaving the installation are properly prepared (label, overpacking, proper containers, etc.) for transportation.

Paying hazardous waste transportation and disposal fees: Actions taken to ensure the money to pay for hazardous waste transportation and disposal is available and then properly allocated.

Procurement of hazardous waste storage containers: Actions taken to ensure the proper containers are available for the storage of hazardous waste (i.e. procurement of 55 gallon metal or plastic drums). Involves the storage required for empty drums awaiting use.

Oversee hazardous waste satellite accumulation point management: Actions taken to ensure operations conducted at unpermitted areas which accumulate hazardous waste prior to it being placed in a permitted TSDF are properly conducted. Includes the training and spot inspections which may be accomplished.

Treatment of hazardous waste: Actions taken by an installation (on site) which are defined as treating hazardous waste by regulations/regulators.

Disposal of hazardous waste: Actions taken by an installation (on site) which are defined as the disposal of hazardous waste by regulations/regulators.

Preparing Spill Prevention Control and Countermeasures Plan (Contingency Plan or Spill Plan): Actions taken to complete the hazardous waste portion of a SPCC plan for the installation.

Test and maintain hazardous waste equipment: Actions taken to obtain equipment for the use in hazardous waste activities (can crusher, aerosol can puncture, etc.) and actions taken to maintain that equipment.

Prepare biennial 'Waste Activities' report: Actions taken to ensure the biennial 'waste activities' report is prepared and properly distributed/maintained.

Preparation of Closure and post-closure plans for treatment, storage and disposal facilities: Actions taken to prepare and maintain the closure and post-closure plans for the TSDF.

Training: Actions taken to either receive or administer training for the purposes of handling hazardous waste.

**Petroleum, Oil, and Lubricant (POL) Management**

This section includes activities performed to ensure the installation follows applicable laws and regulations affecting those that store, transport, dispose of, or utilize petroleum based fuels, oils or lubricants.

Activities associated with POL:

Preparing Spill Prevention Control and Countermeasures Plan (Contingency Plan or Spill Plan): Actions taken to complete the POL portion of a SPCC plan for the installation.

Obtaining and Maintaining POL permits: Actions taken to obtain and comply with applicable POL permits.

Monitoring Used Oil Collection/Recycling: Actions taken to ensure used oil collection/recycling is accomplished according applicable laws and regulations.

**Solid Waste Management**

This section includes activities performed to ensure the installation handles its' solid wastes according to applicable laws and regulations.

Activities associated with solid waste management:

Collection of solid wastes: Actions taken to ensure solid wastes are handled according to applicable laws governing the storage, collection, transfer, and disposal of solid wastes and recyclables.

Obtaining landfill permits: Actions taken to ensure permits are properly obtained, maintained and followed.

**Wastewater/Drinking Water Management**

This section includes activities performed to ensure compliance with regulations, responsibilities and compliance requirements associated with wastewater discharge and the clean water acts for public, community, and noncommunity drinking water systems. Compliance is usually ensured through activities performed to satisfy permit requirements. Such activities common to most wastewater and drinking water permits are monitoring/sampling, record-keeping, reports and concentrations of discharge constituents not exceeded.

Specific activities associated with wastewater and drinking water management:

Paying Wastewater treatment fees: Actions taken to ensure the installation does not violate any agreements with the local community.

Operating industrial waste water pretreatment plants: Actions taken to ensure the operations at such a facility comply with established guidelines and regulations.

Obtaining and maintaining applicable permits: Actions taken to ensure permits are obtained and followed according to the guidelines set forth in the permit. Examples of permits include:

-nonpoint sources
-wastewater
-certification requirements for laboratories analyzing samples
-wastewater treatment plant operator certification
-sludge disposal
-pretreatment standards
-discharges to sewage treatment facilities
-industrial wastewater
-septic tanks
-stormwater pollution prevention plan
-stormwater discharges
-NPDES

Maintaining drinking water standards: Actions taken to ensure the proper standards are adhered to for drinking water.

**Other**

Above and/or Underground Storage tank management: The process of ensuring that the above and below ground storage tanks are appropriately managed according to laws and regulations. To include inspections, emissions monitoring, leak detection, notifications, and record-keeping/documentation requirements (RCRA Subtitle I).

Preparing, performing, and follow-up actions for environmental compliance assessment and management program audits: Actions taken to ensure compliance with internal audits.

Performing activities associated with toxic substances (asbestos, PCBs): Actions taken to comply with applicable regulations, statutes, and laws concerning asbestos and PCB handling, detection, storage, and disposal.

## Appendix B. Pay Grade Categories

This appendix contains the computations completed for the determination of the different pay grade categories described in Chapter III. Page 96 represents the computations for military members (Air Force, enlisted and officer). It was assumed the majority of personnel working in an ENV organization would have between 2 and 20 years of service. The Basic Military Compensation used included base pay, basic allowance for quarters, basic allowance for subsistence, the tax advantages given to military members and variable housing allowance (the Dayton, OH area equaled the average VHA given to military members for the three installations analyzed).

Page 97 represents the computations for DoD civilians. It was assumed those working on the activities listed in Figure 4 for an ENV organization were between GS-7 and GS-15 with between a one and ten step increase in salary. The percentage salary adjustments by geographic locality were 5.72, 6.34 and 6.23 for Dayton, Denver and Dallas respectively. The highest (Denver, or CMAFB) and lowest (Dayton, or WPAFB) adjustments were used to determine the average dollar amount per hour.

Basic Military Compenstation (basic pay + BAQ + BAS + tax advantages)

| Rank | vha (wp | <2 | >2 | 3 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E3 | 51 | 19411 | 20096 | 20620 | 21166 | | | | | | | | |
| E4 | 52 | 20654 | 24427 | 22274 | 23422 | 24055 | | | | | | | |
| E5 | 40 | 22774 | 24117 | 24886 | 25601 | 26716 | 27455 | 28164 | 28823 | 29156 | | | |
| E6 | 60 | 25639 | 27220 | 27977 | 28704 | 29348 | 30001 | 30750 | 31839 | 32530 | 33276 | 33640 | |
| E7 | 90 | | | | | 32569 | 33299 | 34038 | 34783 | 35893 | 36623 | 37354 | 37711 |
| E8 | 88 | | | | | | | 38433 | 39099 | 39828 | 40591 | 51268 | 42012 |
| E9 | 138 | | | | | | | | | 44884 | 45622 | 46377 | 47043 |
| O1 | 61 | 27721 | 28528 | 33094 | | | | | | | | | |
| O2 | 69 | 31956 | 34270 | 39805 | 40838 | 41490 | | | | | | | |
| O3 | 99 | 37237 | 40528 | 42622 | 45999 | 47681 | 48998 | 51065 | 53101 | 54182 | | | |
| O4 | 100 | 41211 | 47481 | 49803 | 49809 | 50496 | 52168 | 54947 | 57463 | 59730 | 62064 | 63597 | |
| O5 | 71 | 47926 | 53814 | 56688 | 56757 | 56747 | 56751 | 58154 | 60824 | 64402 | 68684 | 72112 | 73963 |

Total Military Pay

| Rank | <2 | >2 | 3 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E3 | 19462 | 20147 | 20671 | 21217 | | | | | | | | |
| E4 | 20706 | 24479 | 22326 | 23474 | 24107 | | | | | | | |
| E5 | 22814 | 24157 | 24926 | 25641 | 26756 | 27495 | 28204 | 28863 | 29196 | | | |
| E6 | 25699 | 27280 | 28037 | 28764 | 29408 | 30061 | 30810 | 31899 | 32590 | 33336 | 33700 | |
| E7 | | | | | 32659 | 33389 | 34128 | 34873 | 35983 | 36713 | 37444 | 37801 |
| E8 | | | | | | | 38521 | 39187 | 39916 | 40679 | 51356 | 42100 |
| E9 | | | | | | | | | 45022 | 45760 | 46515 | 47181 |
| O1 | 27782 | 28589 | 33155 | | | | | | | | | |
| O2 | 32025 | 34339 | 39874 | 40907 | 41559 | | | | | | | |
| O3 | 37336 | 40627 | 42721 | 46098 | 47780 | 49097 | 51164 | 53200 | 54281 | | | |
| O4 | 41311 | 47581 | 49903 | 49909 | 50596 | 52268 | 55047 | 57563 | 59830 | 62164 | 63697 | |
| O5 | 47997 | 53885 | 56759 | 56828 | 56818 | 56822 | 58225 | 60895 | 64473 | 68755 | 72183 | 74034 |

| Yearly Averages | Monthly Averages | Weekly Averages (4.33 wk/mo) | Hourly Averages (40hr/wk) |
|---|---|---|---|
| 20374 | 1698 | 392 | 10 |
| 23018 | 1918 | 443 | 11 |
| 26450 | 2204 | 509 | 13 |
| 30144 | 2512 | 580 | 15 |
| 35374 | 2948 | 681 | 17 |
| 41960 | 3497 | 808 | 20 |
| 46120 | 3843 | 888 | 22 |
| 29842 | 2487 | 574 | 14 |
| 37741 | 3145 | 726 | 18 |
| 46923 | 3910 | 903 | 23 |
| 53624 | 4469 | 1032 | 26 |
| 60640 | 5053 | 1167 | 29 |

Determine the Pay Grade Categories

| | | | | | | CAT | RANK | HR AVG |
|---|---|---|---|---|---|---|---|---|
| GS7 | 14 | O1 | 14 | E3 | 10 | A | E3, E4 | 11 |
| GS8 | 15 | O2 | 18 | E4 | 11 | B | E5-E8,O1,O2, GS7-GS | 17 |
| GS9 | 17 | O3 | 23 | E5 | 13 | C | E9,O3,O4,GS12 | 24 |
| GS10 | 20 | O4 | 26 | E6 | 15 | D | O5,GS13-GS15 | 34 |
| GS11 | 21 | O5 | 30 | E7 | 17 | | | |
| GS12 | 25 | | | E8 | 20 | | | |
| GS13 | 30 | | | E9 | 22 | | | |
| GS14 | 35 | | | | | | | |
| GS15 | 41 | | | | | | | |

Civilian Pay

| dayton | one | two | three | four | five | six | seven | eight | nine | ten |
|---|---|---|---|---|---|---|---|---|---|---|
| gs-7 | 25000 | 26000 | 27000 | 27500 | 28500 | 29000 | 30000 | 31000 | 32000 | 32500 |
| gs-8 | 27700 | 28600 | 29500 | 30400 | 31400 | 32300 | 33200 | 34100 | 35000 | 36000 |
| gs-9 | 30600 | 31600 | 32600 | 33600 | 34600 | 35600 | 36680 | 37700 | 38700 | 39700 |
| gs-10 | 33700 | 34800 | 35900 | 37000 | 38100 | 39300 | 40400 | 41500 | 42600 | 43800 |
| gs-11 | 37000 | 38200 | 39500 | 40700 | 41900 | 43100 | 44400 | 45600 | 46800 | 48100 |
| gs-12 | 44300 | 45800 | 47300 | 48800 | 50200 | 51700 | 53200 | 54700 | 56100 | 57600 |
| gs-13 | 52700 | 54500 | 56200 | 58000 | 59700 | 61500 | 53000 | 65000 | 66800 | 68500 |
| gs-14 | 62300 | 64400 | 66400 | 68500 | 70600 | 72700 | 74700 | 76800 | 78900 | 80900 |
| gs-15 | 73300 | 75700 | 78150 | 80600 | 83000 | 85500 | 87900 | 90360 | 92800 | 95243 |

| yearly av | weekly a | hourly | inc. for denver(highest) | use |
|---|---|---|---|---|
| 28850 | 555 | 13.88 | 14.74 | 14 |
| 31820 | 612 | 15.3 | 16.25 | 15 |
| 35138 | 676 | 16.9 | 17.95 | 17 |
| 38710 | 744 | 18.6 | 19.75 | 20 |
| 42530 | 818 | 20.45 | 21.72 | 21 |
| 50970 | 980 | 24.5 | 26.02 | 25 |
| 59590 | 1146 | 28.65 | 30.43 | 30 |
| 71620 | 1377 | 34.43 | 36.56 | 35 |
| 84255 | 1620 | 40.5 | 43.01 | 41 |

# Appendix C

The first three pages of this appendix contain the information regarding the total dollar amount CMAFB, DAFB, and WPAFB should charge to each customer and for what activity as a result of using ABC beneficially. The remainder of the appendix is devoted to an example of how the values were determined for one customer and activity followed by a sample ABC optimization tool as built for DAFB.

For CMAFB (benefit ratio at 0.4, and % time required for ABC data maintenance at 10%):

| Activities | CES | CS(COMM) | SPS | Med | SVS | CMOC | Total |
|---|---|---|---|---|---|---|---|
| Air Management | | | | | | | |
| 1. Obtain and Maintain Air Permits | 6380 | | | | | | 6380 |
| 2. Air Emission Inventory | 3700 | | | | | | 3700 |
| 3. Air Emission (Monitoring, testing and sampling | 1512 | 168 | | | | | 1680 |
| 4. Audits | 1680 | | | | | | 1680 |
| 5. Record-Keeping | 2754 | 306 | | | | | 3060 |
| Hazardous Material Management | | | | | | | |
| 6. Purchase Hazardous Materials | 9904 | 1238 | 619 | 371.4 | 123.8 | 123.8 | 12380 |
| 7. Obtain and Maintain MSDS (hazcom) | 1728 | 96 | 38.4 | 19.2 | 19.2 | 19.2 | 1920 |
| 8. Oversee industrial hygeine audits | 1008 | 33.6 | 33.6 | 22.4 | 11.2 | 11.2 | 1120 |
| 9. Prepare Toxic Release Inventory | 2360 | | | | | | 2360 |
| 10. Prepare Emergency Planning and Community Right to Know Reports | 1180 | | | | | | 1180 |
| 11. Prepare Emergency Plan (SPCC) | 944 | 118 | 59 | 35.4 | 11.8 | 11.8 | 1180 |
| 12. Prepare Tier One/Tier Two reports | 2360 | | | | | | 2360 |
| 13. Respond to spills | 2718 | 151 | 60.4 | 30.2 | 30.2 | 30.2 | 3020 |
| 14. Procurement of hazardous material facility (obtaining and maintaing permit) | 1596 | 16.8 | 16.8 | 16.8 | 16.8 | 16.8 | 1680 |
| 15. Labeling requirements | 702 | 78 | | | | | 780 |
| 16. Purchase and maintain PPE | 9240 | | | | | | 9240 |
| 17. Purchase secondary containment equip | 2152.8 | | 187.2 | | | | 2340 |
| 18. Perform audits | 3216 | 201 | 201 | 201 | 120.6 | 80.4 | 4020 |
| Hazardous Waste Management | | | | | | | |
| 19. Hazardous waste identification | 1540 | 220 | 220 | 110 | 66 | 44 | 2200 |
| 20. RCRA reporting of waste activities | 2016 | 201.6 | 151.2 | 100.8 | 25.2 | 25.2 | 2520 |
| 21. Obtaining EPA hazardous waste generator number | 2412 | 134 | 53.6 | 26.8 | 26.8 | 26.8 | 2680 |
| 22. Preparation of hazardous waste manifest | 3211 | 67.6 | 67.6 | 33.8 | | | 3380 |
| 23. Preparation of wastes for transport | 2265.6 | 47.2 | 23.6 | 23.6 | | | 2360 |
| 24. Paying hazardous waste transporation and disposal fees | 19399 | 408.4 | 204.2 | 204.2 | 204.2 | | 20420 |
| 25. Procurement of hazardous waste storage containers | 3618 | 201 | 80.4 | 40.2 | 40.2 | 40.2 | 4020 |
| 26. Prepare SPCC Plan | 1562.4 | 50.4 | 50.4 | 16.8 | | | 1680 |
| 27. Test and maintain hazardous waste equipment | 3360 | | | | | | 3360 |
| 28. Prepare Biennial 'Waste Activities' report | 1344 | 168 | 117.6 | 16.8 | 16.8 | 16.8 | 1680 |
| 29. Preparation of closure and post-closure plans for TSDF | 918 | 51 | 20.4 | 10.2 | 10.2 | 10.2 | 1020 |
| 30. Training accomplished for Hazardous Waste purposes other than SAP training | 2700 | | | | | | 2700 |
| POL Management | | | | | | | |
| 31. Prepare SPCC Plan | 2680 | | | | | | 2680 |
| 32. Obtain and Maintain POL Permits | 3380 | | | | | | 3380 |
| 33. Monitoring and Permitting of used oil collection/recycling areas | 3380 | | | | | | 3380 |
| Wastewater Management | | | | | | | |
| 34. Obtain and Maintain NPDES permit | 4842 | 161.4 | 161.4 | 107.6 | 53.8 | 53.8 | 5380 |
| 35. Paying wastewater treatment fees | 3192 | 33.6 | 33.6 | 33.6 | 33.6 | 33.6 | 3360 |
| 36. Obtain and Maintain Storm Water permit | 3211 | 33.8 | 33.8 | 33.8 | 33.8 | 33.8 | 3380 |
| | | | | | | | |
| Solid Waste Management | | | | | | | |
| 37. Collection of solid wastes | 8585 | 909 | 202 | 202 | 101 | 101 | 10100 |
| 38. Obtaining and Maintaining Landfill permits | 4248 | 236 | 94.4 | 47.2 | 47.2 | 47.2 | 4720 |
| | | | | | | | |
| OTHER | | | | | | | |
| 39. Managing AST and UST | 3700 | | | | | | 3700 |
| 40. Performing ECAMP (to include pre-audit and post-audit activities) | 32418 | 1801 | 720.4 | 360.2 | 360.2 | 360.2 | 36020 |
| Sum to charge back per customer | 169116.8 | 7130.4 | 3450 | 2064 | 1352.6 | 1086.2 | |
| | Sum of $'s to charge back (contract + labor) = 184200 | | | | | | |

For DAFB (benefit ratio at 0.4, and % time required for ABC data maintenance at 10%):

| Activities | CES | SVS | SPS | EMS | CRS | SUPPLY | TRANS | MED | OPS |
|---|---|---|---|---|---|---|---|---|---|
| Air Management | | | | | | | | | |
| 1. Obtain and Maintain Air Permits | 1156 | 14 | | 7740 | 5620 | 7 | 1266 | 7 | 551 |
| 2. New Source Performance Rvw | 34 | 7 | | 2638 | 1954 | 3 | 497 | 3 | 3 |
| 3. CFC and Halon Management | 35867 | | | 814 | | | 4339 | | |
| 4. Air Emission Inventory | 3786 | 1002 | 631 | 22043 | 4417 | 817 | 3491 | 185 | 1488 |
| 5. Record-Keeping | 642 | 356 | 336 | 2610 | 978 | 346 | 927 | 10 | 214 |
| Hazardous Material Management | | | | | | | | | |
| 6. Prepare Toxic Release Inventory | 272 | | | | | 408 | | | |
| 7. Prepare Emergency Planning and Community Right to Know Reports | 2944 | | | | 136 | | | | |
| 8. Prepare Emergency Plan (SPCC) | 612 | | | | | 1428 | | | |
| 9. Respond to spills | 1777 | 1073 | 1073 | 2381 | 2381 | 1308 | 2381 | | 704 |
| 10. Procurement of hazardous material facility | 2602 | | | | | 11838 | | | |
| 11. Labeling requirements | 136 | | | | | 408 | | 136 | |
| 12. Perform audits | 340 | 340 | 340 | 340 | 340 | 680 | 340 | 340 | 340 |
| Hazardous Waste Management | | | | | | | | | |
| 13. Hazardous waste identification | 20537 | 10128 | 8327 | 27063 | 18736 | 10128 | 14432 | 14432 | 20537 |
| 14. RCRA reporting of waste activities | 3017 | 425 | 425 | 1385 | 1385 | 969 | 905 | 480 | 1929 |
| 15. Obtaining EPA hazardous waste generator number | 680 | 595 | 595 | 731 | 595 | 595 | 595 | 595 | 459 |
| 16. Obtaining and Maintaining TSDF permits | 11008 | 198 | 297 | 850 | 692 | 6922 | 692 | 2967 | 534 |
| 17. Preparation of hazardous waste manifest | 986 | 850 | 850 | 850 | 850 | 850 | 850 | 884 | 850 |
| 18. Paying hazardous waste transporation and disposal fe.es | 29934 | 25943 | 29934 | 41110 | 25943 | 25943 | 25943 | 24746 | 25943 |
| 19. Procurement of hazardous waste storage containers | 1641 | 519 | 519 | 723 | 553 | 689 | 553 | 238 | 689 |
| 20. Oversee (training and inspections) hazardous waste SAP's | 5601 | 918 | 510 | 2031 | 1878 | 918 | 1398 | 1330 | 2456 |
| 21. Prepare SPCC Plan | 6143 | 170 | 255 | 663 | 493 | 493 | 493 | 425 | 765 |
| 22. Prepare Biennial 'Waste Activities' report | 2655 | 170 | 255 | 663 | 493 | 493 | 493 | 425 | 493 |
| 23. Preparation of closure and post-closure plans for TSDF | 4425 | 201 | 201 | 201 | 201 | 670 | 201 | 401 | 201 |
| POL Management | | | | | | | | | |
| 24. Prepare SPCC Plan | 8670 | 34 | 34 | 136 | 17 | 3400 | 5270 | 85 | 34 |
| 25. Monitoring Used Oil | 34 | 34 | 17 | 170 | 17 | 7 | 44 | | |
| Wastewater Management | | | | | | | | | |
| 26. Obtain and Maintain NPDES permit | 2678 | 231 | 231 | 231 | 231 | 231 | 231 | 1561 | 1117 |
| 27. Prepare SPCC Plan | 833 | 238 | 238 | 952 | 952 | 119 | 119 | 119 | 323 |
| 28. Obtain and Maintain Stormwater permit | 3400 | 3400 | 1700 | 8500 | | 1700 | 3400 | | 11900 |
| Solid Waste Management | | | | | | | | | |
| 29. Collection of Solid Wastes (Separating and storing recyclables, payment of disposal fees) | 157971 | 36270 | 24380 | 48761 | 24380 | 24380 | 24380 | 12190 | 32307 |
| 30. Obtaining and Maintaining landfill permits (closure plans, monitoring, record-keeping, etc.) | 680 | | | | | | | | |
| OTHER | | | | | | | | | |
| 31. Managing AST and UST (RCRA reporting, maintaining leak detection, monitoring corrosion control systems, etc.) | 11469 | 2757 | | 2757 | | 5849 | 2757 | 2757 | 1513 |
| 32. Performing ECAMP (to include pre-audit and post-audit activities) | 7802 | 2627 | 1610 | 3390 | 3390 | 2627 | 3390 | 1710 | 14354 |
| Total = | 330332 | 88500 | 72758 | 179733 | 96632 | 104226 | 99387 | 66026 | 119721 |

Sum of $'s to charge back (contract + labor) = 1157315

For WPAFB (benefit ratio at 0.4, and % time required for ABC data maintenance at 10%):

| ACTIVITIES | CE | Avionics | Flight Dynamics | Materials | Propulsion | Armstrong (Human Systems) | LOG | SPTG | 445 Airlift Wing | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| Air Management | | | | | | | | | | |
| Obtain and Maintain Air Permits | 85575 | | | | 9715 | 9715 | 9715 | | | 114720 |
| Air Emission Inventory | 12811 | 12811 | 12811 | 12811 | 12811 | 12811 | 12811 | 12811 | 12811 | 115299 |
| Air Emission (Monitoring, testing and sampling | 156500 | | | | | | | | | 156500 |
| Record-Keeping | 340 | 170 | 170 | 170 | 170 | 170 | 170 | | 340 | 1700 |
| | | | | | | | | | | |
| Hazardous Material Management | | | | | | | | | | |
| Obtain and Maintain MSDS (hazcom) | 240 | | | | | | | | | 240 |
| Prepare Toxic Release Inventory | 4800 | 1440 | 1440 | 1440 | 1440 | 1440 | 1920 | 1440 | 2400 | 17760 |
| Prepare Emergency Planning and Community Right to Know Reports | 1920 | 960 | 1173 | 960 | 960 | 960 | 960 | 480 | 960 | 9333 |
| Prepare Emergency Plan (SPCC)* | 17362 | | | 4353 | | | 3182 | 3182 | | 28079 |
| Respond to spills* | 25003 | 294 | 15296 | 17383 | 15002 | 8839 | 588 | 8839 | 3236 | 94430 |
| Purchase and maintain PPE | 4960 | | | | | | | | | 4960 |
| Purchase secondary containment equip | 4400 | | | | | | | | | 4400 |
| Perform audits | | 1020 | 680 | 1700 | 68 | 680 | | 1700 | | 5848 |
| Hazardous Waste Management | | | | | | | | | | |
| Hazardous waste identification* | 15490 | 3324 | 3324 | 13973 | 5745 | 5745 | 1936 | 3872 | 7261 | 60670 |
| RCRA reporting of waste activities | 431 | | | 1293 | 215 | 215 | | | 215 | 2369 |
| Obtaining and Maintaining TSDF permits | 340 | | | 340 | 170 | 170 | | | 170 | 1190 |
| Operating TSDF* | 3007 | | | 6013 | 1503 | 1503 | | | 1503 | 13529 |
| Preparation of hazardous waste manifest | 96 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 480 |
| Preparation of wastes for transport | 436 | 48 | 48 | 1748 | 48 | 48 | 388 | 388 | 2768 | 5920 |
| Paying hazardous waste transporation and disposal fees | 41516 | | | 41516 | 207582 | 207582 | | | 2163 | 500359 |
| Procurement of hazardous waste storage containers* | 1360 | | | | | | 340 | 340 | 680 | 2720 |
| Oversee (training and inspections) hazardous waste SAP's* | 2040 | | | 2720 | 510 | 510 | | 1700 | 1870 | 9350 |
| Prepare Biennial 'Waste Activities' report | 2400 | 2400 | 1200 | 2400 | 1200 | 1200 | 1200 | | 2400 | 14400 |
| Preparation of closure and post-closure plans for TSDF | 7200 | 960 | 960 | 4800 | 960 | 960 | 960 | | 7200 | 24000 |
| Training accomplished for Hazardous Waste purposes other than SAP training* | 11033 | 1131 | 1131 | 6648 | 3890 | 3890 | 5516 | 5516 | 8275 | 47030 |
| POL Management | | | | | | | | | | |
| Obtain and Maintain POL Permits | 340 | | | 170 | 170 | | | | | 680 |
| Monitoring and Permitting of used oil collection/recycling areas | 3360 | 480 | 480 | 480 | 480 | 480 | 480 | 480 | 480 | 7200 |
| Wastewater Management | | | | | | | | | | |
| Obtain and Maintain NPDES permit | 200850 | | | | | | | | | 200850 |
| Paying wastewater treatment fees | 340 | | | | | | | | | 340 |
| Obtain and Maintain Storm Water permit | 78400 | | | | | | | | | 78400 |
| OTHER | | | | | | | | | | |
| Managing AST and UST | 29088 | 5818 | 5818 | 5818 | 29088 | 5818 | 5818 | 5818 | 5818 | 98902 |
| Performing ECAMP (to include pre-audit and post-audit activities)* | 4821 | 0 | 4534 | 12389 | 2817 | 10672 | 8268 | 16536 | 8612 | 68649 |
| Total= | 716459 | 30904 | 49113 | 139173 | 294592 | 273456 | 54300 | 63150 | 69210 | 1690357 |

Sum of $'s to charge back (contract + labor) = 1690357

The rest of this appendix is devoted to detailing the ABC optimization tool for Dyess AFB. The following example coincides with the development of cost and benefit information for the activity 'Obtain and Maintain Air Permits' for customer CES.

As mentioned in Chapter IV, the following two equations were used to determine the future value of the cost and then related it back to present value for this analysis in the determination of costs in year 2 and year 3. To determine the future value:

$$F = P(1 + i)^n \qquad (1)$$

and conversely, to determine the present value:

$$P = F / (1 + dr)^n \qquad (2)$$

where: n = the number of years, i = 2.5% and dr = 6.3% as stated in Chapter IV.

1. The TOTAL percentage of time devoted by three pay grade categories per year for CES was: 0.002 for the 6 Cat B employees; 0.0 for the 2 Cat C employees; and 0.016 for the 1 Cat D employee (see pages 105 thru 110). The hourly labor rates per category were $17, $24, and $34 for Cat B, C, and D respectively. 2000 hours were spent by the employees conducting business operations for the environmental organization per year. Thus, the amount of labor charges associated with this activity and customer was:

(0.002 * $17/hr + 0.0 * $24/hr + 0.016 * $34/hr ) * 2000 hrs/yr = $1156 for year 1

(see pages 111 thru 116)

2. The ABC data maintenance cost were then 10% of this cost or $115.60 for year 1. (see pages 117 thru 122)

3. The division of model costs were determined by first summing all costs associated with procuring and developing the software program for DAFB. This total was $18702. The portion to be attributable to this customer and activity was determined by using the formula based on time spent per activity. Besides the given percentages of time devoted to the activity and customers, the information required for this calculation is the total amount of time spent by the employees for all the activities and all the customers. For Cat B employees, this figure was 4.5445, Cat C employees it was 1.3 and for the Cat D employee it was 0.8. The division of model costs was then be determined for this activity and customer as follows:
18702 * (0.002 + 0.0 + 0.016)/(4.5445 + 1.3 + 0.80) = $51 (This cost was only incurred in the first year.) (see pages 123 thru 124).

4. The total cost of due to labor was then calculated by summing the software costs and the labor costs: $51 + $115.6 = $166.60 for year 1. (in year 2, the total cost would be the cost in year 1 + the cost of labor for year 2 in present value terms; year three the total cost would be the sum of year 1 + the cost of labor for year 2 in present value terms + the cost of labor for year 3 in present value terms). (see pages 125 thru 130).

5. The division of service contract and other direct costs was determined based on the amount of money spent for the activity and the percentage of time devoted to the activity per customer and the total percentage of time spent on the *activity* by all employees as follows:

[(0.002 + 0.0 + 0.016) / (0.02 + 0.27 + 0.04)] * 0 = 0 (0 is the value DAFB spends directly for obtaining and maintaining air permits. It is 0 because DAFB has no air permits, yet they must perform activities such as filing for standard exemptions instead of air permits, which is why there is time devoted to this activity by the employees). (see pages 131 thru 132)

6. The total amount to charge back to each customer is the sum of the labor charges (part 1) and the service contract and other direct costs (part 5). This equaled:

$1156 (labor) + $0 (service contract costs) = $1156 total to be charged back to CES for 'Obtaining and Maintaining Air permits.' This is the value for year 1. In subsequent years, the value to charge back will decrease by 80% because CES is assumed to have saved 20% and will only require 80% in year two to pay for this activity. The same procedure is followed for year 3. (see pages 133 thru 138)

7. The benefit of charging this cost back, as stated in Chapter III, was 0.40 per dollar charged back. Thus, the benefit as a result of using ABC to make CES aware of the consumption of the ENV resources associated with this activity was: 0.4 * $1156 = $462.40 for year 1. (see pages 139 thru 144).

8. The end result, subtracting the cost from the benefit yields: $462.40 - $166.60 = $295.80 and it is beneficial to track this activity using ABC for year 1. (see pages 145 thru 150)

| TIME MATRIX RESULTS FOR | | | Customer | For wage grade category B | | | total # of employees for this category | | | 6 |
|---|---|---|---|---|---|---|---|---|---|---|
| Dyess AFB | | | | | | | | | | |
| Activities | CES | SVS | SPS | EMS | CRS | SUPPLY | TRANS | MED | OPS | TOTAL |
| Air Management | | | | | | | | | | |
| Obtain and Maintain Air Permits | 0.002 | 0.0004 | 0 | 0.014 | 0.002 | 0.0002 | 0.001 | 0.0002 | 0.0002 | 0.02 |
| New Source Performance Rvw | 0.001 | 0.0002 | 0 | 0.007 | 0.001 | 0.0001 | 0.0005 | 0.0001 | 0.0001 | 0.01 |
| CFC and Halon Management | 0.0095 | 0 | 0 | 0.0004 | 0 | 0 | 0.0001 | 0 | 0 | 0.01 |
| Air Emission Inventory | 0.003 | 0.0006 | 0 | 0.021 | 0.003 | 0.0003 | 0.0015 | 0.0003 | 0.0003 | 0.03 |
| Record-Keeping | 0.003 | 0.0006 | 0 | 0.021 | 0.003 | 0.0003 | 0.0015 | 0.0003 | 0.0003 | 0.03 |
| | | | | | | | | | | |
| Hazardous Material Management | | | | | | | | | | |
| Prepare Toxic Release Inventory | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Prepare Emergency Planning and Community Right to Know Reports | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Prepare Emergency Plan (SPCC) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Respond to spills | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Procurement of hazardous material facility | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Labeling requirements | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Perform audits | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | |
| Hazardous Waste Management | | | | | | | | | | |
| Hazardous waste identification | 0.02 | 0.02 | 0.02 | 0.04 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.2 |
| RCRA reporting of waste activities | 0.0125 | 0.0125 | 0.0125 | 0.0125 | 0.0125 | 0.0125 | 0.0125 | 0 | 0.0125 | 0.1 |
| Obtaining EPA hazardous waste generator number | 0.02 | 0.0175 | 0.0175 | 0.0215 | 0.0175 | 0.0175 | 0.0175 | 0.0175 | 0.0135 | 0.16 |
| Obtaining and Maintaining TSDF permits | 0.0075 | 0.005 | 0.0075 | 0.0215 | 0.0175 | 0.175 | 0.0175 | 0.075 | 0.0135 | 0.34 |
| Preparation of hazardous waste manifest | 0.029 | 0.025 | 0.025 | 0.025 | 0.025 | 0.025 | 0.025 | 0.026 | 0.025 | 0.23 |
| Paying hazardous waste transporation and disposal fees | 0.01875 | 0.01625 | 0.01875 | 0.02575 | 0.01625 | 0.01625 | 0.01625 | 0.0155 | 0.01625 | 0.16 |
| Procurement of hazardous waste storage containers | 0.01625 | 0.01525 | 0.01525 | 0.02125 | 0.01625 | 0.01625 | 0.01625 | 0.007 | 0.01625 | 0.14 |
| Oversee (training and inspections) hazardous waste SAP's | 0.1125 | 0.015 | 0.015 | 0.0195 | 0.015 | 0.015 | 0.015 | 0.013 | 0.02 | 0.24 |
| Prepare SPCC Plan | 0.0075 | 0.005 | 0.0075 | 0.0195 | 0.0145 | 0.0145 | 0.0145 | 0.0125 | 0.0145 | 0.11 |
| Prepare Biennial 'Waste Activities' report | 0.0075 | 0.005 | 0.0075 | 0.0195 | 0.0145 | 0.0145 | 0.0145 | 0.0125 | 0.0145 | 0.11 |
| Preparation of closure and post-closure plans for TSDF | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.002 | 0.001 | 0.01 |
| | | | | | | | | | | |
| POL Management | | | | | | | | | | |
| Prepare SPCC Plan | 0.155 | 0.001 | 0.001 | 0.004 | 0.0005 | 0 | 0.155 | 0.0025 | 0.001 | 0.32 |
| Monitoring Used Oil | 0.001 | 0.001 | 0.0005 | 0.005 | 0.0005 | 0.0002 | 0.0013 | 0 | 0.0005 | 0.01 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Wastewater Management | | | | | | | | | | |
| Obtain and Maintain NPDES permit | 0.006 | 0.003 | 0.003 | 0.003 | 0.003 | 0.003 | 0.003 | 0.003 | 0.003 | 0.03 |
| Prepare SPCC Plan | 0.0105 | 0.007 | 0.007 | 0.028 | 0.028 | 0.0035 | 0.0035 | 0.0035 | 0.0035 | 0.0945 |
| Obtain and Maintain Stormwater permit | 0.1 | 0.1 | 0.05 | 0.25 | 0 | 0.05 | 0.1 | 0 | 0.35 | 1 |
| | | | | | | | | | | |
| Solid Waste Management | | | | | | | | | | |
| Collection of Solid Wastes (Separating and storing recyclables, payment of disposal fees) | 0.34 | 0.06 | 0.06 | 0.12 | 0.06 | 0.06 | 0.06 | 0.03 | 0.06 | 0.85 |
| Obtaining and Maintaining landfill permits (closure plans, monitoring, record-keeping, etc.) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | |
| OTHER | | | | | | | | | | |
| Managing AST and UST (RCRA reporting, maintaining leak detection, monitoring corrosion control systems, etc.) | 0.0655 | 0.0235 | 0 | 0.0235 | 0 | 0.0305 | 0.0235 | 0.0235 | 0 | 0.19 |
| Performing ECAMP (to include pre-audit and post-audit activities) | 0.033 | 0.0055 | 0.005 | 0.005 | 0.005 | 0.0055 | 0.005 | 0.005 | 0.081 | 0.15 |
| | | | | | | | | | total = | 4.5445 |
| | | | | | | EQUIVALENT TO TOTAL/# EMPLOYEES = | | | | 0.75741667 |

| TIME MATRIX RESULTS FOR | | | Customer | For wage grade category C | | | total # of employees for this category | | | 2 |
|---|---|---|---|---|---|---|---|---|---|---|
| Dyess AFB | | | | | | | | | | |
| Activities | CES | SVS | SPS | EMS | CRS | SUPPLY | TRANS | MED | OPS | TOTAL |
| Air Management | | | | | | | | | | |
| Obtain and Maintain Air Permits | 0 | 0 | 0 | 0.14 | 0.11 | 0 | 0.02 | 0 | 0 | 0.27 |
| New Source Performance Rvw | 0 | 0 | 0 | 0.05 | 0.04 | 0 | 0.01 | 0 | 0 | 0.1 |
| CFC and Halon Management | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Air Emission Inventory | 0.001 | 0.001 | 0.001 | 0.002 | 0.002 | 0.001 | 0.002 | 0 | 0 | 0.01 |
| Record-Keeping | 0.007 | 0.007 | 0.007 | 0.014 | 0.014 | 0.007 | 0.014 | 0 | 0 | 0.07 |
| | | | | | | | | | | |
| Hazardous Material Management | | | | | | | | | | |
| Prepare Toxic Release Inventory | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Prepare Emergency Planning and Community Right to Know Reports | 0.05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.05 |
| Prepare Emergency Plan (SPCC) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Respond to spills | 0.005 | 0.005 | 0.005 | 0.01 | 0.01 | 0.005 | 0.01 | 0 | 0 | 0.05 |
| Procurement of hazardous material facility | 0.005 | 0 | 0 | 0 | 0 | 0.045 | 0 | 0 | 0 | 0.05 |
| Labeling requirements | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Perform audits | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | |
| Hazardous Waste Management | | | | | | | | | | |
| Hazardous waste identification | 0.02 | 0 | 0 | 0.02 | 0.02 | 0 | 0.01 | 0.01 | 0.02 | 0.1 |
| RCRA reporting of waste activities | 0.02 | 0 | 0 | 0.02 | 0.02 | 0 | 0.01 | 0.01 | 0.02 | 0.1 |
| Obtaining EPA hazardous waste generator number | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Obtaining and Maintaining TSDF permits | 0.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.2 |
| Preparation of hazardous waste manifest | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Paying hazardous waste transporation and disposal fees | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Procurement of hazardous waste storage containers | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oversee (training and inspections) hazardous waste SAP's | 0.02 | 0 | 0 | 0.02 | 0.02 | 0 | 0.01 | 0.01 | 0.02 | 0.1 |
| Prepare SPCC Plan | 0.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 |
| Prepare Biennial 'Waste Activities' report | 0.05 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.05 |
| Preparation of closure and post-closure plans for TSDF | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | |
| POL Management | | | | | | | | | | |
| Prepare SPCC Plan | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Monitoring Used Oil | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Wastewater Management | | | | | | | | | | |
| Obtain and Maintain NPDES permit | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Prepare SPCC Plan | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Obtain and Maintain Stormwater permit | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | |
| Solid Waste Management | | | | | | | | | | |
| Collection of Solid Wastes (Separating and storing recyclables, payment of disposal fees) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Obtaining and Maintaining landfill permits (closure plans, monitoring, record-keeping, etc.) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | |
| OTHER | | | | | | | | | | |
| Managing AST and UST (RCRA reporting, maintaining leak detection, monitoring corrosion control systems, etc.) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Performing ECAMP (to include pre-audit and post-audit activities) | 0.005 | 0.005 | 0.005 | 0.01 | 0.01 | 0.005 | 0.01 | 0 | 0 | 0.05 |
| | | | | | | | | | total = | 1.3 |
| | | | | | | EQUIVALENT TO TOTAL/# EMPLOYEES = | | | | 0.65 |

| TIME MATRIX RESULTS FOR | | | Customer | For wage grade category D | | | total # of employees for this category | | | 1 |
|---|---|---|---|---|---|---|---|---|---|---|
| Dyess AFB | | | | | | | | | | |
| Activities | CES | SVS | SPS | EMS | CRS | SUPPLY | TRANS | MED | OPS | TOTAL |
| Air Management | | | | | | | | | | |
| Obtain and Maintain Air Permits | 0.016 | 0 | 0 | 0.008 | 0.004 | 0 | 0.004 | 0 | 0.008 | 0.04 |
| New Source Performance Rvw | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CFC and Halon Management | 0.008 | 0 | 0 | 0 | 0 | 0 | 0.002 | 0 | 0 | 0.01 |
| Air Emission Inventory | 0.002 | 0 | 0 | 0.012 | 0.002 | 0 | 0.002 | 0 | 0.002 | 0.02 |
| Record-Keeping | 0.003 | 0 | 0 | 0.018 | 0.003 | 0 | 0.003 | 0 | 0.003 | 0.03 |
| | | | | | | | | | | |
| Hazardous Material Management | | | | | | | | | | |
| Prepare Toxic Release Inventory | 0.004 | 0 | 0 | 0 | 0 | 0.006 | 0 | 0 | 0 | 0.01 |
| Prepare Emergency Planning and Community Right to Know Reports | 0.008 | 0 | 0 | 0 | 0.002 | 0 | 0 | 0 | 0 | 0.01 |
| Prepare Emergency Plan (SPCC) | 0.009 | 0 | 0 | 0 | 0 | 0.021 | 0 | 0 | 0 | 0.03 |
| Respond to spills | 0.003 | 0 | 0 | 0.001 | 0.001 | 0.001 | 0.001 | 0 | 0.003 | 0.01 |
| Procurement of hazardous material facility | 0.009 | 0 | 0 | 0 | 0 | 0.021 | 0 | 0 | 0 | 0.03 |
| Labeling requirements | 0.002 | 0 | 0 | 0 | 0 | 0.006 | 0 | 0.002 | 0 | 0.01 |
| Perform audits | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.01 | 0.005 | 0.005 | 0.005 | 0.05 |
| | | | | | | | | | | |
| Hazardous Waste Management | | | | | | | | | | |
| Hazardous waste identification | 0.008 | 0.004 | 0 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.008 | 0.04 |
| RCRA reporting of waste activities | 0.024 | 0 | 0 | 0 | 0 | 0.008 | 0 | 0 | 0.008 | 0.04 |
| Obtaining EPA hazardous waste generator number | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Obtaining and Maintaining TSDF permits | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Preparation of hazardous waste manifest | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Paying hazardous waste transporation and disposal fees | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Procurement of hazardous waste storage containers | 0.016 | 0 | 0 | 0 | 0 | 0.002 | 0 | 0 | 0.002 | 0.02 |
| Oversee (training and inspections) hazardous waste SAP's | 0.012 | 0.006 | 0 | 0.006 | 0.006 | 0.006 | 0.006 | 0.006 | 0.012 | 0.06 |
| Prepare SPCC Plan | 0.016 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.004 | 0.02 |
| Prepare Biennial 'Waste Activities' report | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Preparation of closure and post-closure plans for TSDF | 0.018 | 0 | 0 | 0 | 0 | 0.002 | 0 | 0 | 0 | 0.02 |
| | | | | | | | | | | |
| POL Management | | | | | | | | | | |
| Prepare SPCC Plan | 0.05 | 0 | 0 | 0 | 0 | 0.05 | 0 | 0 | 0 | 0.1 |
| Monitoring Used Oil | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Wastewater Management | | | | | | | | | | |
| Obtain and Maintain NPDES permit | 0.02 | 0 | 0 | 0 | 0 | 0 | 0 | 0.012 | 0.008 | 0.04 |
| Prepare SPCC Plan | 0.007 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.003 | 0.01 |
| Obtain and Maintain Stormwater permit | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| | | | | | | | | | | |
| Solid Waste Management | | | | | | | | | | |
| Collection of Solid Wastes (Separating and storing recyclables, payment of disposal fees) | 0.045 | 0.027 | 0 | 0 | 0 | 0 | 0 | 0 | 0.018 | 0.09 |
| Obtaining and Maintaining landfill permits (closure plans, monitoring, record-keeping, etc.) | 0.01 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.01 |
| | | | | | | | | | | |
| OTHER | | | | | | | | | | |
| Managing AST and UST (RCRA reporting, maintaining leak detection, monitoring corrosion control systems, etc.) | 0.025 | 0 | 0 | 0 | 0 | 0.015 | 0 | 0 | 0.01 | 0.05 |
| Performing ECAMP (to include pre-audit and post-audit activities) | 0.01 | 0.005 | 0 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.01 | 0.05 |
| | | | | | | | | | total = | 0.8 |
| | | | | | | EQUIVALENT TO TOTAL/# EMPLOYEES = | | | | 0.8 |

| Labor Charges | # of hrs/wk | 40 | Cat B $/hr= | 17 | | | Cat D $/hr= | 34 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Dyess AFB | # wks/yr | 50 | Cat C $/hr= | 24 | | | | total hrs/yr worked = | | 2000 |
| Activities | CES | SVS | SPS | EMS | CRS | SUPPLY | TRANS | MED | OPS | TOTAL |
| Air Management | | | | | | | | | | |
| Obtain and Maintain Air Permits | 1156 | 13.6 | 0 | 7740 | 5620 | 6.8 | 1266 | 6.8 | 550.8 | 16360 |
| New Source Performance Rvw | 34 | 6.8 | 0 | 2638 | 1954 | 3.4 | 497 | 3.4 | 3.4 | 5140 |
| CFC and Halon Management | 867 | 0 | 0 | 13.6 | 0 | 0 | 139.4 | 0 | 0 | 1020 |
| Air Emission Inventory | 286 | 68.4 | 48 | 1626 | 334 | 58.2 | 283 | 10.2 | 146.2 | 2860 |
| Record-Keeping | 642 | 356.4 | 336 | 2610 | 978 | 346.2 | 927 | 10.2 | 214.2 | 6420 |
| | | | | | | | | | | |
| Hazardous Material Management | | | | | | | | | | |
| Prepare Toxic Release Inventory | 272 | 0 | 0 | 0 | 0 | 408 | 0 | 0 | 0 | 680 |
| Prepare Emergency Planning and Community Right to Know Reports | 2944 | 0 | 0 | 0 | 136 | 0 | 0 | 0 | 0 | 3080 |
| Prepare Emergency Plan (SPCC) | 612 | 0 | 0 | 0 | 0 | 1428 | 0 | 0 | 0 | 2040 |
| Respond to spills | 444 | 240 | 240 | 548 | 548 | 308 | 548 | 0 | 204 | 3080 |
| Procurement of hazardous material facility | 852 | 0 | 0 | 0 | 0 | 3588 | 0 | 0 | 0 | 4440 |
| Labeling requirements | 136 | 0 | 0 | 0 | 0 | 408 | 0 | 136 | 0 | 680 |
| Perform audits | 340 | 340 | 340 | 340 | 340 | 680 | 340 | 340 | 340 | 3400 |
| | | | | | | | | | | |
| Hazardous Waste Management | | | | | | | | | | |
| Hazardous waste identification | 2184 | 952 | 680 | 2592 | 1912 | 952 | 1432 | 1432 | 2184 | 14320 |
| RCRA reporting of waste activities | 3017 | 425 | 425 | 1385 | 1385 | 969 | 905 | 480 | 1929 | 10920 |
| Obtaining EPA hazardous waste generator number | 680 | 595 | 595 | 731 | 595 | 595 | 595 | 595 | 459 | 5440 |
| Obtaining and Maintaining TSDF permits | 9855 | 170 | 255 | 731 | 595 | 5950 | 595 | 2550 | 459 | 21160 |
| Preparation of hazardous waste manifest | 986 | 850 | 850 | 850 | 850 | 850 | 850 | 884 | 850 | 7820 |
| Paying hazardous waste transporation and disposal fees | 637.5 | 552.5 | 637.5 | 875.5 | 552.5 | 552.5 | 552.5 | 527 | 552.5 | 5440 |
| Procurement of hazardous waste storage containers | 1640.5 | 518.5 | 518.5 | 722.5 | 552.5 | 688.5 | 552.5 | 238 | 688.5 | 6120 |
| Oversee (training and inspections) hazardous waste SAP's | 5601 | 918 | 510 | 2031 | 1878 | 918 | 1398 | 1330 | 2456 | 17040 |
| Prepare SPCC Plan | 6143 | 170 | 255 | 663 | 493 | 493 | 493 | 425 | 765 | 9900 |
| Prepare Biennial 'Waste Activities' report | 2655 | 170 | 255 | 663 | 493 | 493 | 493 | 425 | 493 | 6140 |
| Preparation of closure and post-closure plans for TSDF | 1258 | 34 | 34 | 34 | 34 | 170 | 34 | 68 | 34 | 1700 |
| | | | | | | | | | | |
| POL Management | | | | | | | | | | |
| Prepare SPCC Plan | 8670 | 34 | 34 | 136 | 17 | 3400 | 5270 | 85 | 34 | 17680 |
| Monitoring Used Oil | 34 | 34 | 17 | 170 | 17 | 6.8 | 44.2 | 0 | 17 | 340 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Wastewater Management | | | | | | | | | | |
| Obtain and Maintain NPDES permit | 1564 | 102 | 102 | 102 | 102 | 102 | 102 | 918 | 646 | 3740 |
| Prepare SPCC Plan | 833 | 238 | 238 | 952 | 952 | 119 | 119 | 119 | 323 | 3893 |
| Obtain and Maintain Stormwater permit | 3400 | 3400 | 1700 | 8500 | 0 | 1700 | 3400 | 0 | 11900 | 34000 |
| | | | | | | | | | | |
| Solid Waste Management | | | | | | | | | | |
| Collection of Solid Wastes (Separating and storing recyclables, payment of disposal fees) | 14620 | 3876 | 2040 | 4080 | 2040 | 2040 | 2040 | 1020 | 3264 | 35020 |
| Obtaining and Maintaining landfill permits (closure plans, monitoring, record-keeping, etc.) | 680 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 680 |
| | | | | | | | | | | |
| OTHER | | | | | | | | | | |
| Managing AST and UST (RCRA reporting, maintaining leak detection, monitoring corrosion control systems, etc.) | 3927 | 799 | 0 | 799 | 0 | 2057 | 799 | 799 | 680 | 9860 |
| Performing ECAMP (to include pre-audit and post-audit activities) | 2042 | 767 | 410 | 990 | 990 | 767 | 990 | 510 | 3434 | 10900 |
| | | | | | | | | | total = | 271313 |
| | CHECK: | | | | | | | | | |
| | should = summation of: | | hrs/yr * | wage grade $/hr * total time spent per wage grade | | | | for all grades = | | 271313 |

| Labor Charges | time = 1 | Year = 2 | pv factor = | 0.96425 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Dyess AFB | | | | | | | | | | |
| Activities | CES | SVS | SPS | EMS | CRS | SUPPLY | TRANS | MED | OPS | TOTAL |
| Air Management | | | | | | | | | | |
| Obtain and Maintain Air Permits | 1114.7 | 13.1 | 0 | 7463.3 | 5419.1 | 6.6 | 1220.7 | 6.6 | 531.1 | 15775.2 |
| New Source Performance Rvw | 32.8 | 6.6 | 0 | 2543.7 | 1884.1 | 3.3 | 479.2 | 3.3 | 3.3 | 4956.3 |
| CFC and Halon Management | 836 | 0 | 0 | 13.1 | 0 | 0 | 134.4 | 0 | 0 | 983.5 |
| Air Emission Inventory | 275.8 | 66 | 46.3 | 1567.9 | 322.1 | 56.1 | 272.9 | 9.8 | 141 | 2757.9 |
| Record-Keeping | 619 | 343.7 | 324 | 2516.7 | 943 | 333.8 | 893.9 | 9.8 | 206.5 | 6190.4 |
| | | | | | | | | | | |
| Hazardous Material Management | | | | | | | | | | |
| Prepare Toxic Release Inventory | 262.3 | 0 | 0 | 0 | 0 | 393.4 | 0 | 0 | 0 | 655.7 |
| Prepare Emergency Planning and Community Right to Know Reports | 2838.8 | 0 | 0 | 0 | 131.1 | 0 | 0 | 0 | 0 | 2969.9 |
| Prepare Emergency Plan (SPCC) | 590.1 | 0 | 0 | 0 | 0 | 1376.9 | 0 | 0 | 0 | 1967 |
| Respond to spills | 428.1 | 231.4 | 231.4 | 528.4 | 528.4 | 297 | 528.4 | 0 | 196.7 | 2969.8 |
| Procurement of hazardous material facility | 821.5 | 0 | 0 | 0 | 0 | 3459.7 | 0 | 0 | 0 | 4281.2 |
| Labeling requirements | 131.1 | 0 | 0 | 0 | 0 | 393.4 | 0 | 131.1 | 0 | 655.6 |
| Perform audits | 327.8 | 327.8 | 327.8 | 327.8 | 327.8 | 655.7 | 327.8 | 327.8 | 327.8 | 3278.1 |
| | | | | | | | | | | |
| Hazardous Waste Management | | | | | | | | | | |
| Hazardous waste identification | 2105.9 | 918 | 655.7 | 2499.3 | 1843.6 | 918 | 1380.8 | 1380.8 | 2105.9 | 13808 |
| RCRA reporting of waste activities | 2909.1 | 409.8 | 409.8 | 1335.5 | 1335.5 | 934.4 | 872.6 | 462.8 | 1860 | 10529.5 |
| Obtaining EPA hazardous waste generator number | 655.7 | 573.7 | 573.7 | 704.9 | 573.7 | 573.7 | 573.7 | 573.7 | 442.6 | 5245.4 |
| Obtaining and Maintaining TSDF permits | 9502.7 | 163.9 | 245.9 | 704.9 | 573.7 | 5737.3 | 573.7 | 2458.8 | 442.6 | 20403.5 |
| Preparation of hazardous waste manifest | 950.8 | 819.6 | 819.6 | 819.6 | 819.6 | 819.6 | 819.6 | 852.4 | 819.6 | 7540.4 |
| Paying hazardous waste transporation and disposal fees | 614.7 | 532.7 | 614.7 | 844.2 | 532.7 | 532.7 | 532.7 | 508.2 | 532.7 | 5245.3 |
| Procurement of hazardous waste storage containers | 1581.9 | 500 | 500 | 696.7 | 532.7 | 663.9 | 532.7 | 229.5 | 663.9 | 5901.3 |
| Oversee (training and inspections) hazardous waste SAP's | 5400.8 | 885.2 | 491.8 | 1958.4 | 1810.9 | 885.2 | 1348 | 1282.5 | 2368.2 | 16431 |
| Prepare SPCC Plan | 5923.4 | 163.9 | 245.9 | 639.3 | 475.4 | 475.4 | 475.4 | 409.8 | 737.7 | 9546.2 |
| Prepare Biennial 'Waste Activities' report | 2560.1 | 163.9 | 245.9 | 639.3 | 475.4 | 475.4 | 475.4 | 409.8 | 475.4 | 5920.6 |
| Preparation of closure and post-closure plans for TSDF | 1213 | 32.8 | 32.8 | 32.8 | 32.8 | 163.9 | 32.8 | 65.6 | 32.8 | 1639.3 |
| | | | | | | | | | | |
| POL Management | | | | | | | | | | |
| Prepare SPCC Plan | 8360 | 32.8 | 32.8 | 131.1 | 16.4 | 3278.5 | 5081.6 | 82 | 32.8 | 17048 |
| Monitoring Used Oil | 32.8 | 32.8 | 16.4 | 163.9 | 16.4 | 6.6 | 42.6 | 0 | 16.4 | 327.9 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Wastewater Management | | | | | | | | | | |
| Obtain and Maintain NPDES permit | 1508.1 | 98.4 | 98.4 | 98.4 | 98.4 | 98.4 | 98.4 | 885.2 | 622.9 | 3606.6 |
| Prepare SPCC Plan | 803.2 | 229.5 | 229.5 | 918 | 918 | 114.7 | 114.7 | 114.7 | 311.5 | 3753.8 |
| Obtain and Maintain Stormwater permit | 3278.5 | 3278.5 | 1639.2 | 8196.1 | 0 | 1639.2 | 3278.5 | 0 | 11474.6 | 32784.6 |
| | | | | | | | | | | |
| Solid Waste Management | | | | | | | | | | |
| Collection of Solid Wastes (Separating and storing recyclables, payment of disposal fees) | 14097.3 | 3737.4 | 1967.1 | 3934.1 | 1967.1 | 1967.1 | 1967.1 | 983.5 | 3147.3 | 33768 |
| Obtaining and Maintaining landfill permits (closure plans, monitoring, record-keeping, etc.) | 655.7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 655.7 |
| | | | | | | | | | | |
| OTHER | | | | | | | | | | |
| Managing AST and UST (RCRA reporting, maintaining leak detection, monitoring corrosion control systems, etc.) | 3786.6 | 770.4 | 0 | 770.4 | 0 | 1983.5 | 770.4 | 770.4 | 655.7 | 9507.4 |
| Performing ECAMP (to include pre-audit and post-audit activities) | 1969 | 739.6 | 395.3 | 954.6 | 954.6 | 739.6 | 954.6 | 491.8 | 3311.2 | 10510.3 |
| | | | | | | | | | TOTAL= | 261613.4 |
| | | | | | | | | | | |
| | | | | | | pv of total yr 1 should equal total here = | | | | 261613.56 |

| Labor Charges | TIME 1 | YEAR 3 | pv factor = | 0.92978 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Dyess AFB | | | | | | | | | | |
| Activities | CES | SVS | SPS | EMS | CRS | SUPPLY | TRANS | MED | OPS | TOTAL |
| Air Management | | | | | | | | | | |
| Obtain and Maintain Air Permits | 1074.8 | 12.6 | 0 | 7196.5 | 5225.4 | 6.3 | 1177.1 | 6.3 | 512.1 | 15211.1 |
| New Source Performance Rvw | 31.6 | 6.3 | 0 | 2452.8 | 1816.8 | 3.2 | 462.1 | 3.2 | 3.2 | 4779.2 |
| CFC and Halon Management | 806.1 | 0 | 0 | 12.6 | 0 | 0 | 129.6 | 0 | 0 | 948.3 |
| Air Emission Inventory | 265.9 | 63.6 | 44.6 | 1511.8 | 310.5 | 54.1 | 263.1 | 9.5 | 135.9 | 2659 |
| Record-Keeping | 596.9 | 331.4 | 312.4 | 2426.7 | 909.3 | 321.9 | 861.9 | 9.5 | 199.2 | 5969.2 |
| | | | | | | | | | | |
| Hazardous Material Management | | | | | | | | | | |
| Prepare Toxic Release Inventory | 252.9 | 0 | 0 | 0 | 0 | 379.4 | 0 | 0 | 0 | 632.3 |
| Prepare Emergency Planning and Community Right to Know Reports | 2737.3 | 0 | 0 | 0 | 126.5 | 0 | 0 | 0 | 0 | 2863.8 |
| Prepare Emergency Plan (SPCC) | 569 | 0 | 0 | 0 | 0 | 1327.7 | 0 | 0 | 0 | 1896.7 |
| Respond to spills | 412.8 | 223.1 | 223.1 | 509.5 | 509.5 | 286.4 | 509.5 | 0 | 189.7 | 2863.6 |
| Procurement of hazardous material facility | 792.2 | 0 | 0 | 0 | 0 | 3336.1 | 0 | 0 | 0 | 4128.3 |
| Labeling requirements | 126.5 | 0 | 0 | 0 | 0 | 379.4 | 0 | 126.5 | 0 | 632.4 |
| Perform audits | 316.1 | 316.1 | 316.1 | 316.1 | 316.1 | 632.3 | 316.1 | 316.1 | 316.1 | 3161.1 |
| | | | | | | | | | | |
| Hazardous Waste Management | | | | | | | | | | |
| Hazardous waste identification | 2030.6 | 885.2 | 632.3 | 2410 | 1777.7 | 885.2 | 1331.4 | 1331.4 | 2030.6 | 13314.4 |
| RCRA reporting of waste activities | 2805.1 | 395.2 | 395.2 | 1287.7 | 1287.7 | 901 | 841.5 | 446.3 | 1793.5 | 10153.2 |
| Obtaining EPA hazardous waste generator number | 632.3 | 553.2 | 553.2 | 679.7 | 553.2 | 553.2 | 553.2 | 553.2 | 426.8 | 5058 |
| Obtaining and Maintaining TSDF permits | 9163 | 158.1 | 237.1 | 679.7 | 553.2 | 5532.2 | 553.2 | 2370.9 | 426.8 | 19674.2 |
| Preparation of hazardous waste manifest | 916.8 | 790.3 | 790.3 | 790.3 | 790.3 | 790.3 | 790.3 | 821.9 | 790.3 | 7270.8 |
| Paying hazardous waste transporation and disposal fees | 592.7 | 513.7 | 592.7 | 814 | 513.7 | 513.7 | 513.7 | 490 | 513.7 | 5057.9 |
| Procurement of hazardous waste storage containers | 1525.3 | 482.1 | 482.1 | 671.8 | 513.7 | 640.2 | 513.7 | 221.3 | 640.2 | 5690.4 |
| Oversee (training and inspections) hazardous waste SAP's | 5207.7 | 853.5 | 474.2 | 1888.4 | 1746.1 | 853.5 | 1299.8 | 1236.6 | 2283.5 | 15843.3 |
| Prepare SPCC Plan | 5711.6 | 158.1 | 237.1 | 616.4 | 458.4 | 458.4 | 458.4 | 395.2 | 711.3 | 9204.9 |
| Prepare Biennial 'Waste Activities' report | 2468.6 | 158.1 | 237.1 | 616.4 | 458.4 | 458.4 | 458.4 | 395.2 | 458.4 | 5709 |
| Preparation of closure and post-closure plans for TSDF | 1169.7 | 31.6 | 31.6 | 31.6 | 31.6 | 158.1 | 31.6 | 63.2 | 31.6 | 1580.6 |
| | | | | | | | | | | |
| POL Management | | | | | | | | | | |
| Prepare SPCC Plan | 8061.2 | 31.6 | 31.6 | 126.5 | 15.8 | 3161.3 | 4899.9 | 79 | 31.6 | 16438.5 |
| Monitoring Used Oil | 31.6 | 31.6 | 15.8 | 158.1 | 15.8 | 6.3 | 41.1 | 0 | 15.8 | 316.1 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Wastewater Management | | | | | | | | | | |
| Obtain and Maintain NPDES permit | 1454.2 | 94.8 | 94.8 | 94.8 | 94.8 | 94.8 | 94.8 | 853.5 | 600.6 | 3477.1 |
| Prepare SPCC Plan | 774.5 | 221.3 | 221.3 | 885.2 | 885.2 | 110.6 | 110.6 | 110.6 | 300.3 | 3619.6 |
| Obtain and Maintain Stormwater permit | 3161.3 | 3161.3 | 1580.6 | 7903.1 | 0 | 1580.6 | 3161.3 | 0 | 11064.4 | 31612.6 |
| | | | | | | | | | | |
| Solid Waste Management | | | | | | | | | | |
| Collection of Solid Wastes (Separating and storing recyclables, payment of disposal fees) | 13593.4 | 3603.8 | 1896.8 | 3793.5 | 1896.8 | 1896.8 | 1896.8 | 948.4 | 3034.8 | 32561.1 |
| Obtaining and Maintaining landfill permits (closure plans, monitoring, record-keeping, etc.) | 632.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 632.3 |
| | | | | | | | | | | |
| OTHER | | | | | | | | | | |
| Managing AST and UST (RCRA reporting, maintaining leak detection, monitoring corrosion control systems, etc.) | 3651.2 | 742.9 | 0 | 742.9 | 0 | 1912.6 | 742.9 | 742.9 | 632.3 | 9167.7 |
| Performing ECAMP (to include pre-audit and post-audit activities) | 1898.6 | 713.1 | 381.2 | 920.5 | 920.5 | 713.1 | 920.5 | 474.2 | 3192.9 | 10134.6 |
| | | | | | | | | | total = | 252261.3 |
| | | | | | | | | | | |
| | | | | | | check: total should be pv year 3 of total yr 1 = | | | | 252261.4 |

| ABC data maintenance Costs | % of time spent on ABC data maintenance given % time spent on activity = | | | | | | | 0.1 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Dyess AFB | | TIME =0 | YEAR =1 | | | | | | | |
| Activities | CES | SVS | SPS | EMS | CRS | SUPPLY | TRANS | MED | OPS | TOTAL |
| Air Management | | | | | | | | | | |
| Obtain and Maintain Air Permits | 115.6 | 1.36 | 0 | 774 | 562 | 0.68 | 126.6 | 0.68 | 55.08 | 1636 |
| New Source Performance Rvw | 3.4 | 0.68 | 0 | 263.8 | 195.4 | 0.34 | 49.7 | 0.34 | 0.34 | 514 |
| CFC and Halon Management | 86.7 | 0 | 0 | 1.36 | 0 | 0 | 13.94 | 0 | 0 | 102 |
| Air Emission Inventory | 28.6 | 6.84 | 4.8 | 162.6 | 33.4 | 5.82 | 28.3 | 1.02 | 14.62 | 286 |
| Record-Keeping | 64.2 | 35.64 | 33.6 | 261 | 97.8 | 34.62 | 92.7 | 1.02 | 21.42 | 642 |
| | | | | | | | | | | |
| Hazardous Material Management | | | | | | | | | | |
| Prepare Toxic Release Inventory | 27.2 | 0 | 0 | 0 | 0 | 40.8 | 0 | 0 | 0 | 68 |
| Prepare Emergency Planning and Community Right to Know Reports | 294.4 | 0 | 0 | 0 | 13.6 | 0 | 0 | 0 | 0 | 308 |
| Prepare Emergency Plan (SPCC) | 61.2 | 0 | 0 | 0 | 0 | 142.8 | 0 | 0 | 0 | 204 |
| Respond to spills | 44.4 | 24 | 24 | 54.8 | 54.8 | 30.8 | 54.8 | 0 | 20.4 | 308 |
| Procurement of hazardous material facility | 85.2 | 0 | 0 | 0 | 0 | 358.8 | 0 | 0 | 0 | 444 |
| Labeling requirements | 13.6 | 0 | 0 | 0 | 0 | 40.8 | 0 | 13.6 | 0 | 68 |
| Perform audits | 34 | 34 | 34 | 34 | 34 | 68 | 34 | 34 | 34 | 340 |
| | | | | | | | | | | |
| Hazardous Waste Management | | | | | | | | | | |
| Hazardous waste identification | 218.4 | 95.2 | 68 | 259.2 | 191.2 | 95.2 | 143.2 | 143.2 | 218.4 | 1432 |
| RCRA reporting of waste activities | 301.7 | 42.5 | 42.5 | 138.5 | 138.5 | 96.9 | 90.5 | 48 | 192.9 | 1092 |
| Obtaining EPA hazardous waste generator number | 68 | 59.5 | 59.5 | 73.1 | 59.5 | 59.5 | 59.5 | 59.5 | 45.9 | 544 |
| Obtaining and Maintaining TSDF permits | 985.5 | 17 | 25.5 | 73.1 | 59.5 | 595 | 59.5 | 255 | 45.9 | 2116 |
| Preparation of hazardous waste manifest | 98.6 | 85 | 85 | 85 | 85 | 85 | 85 | 88.4 | 85 | 782 |
| Paying hazardous waste transporation and disposal fees | 63.75 | 55.25 | 63.75 | 87.55 | 55.25 | 55.25 | 55.25 | 52.7 | 55.25 | 544 |
| Procurement of hazardous waste storage containers | 164.05 | 51.85 | 51.85 | 72.25 | 55.25 | 68.85 | 55.25 | 23.8 | 68.85 | 612 |
| Oversee (training and inspections) hazardous waste SAP's | 560.1 | 91.8 | 51 | 203.1 | 187.8 | 91.8 | 139.8 | 133 | 245.6 | 1704 |
| Prepare SPCC Plan | 614.3 | 17 | 25.5 | 66.3 | 49.3 | 49.3 | 49.3 | 42.5 | 76.5 | 990 |
| Prepare Biennial 'Waste Activities' report | 265.5 | 17 | 25.5 | 66.3 | 49.3 | 49.3 | 49.3 | 42.5 | 49.3 | 614 |
| Preparation of closure and post-closure plans for TSDF | 125.8 | 3.4 | 3.4 | 3.4 | 3.4 | 17 | 3.4 | 6.8 | 3.4 | 170 |
| | | | | | | | | | | |
| POL Management | | | | | | | | | | |
| Prepare SPCC Plan | 867 | 3.4 | 3.4 | 13.6 | 1.7 | 340 | 527 | 8.5 | 3.4 | 1768 |
| Monitoring Used Oil | 3.4 | 3.4 | 1.7 | 17 | 1.7 | 0.68 | 4.42 | 0 | 1.7 | 34 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Wastewater Management | | | | | | | | | | |
| Obtain and Maintain NPDES permit | 156.4 | 10.2 | 10.2 | 10.2 | 10.2 | 10.2 | 10.2 | 91.8 | 64.6 | 374 |
| Prepare SPCC Plan | 83.3 | 23.8 | 23.8 | 95.2 | 95.2 | 11.9 | 11.9 | 11.9 | 32.3 | 389.3 |
| Obtain and Maintain Stormwater permit | 340 | 340 | 170 | 850 | 0 | 170 | 340 | 0 | 1190 | 3400 |
| | | | | | | | | | | |
| Solid Waste Management | | | | | | | | | | |
| Collection of Solid Wastes (Separating and storing recyclables, payment of disposal fees) | 1462 | 387.6 | 204 | 408 | 204 | 204 | 204 | 102 | 326.4 | 3502 |
| Obtaining and Maintaining landfill permits (closure plans, monitoring, record-keeping, etc.) | 68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 68 |
| | | | | | | | | | | |
| OTHER | | | | | | | | | | |
| Managing AST and UST (RCRA reporting, maintaining leak detection, monitoring corrosion control systems, etc.) | 392.7 | 79.9 | 0 | 79.9 | 0 | 205.7 | 79.9 | 79.9 | 68 | 986 |
| Performing ECAMP (to include pre-audit and post-audit activities) | 204.2 | 76.7 | 41 | 99 | 99 | 76.7 | 99 | 51 | 343.4 | 1090 |
| | | | | | | | | | total = | 27131.3 |
| | | | | | | | | | | |
| | | | | | | CHECK: | the given percentage of total labor = | | | 27131.3 |

| ABC data maintenance Costs (CUM) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Dyess AFB | | TIME =1 | YEAR =2 | pv factor= | 0.96425 | | | | | |
| Activities | CES | SVS | SPS | EMS | CRS | SUPPLY | TRANS | MED | OPS | TOTAL |
| Air Management | | | | | | | | | | |
| Obtain and Maintain Air Permits | 227.1 | 2.7 | 0 | 1520.3 | 1103.9 | 1.3 | 248.7 | 1.3 | 108.2 | 3213.5 |
| New Source Performance Rvw | 6.7 | 1.3 | 0 | 518.2 | 383.8 | 0.7 | 97.6 | 0.7 | 0.7 | 1009.7 |
| CFC and Halon Management | 170.3 | 0 | 0 | 2.7 | 0 | 0 | 27.4 | 0 | 0 | 200.4 |
| Air Emission Inventory | 56.2 | 13.4 | 9.4 | 319.4 | 65.6 | 11.4 | 55.6 | 2 | 28.7 | 561.7 |
| Record-Keeping | 126.1 | 70 | 66 | 512.7 | 192.1 | 68 | 182.1 | 2 | 42.1 | 1261.1 |
| | | | | | | | | | | |
| Hazardous Material Management | | | | | | | | | | |
| Prepare Toxic Release Inventory | 53.4 | 0 | 0 | 0 | 0 | 80.1 | 0 | 0 | 0 | 133.5 |
| Prepare Emergency Planning and Community Right to Know Reports | 578.3 | 0 | 0 | 0 | 26.7 | 0 | 0 | 0 | 0 | 605 |
| Prepare Emergency Plan (SPCC) | 120.2 | 0 | 0 | 0 | 0 | 280.5 | 0 | 0 | 0 | 400.7 |
| Respond to spills | 87.2 | 47.1 | 47.1 | 107.6 | 107.6 | 60.5 | 107.6 | 0 | 40.1 | 604.8 |
| Procurement of hazardous material facility | 167.4 | 0 | 0 | 0 | 0 | 704.8 | 0 | 0 | 0 | 872.2 |
| Labeling requirements | 26.7 | 0 | 0 | 0 | 0 | 80.1 | 0 | 26.7 | 0 | 133.5 |
| Perform audits | 66.8 | 66.8 | 66.8 | 66.8 | 66.8 | 133.6 | 66.8 | 66.8 | 66.8 | 668 |
| | | | | | | | | | | |
| Hazardous Waste Management | | | | | | | | | | |
| Hazardous waste identification | 429 | 187 | 133.6 | 509.1 | 375.6 | 187 | 281.3 | 281.3 | 429 | 2812.9 |
| RCRA reporting of waste activities | 592.6 | 83.5 | 83.5 | 272 | 272 | 190.3 | 177.8 | 94.3 | 378.9 | 2144.9 |
| Obtaining EPA hazardous waste generator number | 133.6 | 116.9 | 116.9 | 143.6 | 116.9 | 116.9 | 116.9 | 116.9 | 90.2 | 1068.8 |
| Obtaining and Maintaining TSDF permits | 1935.8 | 33.4 | 50.1 | 143.6 | 116.9 | 1168.7 | 116.9 | 500.9 | 90.2 | 4156.5 |
| Preparation of hazardous waste manifest | 193.7 | 167 | 167 | 167 | 167 | 167 | 167 | 173.6 | 167 | 1536.3 |
| Paying hazardous waste transporation and disposal fees | 125.2 | 108.5 | 125.2 | 172 | 108.5 | 108.5 | 108.5 | 103.5 | 108.5 | 1068.4 |
| Procurement of hazardous waste storage containers | 322.2 | 101.8 | 101.8 | 141.9 | 108.5 | 135.2 | 108.5 | 46.7 | 135.2 | 1201.8 |
| Oversee (training and inspections) hazardous waste SAP's | 1100.2 | 180.3 | 100.2 | 398.9 | 368.9 | 180.3 | 274.6 | 261.2 | 482.4 | 3347 |
| Prepare SPCC Plan | 1206.6 | 33.4 | 50.1 | 130.2 | 96.8 | 96.8 | 96.8 | 83.5 | 150.3 | 1944.5 |
| Prepare Biennial 'Waste Activities' report | 521.5 | 33.4 | 50.1 | 130.2 | 96.8 | 96.8 | 96.8 | 83.5 | 96.8 | 1205.9 |
| Preparation of closure and post-closure plans for TSDF | 247.1 | 6.7 | 6.7 | 6.7 | 6.7 | 33.4 | 6.7 | 13.4 | 6.7 | 334.1 |
| | | | | | | | | | | |
| POL Management | | | | | | | | | | |
| Prepare SPCC Plan | 1703 | 6.7 | 6.7 | 26.7 | 3.3 | 667.8 | 1035.2 | 16.7 | 6.7 | 3472.8 |
| Monitoring Used Oil | 6.7 | 6.7 | 3.3 | 33.4 | 3.3 | 1.3 | 8.7 | 0 | 3.3 | 66.7 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Wastewater Management | | | | | | | | | | |
| Obtain and Maintain NPDES permit | 307.2 | 20 | 20 | 20 | 20 | 20 | 20 | 180.3 | 126.9 | 734.4 |
| Prepare SPCC Plan | 163.6 | 46.7 | 46.7 | 187 | 187 | 23.4 | 23.4 | 23.4 | 63.4 | 764.6 |
| Obtain and Maintain Stormwater permit | 667.8 | 667.8 | 333.9 | 1669.6 | 0 | 333.9 | 667.8 | 0 | 2337.5 | 6678.3 |
| | | | | | | | | | | |
| Solid Waste Management | | | | | | | | | | |
| Collection of Solid Wastes (Separating and storing recyclables, payment of disposal fees) | 2871.7 | 761.3 | 400.7 | 801.4 | 400.7 | 400.7 | 400.7 | 200.4 | 641.1 | 6878.7 |
| Obtaining and Maintaining landfill permits (closure plans, monitoring, record-keeping, etc.) | 133.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 133.6 |
| | | | | | | | | | | |
| OTHER | | | | | | | | | | |
| Managing AST and UST (RCRA reporting, maintaining leak detection, monitoring corrosion control systems, etc.) | 771.4 | 156.9 | 0 | 156.9 | 0 | 404 | 156.9 | 156.9 | 133.6 | 1936.6 |
| Performing ECAMP (to include pre-audit and post-audit activities) | 401.1 | 150.7 | 80.5 | 194.5 | 194.5 | 150.7 | 194.5 | 100.2 | 674.5 | 2141.2 |
| | | | | | | | | | total = | 53292.1 |
| | | | | | | | | | | |
| | | | | | | CHECK: | pv factor times total yr 1 + YR 1 TOT= | | | 53292.66 |

| ABC data maintenance Costs | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Dyess AFB | | TIME =2 | YEAR =3 | pv factor= | 0.92978 | | | | | |
| Activities | CES | SVS | SPS | EMS | CRS | SUPPLY | TRANS | MED | OPS | TOTAL |
| Air Management | | | | | | | | | | |
| Obtain and Maintain Air Permits | 450.2 | 5.3 | 0 | 3013.9 | 2188.4 | 2.6 | 493 | 2.6 | 214.5 | 6370.5 |
| New Source Performance Rvw | 13.3 | 2.6 | 0 | 1027.3 | 760.9 | 1.4 | 193.5 | 1.4 | 1.4 | 2001.8 |
| CFC and Halon Management | 337.6 | 0 | 0 | 5.3 | 0 | 0 | 54.3 | 0 | 0 | 397.2 |
| Air Emission Inventory | 111.4 | 26.6 | 18.7 | 633.2 | 130.1 | 22.6 | 110.2 | 4 | 56.9 | 1113.7 |
| Record-Keeping | 250 | 138.8 | 130.8 | 1016.4 | 380.8 | 134.8 | 361 | 4 | 83.4 | 2500 |
| | | | | | | | | | | |
| Hazardous Material Management | | | | | | | | | | |
| Prepare Toxic Release Inventory | 105.9 | 0 | 0 | 0 | 0 | 158.8 | 0 | 0 | 0 | 264.7 |
| Prepare Emergency Planning and Community Right to Know Reports | 1146.4 | 0 | 0 | 0 | 52.9 | 0 | 0 | 0 | 0 | 1199.3 |
| Prepare Emergency Plan (SPCC) | 238.3 | 0 | 0 | 0 | 0 | 556.1 | 0 | 0 | 0 | 794.4 |
| Respond to spills | 172.9 | 93.4 | 93.4 | 213.4 | 213.4 | 119.9 | 213.4 | 0 | 79.5 | 1199.3 |
| Procurement of hazardous material facility | 331.8 | 0 | 0 | 0 | 0 | 1397.2 | 0 | 0 | 0 | 1729 |
| Labeling requirements | 52.9 | 0 | 0 | 0 | 0 | 158.8 | 0 | 52.9 | 0 | 264.6 |
| Perform audits | 132.4 | 132.4 | 132.4 | 132.4 | 132.4 | 264.8 | 132.4 | 132.4 | 132.4 | 1324 |
| | | | | | | | | | | |
| Hazardous Waste Management | | | | | | | | | | |
| Hazardous waste identification | 850.5 | 370.7 | 264.8 | 1009.3 | 744.6 | 370.7 | 557.6 | 557.6 | 850.5 | 5576.3 |
| RCRA reporting of waste activities | 1174.8 | 165.5 | 165.5 | 539.3 | 539.3 | 377.3 | 352.4 | 186.9 | 751.2 | 4252.2 |
| Obtaining EPA hazardous waste generator number | 264.8 | 231.7 | 231.7 | 284.7 | 231.7 | 231.7 | 231.7 | 231.7 | 178.8 | 2118.5 |
| Obtaining and Maintaining TSDF permits | 3837.6 | 66.2 | 99.3 | 284.7 | 231.7 | 2316.9 | 231.7 | 993 | 178.8 | 8239.9 |
| Preparation of hazardous waste manifest | 384 | 331 | 331 | 331 | 331 | 331 | 331 | 344.2 | 331 | 3045.2 |
| Paying hazardous waste transporation and disposal fees | 248.2 | 215.1 | 248.2 | 341 | 215.1 | 215.1 | 215.1 | 205.2 | 215.1 | 2118.1 |
| Procurement of hazardous waste storage containers | 638.8 | 201.9 | 201.9 | 281.3 | 215.1 | 268.1 | 215.1 | 92.6 | 268.1 | 2382.9 |
| Oversee (training and inspections) hazardous waste SAP's | 2181.1 | 357.5 | 198.6 | 790.8 | 731.3 | 357.5 | 544.4 | 517.9 | 956.4 | 6635.5 |
| Prepare SPCC Plan | 2392.1 | 66.2 | 99.3 | 258.1 | 191.9 | 191.9 | 191.9 | 165.5 | 297.9 | 3854.8 |
| Prepare Biennial 'Waste Activities' report | 1033.9 | 66.2 | 99.3 | 258.1 | 191.9 | 191.9 | 191.9 | 165.5 | 191.9 | 2390.6 |
| Preparation of closure and post-closure plans for TSDF | 489.9 | 13.3 | 13.3 | 13.3 | 13.3 | 66.2 | 13.3 | 26.5 | 13.3 | 662.4 |
| | | | | | | | | | | |
| POL Management | | | | | | | | | | |
| Prepare SPCC Plan | 3376.1 | 13.3 | 13.3 | 52.9 | 6.6 | 1323.9 | 2052.2 | 33.1 | 13.3 | 6884.7 |
| Monitoring Used Oil | 13.3 | 13.3 | 6.6 | 66.2 | 6.6 | 2.6 | 17.2 | 0 | 6.6 | 132.4 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Wastewater Management | | | | | | | | | | |
| Obtain and Maintain NPDES permit | 609 | 39.7 | 39.7 | 39.7 | 39.7 | 39.7 | 39.7 | 357.5 | 251.6 | 1456.3 |
| Prepare SPCC Plan | 324.4 | 92.6 | 92.6 | 370.7 | 370.7 | 46.4 | 46.4 | 46.4 | 125.7 | 1515.9 |
| Obtain and Maintain Stormwater permit | 1323.9 | 1323.9 | 662 | 3309.9 | 0 | 662 | 1323.9 | 0 | 4633.9 | 13239.5 |
| | | | | | | | | | | |
| Solid Waste Management | | | | | | | | | | |
| Collection of Solid Wastes (Separating and storing recyclables, payment of disposal fees) | 5693 | 1509.3 | 794.4 | 1588.8 | 794.4 | 794.4 | 794.4 | 397.2 | 1271 | 13636.9 |
| Obtaining and Maintaining landfill permits (closure plans, monitoring, record-keeping, etc.) | 264.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 264.8 |
| | | | | | | | | | | |
| OTHER | | | | | | | | | | |
| Managing AST and UST (RCRA reporting, maintaining leak detection, monitoring corrosion control systems, etc.) | 1529.2 | 311.1 | 0 | 311.1 | 0 | 801 | 311.1 | 311.1 | 264.8 | 3839.4 |
| Performing ECAMP (to include pre-audit and post-audit activities) | 795.2 | 298.7 | 159.6 | 385.5 | 385.5 | 298.7 | 385.5 | 198.6 | 1337.2 | 4244.5 |
| | | | | | | | | | total = | 105649.3 |
| | | | | | | | | | | |
| | | | | | CHECK: | pv factor yr3 times total yr 1 + YR 1 +YR2 | | | | 105649.5 |

| Division of ABC model Costs | 3.5 | days/train | | hrs per day | 8 | | total cost = | 18702 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| cost to set up ABC system (150hrs)= | 2550 | | cost of software = | | 1100011000 | | | | | |
| Activities | CES | SVS | SPS | EMS | CRS | SUPPLY | TRANS | MED | OPS | TOTAL |
| Air Management | | | | | | | | | | |
| Obtain and Maintain Air Permits | 51 | 1 | 0 | 456 | 327 | 1 | 70 | 1 | 23 | 930 |
| New Source Performance Rvw | 3 | 1 | 0 | 160 | 115 | 0 | 30 | 0 | 0 | 309 |
| CFC and Halon Management | 49 | 0 | 0 | 1 | 0 | 0 | 6 | 0 | 0 | 56 |
| Air Emission Inventory | 17 | 5 | 3 | 99 | 20 | 4 | 15 | 1 | 6 | 170 |
| Record-Keeping | 37 | 21 | 20 | 149 | 56 | 21 | 52 | 1 | 9 | 366 |
| | | | | | | | | | | |
| Hazardous Material Management | | | | | | | | | | |
| Prepare Toxic Release Inventory | 11 | 0 | 0 | 0 | 0 | 17 | 0 | 0 | 0 | 28 |
| Prepare Emergency Planning and Community Right to Know Reports | 163 | 0 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 169 |
| Prepare Emergency Plan (SPCC) | 25 | 0 | 0 | 0 | 0 | 59 | 0 | 0 | 0 | 84 |
| Respond to spills | 23 | 14 | 14 | 31 | 31 | 17 | 31 | 0 | 8 | 169 |
| Procurement of hazardous material facility | 39 | 0 | 0 | 0 | 0 | 186 | 0 | 0 | 0 | 225 |
| Labeling requirements | 6 | 0 | 0 | 0 | 0 | 17 | 0 | 6 | 0 | 29 |
| Perform audits | 14 | 14 | 14 | 14 | 14 | 28 | 14 | 14 | 14 | 140 |
| | | | | | | | | | | |
| Hazardous Waste Management | | | | | | | | | | |
| Hazardous waste identification | 135 | 68 | 56 | 180 | 124 | 68 | 96 | 96 | 135 | 958 |
| RCRA reporting of waste activities | 159 | 35 | 35 | 91 | 91 | 58 | 63 | 28 | 114 | 674 |
| Obtaining EPA hazardous waste generator number | 56 | 49 | 49 | 61 | 49 | 49 | 49 | 49 | 38 | 449 |
| Obtaining and Maintaining TSDF permits | 584 | 14 | 21 | 61 | 49 | 493 | 49 | 211 | 38 | 1520 |
| Preparation of hazardous waste manifest | 82 | 70 | 70 | 70 | 70 | 70 | 70 | 73 | 70 | 645 |
| Paying hazardous waste transporation and disposal fees | 53 | 46 | 53 | 72 | 46 | 46 | 46 | 44 | 46 | 452 |
| Procurement of hazardous waste storage containers | 91 | 43 | 43 | 60 | 46 | 51 | 46 | 20 | 51 | 451 |
| Oversee (training and inspections) hazardous waste SAP's | 407 | 59 | 42 | 128 | 115 | 59 | 87 | 82 | 146 | 1125 |
| Prepare SPCC Plan | 348 | 14 | 21 | 55 | 41 | 41 | 41 | 35 | 52 | 648 |
| Prepare Biennial 'Waste Activities' report | 162 | 14 | 21 | 55 | 41 | 41 | 41 | 35 | 41 | 451 |
| Preparation of closure and post-closure plans for TSDF | 53 | 3 | 3 | 3 | 3 | 8 | 3 | 6 | 3 | 85 |
| | | | | | | | | | | |
| POL Management | | | | | | | | | | |
| Prepare SPCC Plan | 577 | 3 | 3 | 11 | 1 | 141 | 436 | 7 | 3 | 1182 |
| Monitoring Used Oil | 3 | 3 | 1 | 14 | 1 | 1 | 4 | 0 | 1 | 28 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Wastewater Management | | | | | | | | | | |
| Obtain and Maintain NPDES permit | 73 | 8 | 8 | 8 | 8 | 8 | 8 | 42 | 31 | 194 |
| Prepare SPCC Plan | 49 | 20 | 20 | 79 | 79 | 10 | 10 | 10 | 18 | 295 |
| Obtain and Maintain Stormwater permit | 281 | 281 | 141 | 704 | 0 | 141 | 281 | 0 | 985 | 2814 |
| | | | | | | | | | | |
| Solid Waste Management | | | | | | | | | | |
| Collection of Solid Wastes (Separating and storing recyclables, payment of disposal fees) | 1084 | 245 | 169 | 338 | 169 | 169 | 169 | 84 | 220 | 2647 |
| Obtaining and Maintaining landfill permits (closure plans, monitoring, record-keeping, etc.) | 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 28 |
| | | | | | | | | | | |
| OTHER | | | | | | | | | | |
| Managing AST and UST (RCRA reporting, maintaining leak detection, monitoring corrosion control systems, etc.) | 255 | 66 | 0 | 66 | 0 | 128 | 66 | 66 | 28 | 675 |
| Performing ECAMP (to include pre-audit and post-audit activities) | 135 | 44 | 28 | 56 | 56 | 44 | 56 | 28 | 256 | 703 |
| | | | | | | | | | total = | 18699 |
| | | | | | | | | | | |
| | | | | | | CHECK: | total should equal model cost total = | | | 18702 |

| total cost of labor and model (cost of ABC) | year 1 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| Activities | CES | SVS | SPS | EMS | CRS | SUPPLY | TRANS | MED | OPS | TOTAL |
| Air Management | | | | | | | | | | |
| Obtain and Maintain Air Permits | 166.6 | 2.36 | 0 | 1230 | 889 | 1.68 | 196.6 | 1.68 | 78.08 | 2566 |
| New Source Performance Rvw | 6.4 | 1.68 | 0 | 423.8 | 310.4 | 0.34 | 79.7 | 0.34 | 0.34 | 823 |
| CFC and Halon Management | 135.7 | 0 | 0 | 2.36 | 0 | 0 | 19.94 | 0 | 0 | 158 |
| Air Emission Inventory | 45.6 | 11.84 | 7.8 | 261.6 | 53.4 | 9.82 | 43.3 | 2.02 | 20.62 | 456 |
| Record-Keeping | 101.2 | 56.64 | 53.6 | 410 | 153.8 | 55.62 | 144.7 | 2.02 | 30.42 | 1008 |
| | | | | | | | | | | |
| Hazardous Material Management | | | | | | | | | | |
| Prepare Toxic Release Inventory | 38.2 | 0 | 0 | 0 | 0 | 57.8 | 0 | 0 | 0 | 96 |
| Prepare Emergency Planning and Community Right to Know Reports | 457.4 | 0 | 0 | 0 | 19.6 | 0 | 0 | 0 | 0 | 477 |
| Prepare Emergency Plan (SPCC) | 86.2 | 0 | 0 | 0 | 0 | 201.8 | 0 | 0 | 0 | 288 |
| Respond to spills | 67.4 | 38 | 38 | 85.8 | 85.8 | 47.8 | 85.8 | 0 | 28.4 | 477 |
| Procurement of hazardous material facility | 124.2 | 0 | 0 | 0 | 0 | 544.8 | 0 | 0 | 0 | 669 |
| Labeling requirements | 19.6 | 0 | 0 | 0 | 0 | 57.8 | 0 | 19.6 | 0 | 97 |
| Perform audits | 48 | 48 | 48 | 48 | 48 | 96 | 48 | 48 | 48 | 480 |
| | | | | | | | | | | |
| Hazardous Waste Management | | | | | | | | | | |
| Hazardous waste identification | 353.4 | 163.2 | 124 | 439.2 | 315.2 | 163.2 | 239.2 | 239.2 | 353.4 | 2390 |
| RCRA reporting of waste activities | 460.7 | 77.5 | 77.5 | 229.5 | 229.5 | 154.9 | 153.5 | 76 | 306.9 | 1766 |
| Obtaining EPA hazardous waste generator number | 124 | 108.5 | 108.5 | 134.1 | 108.5 | 108.5 | 108.5 | 108.5 | 83.9 | 993 |
| Obtaining and Maintaining TSDF permits | 1569.5 | 31 | 46.5 | 134.1 | 108.5 | 1088 | 108.5 | 466 | 83.9 | 3636 |
| Preparation of hazardous waste manifest | 180.6 | 155 | 155 | 155 | 155 | 155 | 155 | 161.4 | 155 | 1427 |
| Paying hazardous waste transporation and disposal fees | 116.75 | 101.25 | 116.75 | 159.55 | 101.25 | 101.25 | 101.25 | 96.7 | 101.25 | 996 |
| Procurement of hazardous waste storage containers | 255.05 | 94.85 | 94.85 | 132.25 | 101.25 | 119.85 | 101.25 | 43.8 | 119.85 | 1063 |
| Oversee (training and inspections) hazardous waste SAP's | 967.1 | 150.8 | 93 | 331.1 | 302.8 | 150.8 | 226.8 | 215 | 391.6 | 2829 |
| Prepare SPCC Plan | 962.3 | 31 | 46.5 | 121.3 | 90.3 | 90.3 | 90.3 | 77.5 | 128.5 | 1638 |
| Prepare Biennial 'Waste Activities' report | 427.5 | 31 | 46.5 | 121.3 | 90.3 | 90.3 | 90.3 | 77.5 | 90.3 | 1065 |
| Preparation of closure and post-closure plans for TSDF | 178.8 | 6.4 | 6.4 | 6.4 | 6.4 | 25 | 6.4 | 12.8 | 6.4 | 255 |
| | | | | | | | | | | |
| POL Management | | | | | | | | | | |
| Prepare SPCC Plan | 1444 | 6.4 | 6.4 | 24.6 | 2.7 | 481 | 963 | 15.5 | 6.4 | 2950 |
| Monitoring Used Oil | 6.4 | 6.4 | 2.7 | 31 | 2.7 | 1.68 | 8.42 | 0 | 2.7 | 62 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Wastewater Management | | | | | | | | | | |
| Obtain and Maintain NPDES permit | 229.4 | 18.2 | 18.2 | 18.2 | 18.2 | 18.2 | 18.2 | 133.8 | 95.6 | 568 |
| Prepare SPCC Plan | 132.3 | 43.8 | 43.8 | 174.2 | 174.2 | 21.9 | 21.9 | 21.9 | 50.3 | 684.3 |
| Obtain and Maintain Stormwater permit | 621 | 621 | 311 | 1554 | 0 | 311 | 621 | 0 | 2175 | 6214 |
| | | | | | | | | | | |
| Solid Waste Management | | | | | | | | | | |
| Collection of Solid Wastes (Separating and storing recyclables, payment of disposal fees) | 2546 | 632.6 | 373 | 746 | 373 | 373 | 373 | 186 | 546.4 | 6149 |
| Obtaining and Maintaining landfill permits (closure plans, monitoring, record-keeping, etc.) | 96 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 96 |
| | | | | | | | | | | |
| OTHER | | | | | | | | | | |
| Managing AST and UST (RCRA reporting, maintaining leak detection, monitoring corrosion control systems, etc.) | 647.7 | 145.9 | 0 | 145.9 | 0 | 333.7 | 145.9 | 145.9 | 96 | 1661 |
| Performing ECAMP (to include pre-audit and post-audit activities) | 339.2 | 120.7 | 69 | 155 | 155 | 120.7 | 155 | 79 | 599.4 | 1793 |
| | | | | | | | | | total = | 45830.3 |
| | | | | | | | | | | |
| | | | | | | CHECK: | labor + model cost = | | | 45833.3 |

| total cost of labor and model (cost of ABC) | year 2 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| Activities | CES | SVS | SPS | EMS | CRS | SUPPLY | TRANS | MED | OPS | TOTAL |
| Air Management | | | | | | | | | | |
| Obtain and Maintain Air Permits | 278.1 | 3.7 | 0 | 1976.3 | 1430.9 | 2.3 | 318.7 | 2.3 | 131.2 | 4143.5 |
| New Source Performance Rvw | 9.7 | 2.3 | 0 | 678.2 | 498.8 | 0.7 | 127.6 | 0.7 | 0.7 | 1318.7 |
| CFC and Halon Management | 219.3 | 0 | 0 | 3.7 | 0 | 0 | 33.4 | 0 | 0 | 256.4 |
| Air Emission Inventory | 73.2 | 18.4 | 12.4 | 418.4 | 85.6 | 15.4 | 70.6 | 3 | 34.7 | 731.7 |
| Record-Keeping | 163.1 | 91 | 86 | 661.7 | 248.1 | 89 | 234.1 | 3 | 51.1 | 1627.1 |
| | | | | | | | | | | |
| Hazardous Material Management | | | | | | | | | | |
| Prepare Toxic Release Inventory | 64.4 | 0 | 0 | 0 | 0 | 97.1 | 0 | 0 | 0 | 161.5 |
| Prepare Emergency Planning and Community Right to Know Reports | 741.3 | 0 | 0 | 0 | 32.7 | 0 | 0 | 0 | 0 | 774 |
| Prepare Emergency Plan (SPCC) | 145.2 | 0 | 0 | 0 | 0 | 339.5 | 0 | 0 | 0 | 484.7 |
| Respond to spills | 110.2 | 61.1 | 61.1 | 138.6 | 138.6 | 77.5 | 138.6 | 0 | 48.1 | 773.8 |
| Procurement of hazardous material facility | 206.4 | 0 | 0 | 0 | 0 | 890.8 | 0 | 0 | 0 | 1097.2 |
| Labeling requirements | 32.7 | 0 | 0 | 0 | 0 | 97.1 | 0 | 32.7 | 0 | 162.5 |
| Perform audits | 80.8 | 80.8 | 80.8 | 80.8 | 80.8 | 161.6 | 80.8 | 80.8 | 80.8 | 808 |
| | | | | | | | | | | |
| Hazardous Waste Management | | | | | | | | | | |
| Hazardous waste identification | 564 | 255 | 189.6 | 689.1 | 499.6 | 255 | 377.3 | 377.3 | 564 | 3770.9 |
| RCRA reporting of waste activities | 751.6 | 118.5 | 118.5 | 363 | 363 | 248.3 | 240.8 | 122.3 | 492.9 | 2818.9 |
| Obtaining EPA hazardous waste generator number | 189.6 | 165.9 | 165.9 | 204.6 | 165.9 | 165.9 | 165.9 | 165.9 | 128.2 | 1517.8 |
| Obtaining and Maintaining TSDF permits | 2519.8 | 47.4 | 71.1 | 204.6 | 165.9 | 1661.7 | 165.9 | 711.9 | 128.2 | 5676.5 |
| Preparation of hazardous waste manifest | 275.7 | 237 | 237 | 237 | 237 | 237 | 237 | 246.6 | 237 | 2181.3 |
| Paying hazardous waste transporation and disposal fees | 178.2 | 154.5 | 178.2 | 244 | 154.5 | 154.5 | 154.5 | 147.5 | 154.5 | 1520.4 |
| Procurement of hazardous waste storage containers | 413.2 | 144.8 | 144.8 | 201.9 | 154.5 | 186.2 | 154.5 | 66.7 | 186.2 | 1652.8 |
| Oversee (training and inspections) hazardous waste SAP's | 1507.2 | 239.3 | 142.2 | 526.9 | 483.9 | 239.3 | 361.6 | 343.2 | 628.4 | 4472 |
| Prepare SPCC Plan | 1554.6 | 47.4 | 71.1 | 185.2 | 137.8 | 137.8 | 137.8 | 118.5 | 202.3 | 2592.5 |
| Prepare Biennial 'Waste Activities' report | 683.5 | 47.4 | 71.1 | 185.2 | 137.8 | 137.8 | 137.8 | 118.5 | 137.8 | 1656.9 |
| Preparation of closure and post-closure plans for TSDF | 300.1 | 9.7 | 9.7 | 9.7 | 9.7 | 41.4 | 9.7 | 19.4 | 9.7 | 419.1 |
| | | | | | | | | | | |
| POL Management | | | | | | | | | | |
| Prepare SPCC Plan | 2280 | 9.7 | 9.7 | 37.7 | 4.3 | 808.8 | 1471.2 | 23.7 | 9.7 | 4654.8 |
| Monitoring Used Oil | 9.7 | 9.7 | 4.3 | 47.4 | 4.3 | 2.3 | 12.7 | 0 | 4.3 | 94.7 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Wastewater Management | | | | | | | | | | |
| Obtain and Maintain NPDES permit | 380.2 | 28 | 28 | 28 | 28 | 28 | 28 | 222.3 | 157.9 | 928.4 |
| Prepare SPCC Plan | 212.6 | 66.7 | 66.7 | 266 | 266 | 33.4 | 33.4 | 33.4 | 81.4 | 1059.6 |
| Obtain and Maintain Stormwater permit | 948.8 | 948.8 | 474.9 | 2373.6 | 0 | 474.9 | 948.8 | 0 | 3322.5 | 9492.3 |
| | | | | | | | | | | |
| Solid Waste Management | | | | | | | | | | |
| Collection of Solid Wastes (Separating and storing recyclables, payment of disposal fees) | 3955.7 | 1006.3 | 569.7 | 1139.4 | 569.7 | 569.7 | 569.7 | 284.4 | 861.1 | 9525.7 |
| Obtaining and Maintaining landfill permits (closure plans, monitoring, record-keeping, etc.) | 161.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 161.6 |
| | | | | | | | | | | |
| OTHER | | | | | | | | | | |
| Managing AST and UST (RCRA reporting, maintaining leak detection, monitoring corrosion control systems, etc.) | 1026.4 | 222.9 | 0 | 222.9 | 0 | 532 | 222.9 | 222.9 | 161.6 | 2611.6 |
| Performing ECAMP (to include pre-audit and post-audit activities) | 536.1 | 194.7 | 108.5 | 250.5 | 250.5 | 194.7 | 250.5 | 128.2 | 930.5 | 2844.2 |
| | | | | | | | | | total = | 71991.1 |
| | | | | | | | | | | |
| | | | | | | CHECK: | total ABC data maintenance labor yr 2 | | | |
| | | | | | | | plus cost of ABC software yr 1 = | | | 71991.1 |

| total cost of labor and model (cost of ABC) | year 3 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| Activities | CES | SVS | SPS | EMS | CRS | SUPPLY | TRANS | MED | OPS | TOTAL |
| Air Management | | | | | | | | | | |
| Obtain and Maintain Air Permits | 501.2 | 6.3 | 0 | 3469.9 | 2515.4 | 3.6 | 563 | 3.6 | 237.5 | 7300.5 |
| New Source Performance Rvw | 16.3 | 3.6 | 0 | 1187.3 | 875.9 | 1.4 | 223.5 | 1.4 | 1.4 | 2310.8 |
| CFC and Halon Management | 386.6 | 0 | 0 | 6.3 | 0 | 0 | 60.3 | 0 | 0 | 453.2 |
| Air Emission Inventory | 128.4 | 31.6 | 21.7 | 732.2 | 150.1 | 26.6 | 125.2 | 5 | 62.9 | 1283.7 |
| Record-Keeping | 287 | 159.8 | 150.8 | 1165.4 | 436.8 | 155.8 | 413 | 5 | 92.4 | 2866 |
| | | | | | | | | | | |
| Hazardous Material Management | | | | | | | | | | |
| Prepare Toxic Release Inventory | 116.9 | 0 | 0 | 0 | 0 | 175.8 | 0 | 0 | 0 | 292.7 |
| Prepare Emergency Planning and Community Right to Know Reports | 1309.4 | 0 | 0 | 0 | 58.9 | 0 | 0 | 0 | 0 | 1368.3 |
| Prepare Emergency Plan (SPCC) | 263.3 | 0 | 0 | 0 | 0 | 615.1 | 0 | 0 | 0 | 878.4 |
| Respond to spills | 195.9 | 107.4 | 107.4 | 244.4 | 244.4 | 136.9 | 244.4 | 0 | 87.5 | 1368.3 |
| Procurement of hazardous material facility | 370.8 | 0 | 0 | 0 | 0 | 1583.2 | 0 | 0 | 0 | 1954 |
| Labeling requirements | 58.9 | 0 | 0 | 0 | 0 | 175.8 | 0 | 58.9 | 0 | 293.6 |
| Perform audits | 146.4 | 146.4 | 146.4 | 146.4 | 146.4 | 292.8 | 146.4 | 146.4 | 146.4 | 1464 |
| | | | | | | | | | | |
| Hazardous Waste Management | | | | | | | | | | |
| Hazardous waste identification | 985.5 | 438.7 | 320.8 | 1189.3 | 868.6 | 438.7 | 653.6 | 653.6 | 985.5 | 6534.3 |
| RCRA reporting of waste activities | 1333.8 | 200.5 | 200.5 | 630.3 | 630.3 | 435.3 | 415.4 | 214.9 | 865.2 | 4926.2 |
| Obtaining EPA hazardous waste generator number | 320.8 | 280.7 | 280.7 | 345.7 | 280.7 | 280.7 | 280.7 | 280.7 | 216.8 | 2567.5 |
| Obtaining and Maintaining TSDF permits | 4421.6 | 80.2 | 120.3 | 345.7 | 280.7 | 2809.9 | 280.7 | 1204 | 216.8 | 9759.9 |
| Preparation of hazardous waste manifest | 466 | 401 | 401 | 401 | 401 | 401 | 401 | 417.2 | 401 | 3690.2 |
| Paying hazardous waste transporation and disposal fees | 301.2 | 261.1 | 301.2 | 413 | 261.1 | 261.1 | 261.1 | 249.2 | 261.1 | 2570.1 |
| Procurement of hazardous waste storage containers | 729.8 | 244.9 | 244.9 | 341.3 | 261.1 | 319.1 | 261.1 | 112.6 | 319.1 | 2833.9 |
| Oversee (training and inspections) hazardous waste SAP's | 2588.1 | 416.5 | 240.6 | 918.8 | 846.3 | 416.5 | 631.4 | 599.9 | 1102.4 | 7760.5 |
| Prepare SPCC Plan | 2740.1 | 80.2 | 120.3 | 313.1 | 232.9 | 232.9 | 232.9 | 200.5 | 349.9 | 4502.8 |
| Prepare Biennial 'Waste Activities' report | 1195.9 | 80.2 | 120.3 | 313.1 | 232.9 | 232.9 | 232.9 | 200.5 | 232.9 | 2841.6 |
| Preparation of closure and post-closure plans for TSDF | 542.9 | 16.3 | 16.3 | 16.3 | 16.3 | 74.2 | 16.3 | 32.5 | 16.3 | 747.4 |
| | | | | | | | | | | |
| POL Management | | | | | | | | | | |
| Prepare SPCC Plan | 3953.1 | 16.3 | 16.3 | 63.9 | 7.6 | 1464.9 | 2488.2 | 40.1 | 16.3 | 8066.7 |
| Monitoring Used Oil | 16.3 | 16.3 | 7.6 | 80.2 | 7.6 | 3.6 | 21.2 | 0 | 7.6 | 160.4 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Wastewater Management | | | | | | | | | | |
| Obtain and Maintain NPDES permit | 682 | 47.7 | 47.7 | 47.7 | 47.7 | 47.7 | 47.7 | 399.5 | 282.6 | 1650.3 |
| Prepare SPCC Plan | 373.4 | 112.6 | 112.6 | 449.7 | 449.7 | 56.4 | 56.4 | 56.4 | 143.7 | 1810.9 |
| Obtain and Maintain Stormwater permit | 1604.9 | 1604.9 | 803 | 4013.9 | 0 | 803 | 1604.9 | 0 | 5618.9 | 16053.5 |
| | | | | | | | | | | |
| Solid Waste Management | | | | | | | | | | |
| Collection of Solid Wastes (Separating and storing recyclables, payment of disposal fees) | 6777 | 1754.3 | 963.4 | 1926.8 | 963.4 | 963.4 | 963.4 | 481.2 | 1491 | 16283.9 |
| Obtaining and Maintaining landfill permits (closure plans, monitoring, record-keeping, etc.) | 292.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 292.8 |
| | | | | | | | | | | |
| OTHER | | | | | | | | | | |
| Managing AST and UST (RCRA reporting, maintaining leak detection, monitoring corrosion control systems, etc.) | 1784.2 | 377.1 | 0 | 377.1 | 0 | 929 | 377.1 | 377.1 | 292.8 | 4514.4 |
| Performing ECAMP (to include pre-audit and post-audit activities) | 930.2 | 342.7 | 187.6 | 441.5 | 441.5 | 342.7 | 441.5 | 226.6 | 1593.2 | 4947.5 |
| | | | | | | | | | total = | 124348.3 |
| | | | | | | | | | | |
| | | | | | | CHECK: | total shoul equal total labor yr 3 | | | |
| | | | | | | | plus ABC software cost= | | 124348.3 | |

| Direct $'s to charge back | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| Activities | CES | SVS | SPS | EMS | CRS | SUPPLY | TRANS | MED | OPS | TOTAL |
| Air Management | | | | | | | | | | |
| Obtain and Maintain Air Permits | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| New Source Performance Rvw | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CFC and Halon Management | 35000 | 0 | 0 | 800 | 0 | 0 | 4200 | 0 | 0 | 40000 |
| Air Emission Inventory | 3500 | 933.333333 | 583.333333 | 20416.6667 | 4083.33333 | 758.333333 | 3208.33333 | 175 | 1341.66667 | 35000 |
| Record-Keeping | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | |
| Hazardous Material Management | | | | | | | | | | |
| Prepare Toxic Release Inventory | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Prepare Emergency Planning and Community Right to Know Reports | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Prepare Emergency Plan (SPCC) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Respond to spills | 1333.33333 | 833.333333 | 833.333333 | 1833.33333 | 1833.33333 | 1000 | 1833.33333 | 0 | 500 | 10000 |
| Procurement of hazardous material facility | 1750 | 0 | 0 | 0 | 0 | 8250 | 0 | 0 | 0 | 10000 |
| Labeling requirements | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Perform audits | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | |
| Hazardous Waste Management | | | | | | | | | | |
| Hazardous waste identification | 18352.9412 | 9176.47059 | 7647.05882 | 24470.5882 | 16823.5294 | 9176.47059 | 13000 | 13000 | 18352.9412 | 130000 |
| RCRA reporting of waste activities | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Obtaining EPA hazardous waste generator number | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Obtaining and Maintaining TSDF permits | 1152.77778 | 27.7777778 | 41.6666667 | 119.444444 | 97.2222222 | 972.222222 | 97.2222222 | 416.666667 | 75 | 3000 |
| Preparation of hazardous waste manifest | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Paying hazardous waste transporation and disposal fees | 29296.875 | 25390.625 | 29296.875 | 40234.375 | 25390.625 | 25390.625 | 25390.625 | 24218.75 | 25390.625 | 250000 |
| Procurement of hazardous waste storage containers | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oversee (training and inspections) hazardous waste SAP's | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Prepare SPCC Plan | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Prepare Biennial 'Waste Activities' report | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Preparation of closure and post-closure plans for TSDF | 3166.66667 | 166.666667 | 166.666667 | 166.666667 | 166.666667 | 500 | 166.666667 | 333.333333 | 166.666667 | 5000 |
| | | | | | | | | | | |
| POL Management | | | | | | | | | | |
| Prepare SPCC Plan | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Monitoring Used Oil | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Wastewater Management | | | | | | | | | | |
| Obtain and Maintain NPDES permit | 1114.28571 | 128.571429 | 128.571429 | 128.571429 | 128.571429 | 128.571429 | 128.571429 | 642.857143 | 471.428571 | 3000 |
| Prepare SPCC Plan | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Obtain and Maintain Stormwater permit | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | |
| Solid Waste Management | | | | | | | | | | |
| Collection of Solid Wastes (Separating and storing recyclables, payment of disposal fees) | 143351.064 | 32393.617 | 22340.4255 | 44680.8511 | 22340.4255 | 22340.4255 | 22340.4255 | 11170.2128 | 29042.5532 | 350000 |
| Obtaining and Maintaining landfill permits (closure plans, monitoring, record-keeping, etc.) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | |
| OTHER | | | | | | | | | | |
| Managing AST and UST (RCRA reporting, maintaining leak detection, monitoring corrosion control systems, etc.) | 7541.66667 | 1958.33333 | 0 | 1958.33333 | 0 | 3791.66667 | 1958.33333 | 1958.33333 | 833.333333 | 20000 |
| Performing ECAMP (to include pre-audit and post-audit activities) | 5760 | 1860 | 1200 | 2400 | 2400 | 1860 | 2400 | 1200 | 10920 | 30000 |
| | | | | | | | | | total = | 886000 |

| Sum of charges (Labor charges and direct) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| Activities | CES | SVS | SPS | EMS | CRS | SUPPLY | TRANS | MED | OPS | TOTAL |
| Air Management | | | | | | | | | | |
| Obtain and Maintain Air Permits | 1156 | 14 | 0 | 7740 | 5620 | 7 | 1266 | 7 | 551 | 16361 |
| New Source Performance Rvw | 34 | 7 | 0 | 2638 | 1954 | 3 | 497 | 3 | 3 | 5139 |
| CFC and Halon Management | 35867 | 0 | 0 | 814 | 0 | 0 | 4339 | 0 | 0 | 41020 |
| Air Emission Inventory | 3786 | 1002 | 631 | 22043 | 4417 | 817 | 3491 | 185 | 1488 | 37860 |
| Record-Keeping | 642 | 356 | 336 | 2610 | 978 | 346 | 927 | 10 | 214 | 6419 |
| | | | | | | | | | | |
| Hazardous Material Management | | | | | | | | | | |
| Prepare Toxic Release Inventory | 272 | 0 | 0 | 0 | 0 | 408 | 0 | 0 | 0 | 680 |
| Prepare Emergency Planning and Community Right to Know Reports | 2944 | 0 | 0 | 0 | 136 | 0 | 0 | 0 | 0 | 3080 |
| Prepare Emergency Plan (SPCC) | 612 | 0 | 0 | 0 | 0 | 1428 | 0 | 0 | 0 | 2040 |
| Respond to spills | 1777 | 1073 | 1073 | 2381 | 2381 | 1308 | 2381 | 0 | 704 | 13078 |
| Procurement of hazardous material facility | 2602 | 0 | 0 | 0 | 0 | 11838 | 0 | 0 | 0 | 14440 |
| Labeling requirements | 136 | 0 | 0 | 0 | 0 | 408 | 0 | 136 | 0 | 680 |
| Perform audits | 340 | 340 | 340 | 340 | 340 | 680 | 340 | 340 | 340 | 3400 |
| | | | | | | | | | | |
| Hazardous Waste Management | | | | | | | | | | |
| Hazardous waste identification | 20537 | 10128 | 8327 | 27063 | 18736 | 10128 | 14432 | 14432 | 20537 | 144320 |
| RCRA reporting of waste activities | 3017 | 425 | 425 | 1385 | 1385 | 969 | 905 | 480 | 1929 | 10920 |
| Obtaining EPA hazardous waste generator number | 680 | 595 | 595 | 731 | 595 | 595 | 595 | 595 | 459 | 5440 |
| Obtaining and Maintaining TSDF permits | 11008 | 198 | 297 | 850 | 692 | 6922 | 692 | 2967 | 534 | 24160 |
| Preparation of hazardous waste manifest | 986 | 850 | 850 | 850 | 850 | 850 | 850 | 884 | 850 | 7820 |
| Paying hazardous waste transporation and disposal fees | 29934 | 25943 | 29934 | 41110 | 25943 | 25943 | 25943 | 24746 | 25943 | 255439 |
| Procurement of hazardous waste storage containers | 1641 | 519 | 519 | 723 | 553 | 689 | 553 | 238 | 689 | 6124 |
| Oversee (training and inspections) hazardous waste SAP's | 5601 | 918 | 510 | 2031 | 1878 | 918 | 1398 | 1330 | 2456 | 17040 |
| Prepare SPCC Plan | 6143 | 170 | 255 | 663 | 493 | 493 | 493 | 425 | 765 | 9900 |
| Prepare Biennial 'Waste Activities' report | 2655 | 170 | 255 | 663 | 493 | 493 | 493 | 425 | 493 | 6140 |
| Preparation of closure and post-closure plans for TSDF | 4425 | 201 | 201 | 201 | 201 | 670 | 201 | 401 | 201 | 6702 |
| | | | | | | | | | | |
| POL Management | | | | | | | | | | |
| Prepare SPCC Plan | 8670 | 34 | 34 | 136 | 17 | 3400 | 5270 | 85 | 34 | 17680 |
| Monitoring Used Oil | 34 | 34 | 17 | 170 | 17 | 7 | 44 | 0 | 17 | 340 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Wastewater Management | | | | | | | | | | |
| Obtain and Maintain NPDES permit | 2678 | 231 | 231 | 231 | 231 | 231 | 231 | 1561 | 1117 | 6742 |
| Prepare SPCC Plan | 833 | 238 | 238 | 952 | 952 | 119 | 119 | 119 | 323 | 3893 |
| Obtain and Maintain Stormwater permit | 3400 | 3400 | 1700 | 8500 | 0 | 1700 | 3400 | 0 | 11900 | 34000 |
| | | | | | | | | | | |
| Solid Waste Management | | | | | | | | | | |
| Collection of Solid Wastes (Separating and storing recyclables, payment of disposal fees) | 157971 | 36270 | 24380 | 48761 | 24380 | 24380 | 24380 | 12190 | 32307 | 385019 |
| Obtaining and Maintaining landfill permits (closure plans, monitoring, record-keeping, etc.) | 680 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 680 |
| | | | | | | | | | | |
| OTHER | | | | | | | | | | |
| Managing AST and UST (RCRA reporting, maintaining leak detection, monitoring corrosion control systems, etc.) | 11469 | 2757 | 0 | 2757 | 0 | 5849 | 2757 | 2757 | 1513 | 29859 |
| Performing ECAMP (to include pre-audit and post-audit activities) | 7802 | 2627 | 1610 | 3390 | 3390 | 2627 | 3390 | 1710 | 14354 | 40900 |
| | 330332 | 88500 | 72758 | 179733 | 96632 | 104226 | 99387 | 66026 | 119721 | |
| | | | | | | | | | total = | 1157315 |
| | | | | | | | | | | |
| | | | | | check: total should be = to sum of labor and contracts | | | | | 1157313 |

| Sum of charges (Labor charges and direct) | for year 2, can only charge back the amount from yr 1 less the money saved from yr 1 (or 80% of the original) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Activities | CES | SVS | SPS | EMS | CRS | SUPPLY | TRANS | MED | OPS | TOTAL |
| Air Management | | | | | | | | | | |
| Obtain and Maintain Air Permits | 924.8 | 11.2 | 0 | 6192 | 4496 | 5.6 | 1012.8 | 5.6 | 440.8 | 13088.8 |
| New Source Performance Rvw | 27.2 | 5.6 | 0 | 2110.4 | 1563.2 | 2.4 | 397.6 | 2.4 | 2.4 | 4111.2 |
| CFC and Halon Management | 28693.6 | 0 | 0 | 651.2 | 0 | 0 | 3471.2 | 0 | 0 | 32816 |
| Air Emission Inventory | 3028.8 | 801.6 | 504.8 | 17634.4 | 3533.6 | 653.6 | 2792.8 | 148 | 1190.4 | 30288 |
| Record-Keeping | 513.6 | 284.8 | 268.8 | 2088 | 782.4 | 276.8 | 741.6 | 8 | 171.2 | 5135.2 |
| | | | | | | | | | | |
| Hazardous Material Management | | | | | | | | | | |
| Prepare Toxic Release Inventory | 217.6 | 0 | 0 | 0 | 0 | 326.4 | 0 | 0 | 0 | 544 |
| Prepare Emergency Planning and Community Right to Know Reports | 2355.2 | 0 | 0 | 0 | 108.8 | 0 | 0 | 0 | 0 | 2464 |
| Prepare Emergency Plan (SPCC) | 489.6 | 0 | 0 | 0 | 0 | 1142.4 | 0 | 0 | 0 | 1632 |
| Respond to spills | 1421.6 | 858.4 | 858.4 | 1904.8 | 1904.8 | 1046.4 | 1904.8 | 0 | 563.2 | 10462.4 |
| Procurement of hazardous material facility | 2081.6 | 0 | 0 | 0 | 0 | 9470.4 | 0 | 0 | 0 | 11552 |
| Labeling requirements | 108.8 | 0 | 0 | 0 | 0 | 326.4 | 0 | 108.8 | 0 | 544 |
| Perform audits | 272 | 272 | 272 | 272 | 272 | 544 | 272 | 272 | 272 | 2720 |
| | | | | | | | | | | |
| Hazardous Waste Management | | | | | | | | | | |
| Hazardous waste identification | 16429.6 | 8102.4 | 6661.6 | 21650.4 | 14988.8 | 8102.4 | 11545.6 | 11545.6 | 16429.6 | 115456 |
| RCRA reporting of waste activities | 2413.6 | 340 | 340 | 1108 | 1108 | 775.2 | 724 | 384 | 1543.2 | 8736 |
| Obtaining EPA hazardous waste generator number | 544 | 476 | 476 | 584.8 | 476 | 476 | 476 | 476 | 367.2 | 4352 |
| Obtaining and Maintaining TSDF permits | 8806.4 | 158.4 | 237.6 | 680 | 553.6 | 5537.6 | 553.6 | 2373.6 | 427.2 | 19328 |
| Preparation of hazardous waste manifest | 788.8 | 680 | 680 | 680 | 680 | 680 | 680 | 707.2 | 680 | 6256 |
| Paying hazardous waste transporation and disposal fees | 23947.2 | 20754.4 | 23947.2 | 32888 | 20754.4 | 20754.4 | 20754.4 | 19796.8 | 20754.4 | 204351.2 |
| Procurement of hazardous waste storage containers | 1312.8 | 415.2 | 415.2 | 578.4 | 442.4 | 551.2 | 442.4 | 190.4 | 551.2 | 4899.2 |
| Oversee (training and inspections) hazardous waste SAP's | 4480.8 | 734.4 | 408 | 1624.8 | 1502.4 | 734.4 | 1118.4 | 1064 | 1964.8 | 13632 |
| Prepare SPCC Plan | 4914.4 | 136 | 204 | 530.4 | 394.4 | 394.4 | 394.4 | 340 | 612 | 7920 |
| Prepare Biennial 'Waste Activities' report | 2124 | 136 | 204 | 530.4 | 394.4 | 394.4 | 394.4 | 340 | 394.4 | 4912 |
| Preparation of closure and post-closure plans for TSDF | 3540 | 160.8 | 160.8 | 160.8 | 160.8 | 536 | 160.8 | 320.8 | 160.8 | 5361.6 |
| | | | | | | | | | | |
| POL Management | | | | | | | | | | |
| Prepare SPCC Plan | 6936 | 27.2 | 27.2 | 108.8 | 13.6 | 2720 | 4216 | 68 | 27.2 | 14144 |
| Monitoring Used Oil | 27.2 | 27.2 | 13.6 | 136 | 13.6 | 5.6 | 35.2 | 0 | 13.6 | 272 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Wastewater Management | | | | | | | | | | |
| Obtain and Maintain NPDES permit | 2142.4 | 184.8 | 184.8 | 184.8 | 184.8 | 184.8 | 184.8 | 1248.8 | 893.6 | 5393.6 |
| Prepare SPCC Plan | 666.4 | 190.4 | 190.4 | 761.6 | 761.6 | 95.2 | 95.2 | 95.2 | 258.4 | 3114.4 |
| Obtain and Maintain Stormwater permit | 2720 | 2720 | 1360 | 6800 | 0 | 1360 | 2720 | 0 | 9520 | 27200 |
| | | | | | | | | | | |
| Solid Waste Management | | | | | | | | | | |
| Collection of Solid Wastes (Separating and storing recyclables, payment of disposal fees) | 126376.8 | 29016 | 19504 | 39008.8 | 19504 | 19504 | 19504 | 9752 | 25845.6 | 308015.2 |
| Obtaining and Maintaining landfill permits (closure plans, monitoring, record-keeping, etc.) | 544 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 544 |
| | | | | | | | | | | |
| OTHER | | | | | | | | | | |
| Managing AST and UST (RCRA reporting, maintaining leak detection, monitoring corrosion control systems, etc.) | 9175.2 | 2205.6 | 0 | 2205.6 | 0 | 4679.2 | 2205.6 | 2205.6 | 1210.4 | 23887.2 |
| Performing ECAMP (to include pre-audit and post-audit activities) | 6241.6 | 2101.6 | 1288 | 2712 | 2712 | 2101.6 | 2712 | 1368 | 11483.2 | 32720 |
| | | | | | | | | | total = | 925852 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | check: total should = (1-benefit ratio)total from yr 1 = | | | | | 925852 |

| Sum of charges (Labor charges and direct) | | for year 3, can only charge back the amount from yr 2 less the money saved from yr 2 (or 80% of the original) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Activities | CES | SVS | SPS | EMS | CRS | SUPPLY | TRANS | MED | OPS | TOTAL |
| Air Management | | | | | | | | | | |
| Obtain and Maintain Air Permits | 739.84 | 8.96 | 0 | 4953.6 | 3596.8 | 4.48 | 810.24 | 4.48 | 352.64 | 10471.04 |
| New Source Performance Rvw | 21.76 | 4.48 | 0 | 1688.32 | 1250.56 | 1.92 | 318.08 | 1.92 | 1.92 | 3288.96 |
| CFC and Halon Management | 22954.88 | 0 | 0 | 520.96 | 0 | 0 | 2776.96 | 0 | 0 | 26252.8 |
| Air Emission Inventory | 2423.04 | 641.28 | 403.84 | 14107.52 | 2826.88 | 522.88 | 2234.24 | 118.4 | 952.32 | 24230.4 |
| Record-Keeping | 410.88 | 227.84 | 215.04 | 1670.4 | 625.92 | 221.44 | 593.28 | 6.4 | 136.96 | 4108.16 |
| | | | | | | | | | | |
| Hazardous Material Management | | | | | | | | | | |
| Prepare Toxic Release Inventory | 174.08 | 0 | 0 | 0 | 0 | 261.12 | 0 | 0 | 0 | 435.2 |
| Prepare Emergency Planning and Community Right to Know Reports | 1884.16 | 0 | 0 | 0 | 87.04 | 0 | 0 | 0 | 0 | 1971.2 |
| Prepare Emergency Plan (SPCC) | 391.68 | 0 | 0 | 0 | 0 | 913.92 | 0 | 0 | 0 | 1305.6 |
| Respond to spills | 1137.28 | 686.72 | 686.72 | 1523.84 | 1523.84 | 837.12 | 1523.84 | 0 | 450.56 | 8369.92 |
| Procurement of hazardous material facility | 1665.28 | 0 | 0 | 0 | 0 | 7576.32 | 0 | 0 | 0 | 9241.6 |
| Labeling requirements | 87.04 | 0 | 0 | 0 | 0 | 261.12 | 0 | 87.04 | 0 | 435.2 |
| Perform audits | 217.6 | 217.6 | 217.6 | 217.6 | 217.6 | 435.2 | 217.6 | 217.6 | 217.6 | 2176 |
| | | | | | | | | | | |
| Hazardous Waste Management | | | | | | | | | | |
| Hazardous waste identification | 13143.68 | 6481.92 | 5329.28 | 17320.32 | 11991.04 | 6481.92 | 9236.48 | 9236.48 | 13143.68 | 92364.8 |
| RCRA reporting of waste activities | 1930.88 | 272 | 272 | 886.4 | 886.4 | 620.16 | 579.2 | 307.2 | 1234.56 | 6988.8 |
| Obtaining EPA hazardous waste generator number | 435.2 | 380.8 | 380.8 | 467.84 | 380.8 | 380.8 | 380.8 | 380.8 | 293.76 | 3481.6 |
| Obtaining and Maintaining TSDF permits | 7045.12 | 126.72 | 190.08 | 544 | 442.88 | 4430.08 | 442.88 | 1898.88 | 341.76 | 15462.4 |
| Preparation of hazardous waste manifest | 631.04 | 544 | 544 | 544 | 544 | 544 | 544 | 565.76 | 544 | 5004.8 |
| Paying hazardous waste transporation and disposal fees | 19157.76 | 16603.52 | 19157.76 | 26310.4 | 16603.52 | 16603.52 | 16603.52 | 15837.44 | 16603.52 | 163480.96 |
| Procurement of hazardous waste storage containers | 1050.24 | 332.16 | 332.16 | 462.72 | 353.92 | 440.96 | 353.92 | 152.32 | 440.96 | 3919.36 |
| Oversee (training and inspections) hazardous waste SAP's | 3584.64 | 587.52 | 326.4 | 1299.84 | 1201.92 | 587.52 | 894.72 | 851.2 | 1571.84 | 10905.6 |
| Prepare SPCC Plan | 3931.52 | 108.8 | 163.2 | 424.32 | 315.52 | 315.52 | 315.52 | 272 | 489.6 | 6336 |
| Prepare Biennial 'Waste Activities' report | 1699.2 | 108.8 | 163.2 | 424.32 | 315.52 | 315.52 | 315.52 | 272 | 315.52 | 3929.6 |
| Preparation of closure and post-closure plans for TSDF | 2832 | 128.64 | 128.64 | 128.64 | 128.64 | 428.8 | 128.64 | 256.64 | 128.64 | 4289.28 |
| | | | | | | | | | | |
| POL Management | | | | | | | | | | |
| Prepare SPCC Plan | 5548.8 | 21.76 | 21.76 | 87.04 | 10.88 | 2176 | 3372.8 | 54.4 | 21.76 | 11315.2 |
| Monitoring Used Oil | 21.76 | 21.76 | 10.88 | 108.8 | 10.88 | 4.48 | 28.16 | 0 | 10.88 | 217.6 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Wastewater Management | | | | | | | | | | |
| Obtain and Maintain NPDES permit | 1713.92 | 147.84 | 147.84 | 147.84 | 147.84 | 147.84 | 147.84 | 999.04 | 714.88 | 4314.88 |
| Prepare SPCC Plan | 533.12 | 152.32 | 152.32 | 609.28 | 609.28 | 76.16 | 76.16 | 76.16 | 206.72 | 2491.52 |
| Obtain and Maintain Stormwater permit | 2176 | 2176 | 1088 | 5440 | 0 | 1088 | 2176 | 0 | 7616 | 21760 |
| | | | | | | | | | | |
| Solid Waste Management | | | | | | | | | | |
| Collection of Solid Wastes (Separating and storing recyclables, payment of disposal fees) | 101101.44 | 23212.8 | 15603.2 | 31207.04 | 15603.2 | 15603.2 | 15603.2 | 7801.6 | 20676.48 | 246412.16 |
| Obtaining and Maintaining landfill permits (closure plans, monitoring, record-keeping, etc.) | 435.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 435.2 |
| | | | | | | | | | | |
| OTHER | | | | | | | | | | |
| Managing AST and UST (RCRA reporting, maintaining leak detection, monitoring corrosion control systems, etc.) | 7340.16 | 1764.48 | 0 | 1764.48 | 0 | 3743.36 | 1764.48 | 1764.48 | 968.32 | 19109.76 |
| Performing ECAMP (to include pre-audit and post-audit activities) | 4993.28 | 1681.28 | 1030.4 | 2169.6 | 2169.6 | 1681.28 | 2169.6 | 1094.4 | 9186.56 | 26176 |
| | | | | | | | | | total = | 740681.6 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | check: total should = (1-benefit ratio)total from yr 1 = | | | | | 740681.6 |

| BENEFIT | time =0 | Year =1 | | | | using a benefit ratio= | | 0.4 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| Activities | CES | SVS | SPS | EMS | CRS | SUPPLY | TRANS | MED | OPS | TOTAL |
| Air Management | | | | | | | | | | |
| Obtain and Maintain Air Permits | 462.4 | 5.6 | 0 | 3096 | 2248 | 2.8 | 506.4 | 2.8 | 220.4 | 6544.4 |
| New Source Performance Rvw | 13.6 | 2.8 | 0 | 1055.2 | 781.6 | 1.2 | 198.8 | 1.2 | 1.2 | 2055.6 |
| CFC and Halon Management | 14346.8 | 0 | 0 | 325.6 | 0 | 0 | 1735.6 | 0 | 0 | 16408 |
| Air Emission Inventory | 1514.4 | 400.8 | 252.4 | 8817.2 | 1766.8 | 326.8 | 1396.4 | 74 | 595.2 | 15144 |
| Record-Keeping | 256.8 | 142.4 | 134.4 | 1044 | 391.2 | 138.4 | 370.8 | 4 | 85.6 | 2567.6 |
| | | | | | | | | | | |
| Hazardous Material Management | | | | | | | | | | |
| Prepare Toxic Release Inventory | 108.8 | 0 | 0 | 0 | 0 | 163.2 | 0 | 0 | 0 | 272 |
| Prepare Emergency Planning and Community Right to Know Reports | 1177.6 | 0 | 0 | 0 | 54.4 | 0 | 0 | 0 | 0 | 1232 |
| Prepare Emergency Plan (SPCC) | 244.8 | 0 | 0 | 0 | 0 | 571.2 | 0 | 0 | 0 | 816 |
| Respond to spills | 710.8 | 429.2 | 429.2 | 952.4 | 952.4 | 523.2 | 952.4 | 0 | 281.6 | 5231.2 |
| Procurement of hazardous material facility | 1040.8 | 0 | 0 | 0 | 0 | 4735.2 | 0 | 0 | 0 | 5776 |
| Labeling requirements | 54.4 | 0 | 0 | 0 | 0 | 163.2 | 0 | 54.4 | 0 | 272 |
| Perform audits | 136 | 136 | 136 | 136 | 136 | 272 | 136 | 136 | 136 | 1360 |
| | | | | | | | | | | |
| Hazardous Waste Management | | | | | | | | | | |
| Hazardous waste identification | 8214.8 | 4051.2 | 3330.8 | 10825.2 | 7494.4 | 4051.2 | 5772.8 | 5772.8 | 8214.8 | 57728 |
| RCRA reporting of waste activities | 1206.8 | 170 | 170 | 554 | 554 | 387.6 | 362 | 192 | 771.6 | 4368 |
| Obtaining EPA hazardous waste generator number | 272 | 238 | 238 | 292.4 | 238 | 238 | 238 | 238 | 183.6 | 2176 |
| Obtaining and Maintaining TSDF permits | 4403.2 | 79.2 | 118.8 | 340 | 276.8 | 2768.8 | 276.8 | 1186.8 | 213.6 | 9664 |
| Preparation of hazardous waste manifest | 394.4 | 340 | 340 | 340 | 340 | 340 | 340 | 353.6 | 340 | 3128 |
| Paying hazardous waste transporation and disposal fees | 11973.6 | 10377.2 | 11973.6 | 16444 | 10377.2 | 10377.2 | 10377.2 | 9898.4 | 10377.2 | 102175.6 |
| Procurement of hazardous waste storage containers | 656.4 | 207.6 | 207.6 | 289.2 | 221.2 | 275.6 | 221.2 | 95.2 | 275.6 | 2449.6 |
| Oversee (training and inspections) hazardous waste SAP's | 2240.4 | 367.2 | 204 | 812.4 | 751.2 | 367.2 | 559.2 | 532 | 982.4 | 6816 |
| Prepare SPCC Plan | 2457.2 | 68 | 102 | 265.2 | 197.2 | 197.2 | 197.2 | 170 | 306 | 3960 |
| Prepare Biennial 'Waste Activities' report | 1062 | 68 | 102 | 265.2 | 197.2 | 197.2 | 197.2 | 170 | 197.2 | 2456 |
| Preparation of closure and post-closure plans for TSDF | 1770 | 80.4 | 80.4 | 80.4 | 80.4 | 268 | 80.4 | 160.4 | 80.4 | 2680.8 |
| | | | | | | | | | | |
| POL Management | | | | | | | | | | |
| Prepare SPCC Plan | 3468 | 13.6 | 13.6 | 54.4 | 6.8 | 1360 | 2108 | 34 | 13.6 | 7072 |
| Monitoring Used Oil | 13.6 | 13.6 | 6.8 | 68 | 6.8 | 2.8 | 17.6 | 0 | 6.8 | 136 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Wastewater Management | | | | | | | | | | |
| Obtain and Maintain NPDES permit | 1071.2 | 92.4 | 92.4 | 92.4 | 92.4 | 92.4 | 92.4 | 624.4 | 446.8 | 2696.8 |
| Prepare SPCC Plan | 333.2 | 95.2 | 95.2 | 380.8 | 380.8 | 47.6 | 47.6 | 47.6 | 129.2 | 1557.2 |
| Obtain and Maintain Stormwater permit | 1360 | 1360 | 680 | 3400 | 0 | 680 | 1360 | 0 | 4760 | 13600 |
| | | | | | | | | | | |
| Solid Waste Management | | | | | | | | | | |
| Collection of Solid Wastes (Separating and storing recyclables, payment of disposal fees) | 63188.4 | 14508 | 9752 | 19504.4 | 9752 | 9752 | 9752 | 4876 | 12922.8 | 154007.6 |
| Obtaining and Maintaining landfill permits (closure plans, monitoring, record-keeping, etc.) | 272 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 272 |
| | | | | | | | | | | |
| OTHER | | | | | | | | | | |
| Managing AST and UST (RCRA reporting, maintaining leak detection, monitoring corrosion control systems, etc.) | 4587.6 | 1102.8 | 0 | 1102.8 | 0 | 2339.6 | 1102.8 | 1102.8 | 605.2 | 11943.6 |
| Performing ECAMP (to include pre-audit and post-audit activities) | 3120.8 | 1050.8 | 644 | 1356 | 1356 | 1050.8 | 1356 | 684 | 5741.6 | 16360 |
| | | | | | | | | | total = | 462926 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | check: total should be = ratio *sum of labor and contracts = | | | | | 462926 |

| CUMULATIVE BENEFIT (YEAR 1 + YEAR 2) | | Time =1 | Year =2 | yr2 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | pv factor | 0.96425 | | | | | | |
| Activities | CES | SVS | SPS | EMS | CRS | SUPPLY | TRANS | MED | OPS | TOTAL |
| Air Management | | | | | | | | | | |
| Obtain and Maintain Air Permits | 819.1 | 9.9 | 0 | 5484.3 | 3982.1 | 5 | 897 | 5 | 390.4 | 11592.8 |
| New Source Performance Rvw | 24.1 | 5 | 0 | 1869.2 | 1384.5 | 2.1 | 352.2 | 2.1 | 2.1 | 3641.3 |
| CFC and Halon Management | 25413.9 | 0 | 0 | 576.8 | 0 | 0 | 3074.4 | 0 | 0 | 29065.1 |
| Air Emission Inventory | 2682.6 | 710 | 447.1 | 15618.8 | 3129.7 | 578.9 | 2473.6 | 131.1 | 1054.3 | 26826.1 |
| Record-Keeping | 454.9 | 252.2 | 238.1 | 1849.3 | 693 | 245.2 | 656.8 | 7.1 | 151.6 | 4548.2 |
| | | | | | | | | | | |
| Hazardous Material Management | | | | | | | | | | |
| Prepare Toxic Release Inventory | 192.7 | 0 | 0 | 0 | 0 | 289.1 | 0 | 0 | 0 | 481.8 |
| Prepare Emergency Planning and Community Right to Know Reports | 2086 | 0 | 0 | 0 | 96.4 | 0 | 0 | 0 | 0 | 2182.4 |
| Prepare Emergency Plan (SPCC) | 433.6 | 0 | 0 | 0 | 0 | 1011.8 | 0 | 0 | 0 | 1445.4 |
| Respond to spills | 1259.1 | 760.3 | 760.3 | 1687.1 | 1687.1 | 926.8 | 1687.1 | 0 | 498.8 | 9266.6 |
| Procurement of hazardous material facility | 1843.7 | 0 | 0 | 0 | 0 | 8387.9 | 0 | 0 | 0 | 10231.6 |
| Labeling requirements | 96.4 | 0 | 0 | 0 | 0 | 289.1 | 0 | 96.4 | 0 | 481.9 |
| Perform audits | 240.9 | 240.9 | 240.9 | 240.9 | 240.9 | 481.8 | 240.9 | 240.9 | 240.9 | 2409 |
| | | | | | | | | | | |
| Hazardous Waste Management | | | | | | | | | | |
| Hazardous waste identification | 14551.7 | 7176.3 | 5900.2 | 19175.8 | 13275.6 | 7176.3 | 10225.9 | 10225.9 | 14551.7 | 102259.4 |
| RCRA reporting of waste activities | 2137.7 | 301.1 | 301.1 | 981.4 | 981.4 | 686.6 | 641.2 | 340.1 | 1366.8 | 7737.4 |
| Obtaining EPA hazardous waste generator number | 481.8 | 421.6 | 421.6 | 518 | 421.6 | 421.6 | 421.6 | 421.6 | 325.2 | 3854.6 |
| Obtaining and Maintaining TSDF permits | 7799.8 | 140.3 | 210.4 | 602.3 | 490.3 | 4904.7 | 490.3 | 2102.3 | 378.4 | 17118.8 |
| Preparation of hazardous waste manifest | 698.6 | 602.3 | 602.3 | 602.3 | 602.3 | 602.3 | 602.3 | 626.4 | 602.3 | 5541.1 |
| Paying hazardous waste transporation and disposal fees | 21210 | 18382.2 | 21210 | 29128.9 | 18382.2 | 18382.2 | 18382.2 | 17534 | 18382.2 | 180993.9 |
| Procurement of hazardous waste storage containers | 1162.7 | 367.7 | 367.7 | 512.3 | 391.8 | 488.2 | 391.8 | 168.6 | 488.2 | 4339 |
| Oversee (training and inspections) hazardous waste SAP's | 3968.6 | 650.5 | 361.4 | 1439.1 | 1330.7 | 650.5 | 990.6 | 942.4 | 1740.2 | 12074 |
| Prepare SPCC Plan | 4352.7 | 120.5 | 180.7 | 469.8 | 349.3 | 349.3 | 349.3 | 301.1 | 542 | 7014.7 |
| Prepare Biennial 'Waste Activities' report | 1881.2 | 120.5 | 180.7 | 469.8 | 349.3 | 349.3 | 349.3 | 301.1 | 349.3 | 4350.5 |
| Preparation of closure and post-closure plans for TSDF | 3135.4 | 142.4 | 142.4 | 142.4 | 142.4 | 474.7 | 142.4 | 284.1 | 142.4 | 4748.6 |
| | | | | | | | | | | |
| POL Management | | | | | | | | | | |
| Prepare SPCC Plan | 6143.2 | 24.1 | 24.1 | 96.4 | 12 | 2409.1 | 3734.1 | 60.2 | 24.1 | 12527.3 |
| Monitoring Used Oil | 24.1 | 24.1 | 12 | 120.5 | 12 | 5 | 31.2 | 0 | 12 | 240.9 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Wastewater Management | | | | | | | | | | |
| Obtain and Maintain NPDES permit | 1897.5 | 163.7 | 163.7 | 163.7 | 163.7 | 163.7 | 163.7 | 1106.1 | 791.5 | 4777.3 |
| Prepare SPCC Plan | 590.2 | 168.6 | 168.6 | 674.5 | 674.5 | 84.3 | 84.3 | 84.3 | 228.9 | 2758.2 |
| Obtain and Maintain Stormwater permit | 2409.1 | 2409.1 | 1204.6 | 6022.8 | 0 | 1204.6 | 2409.1 | 0 | 8431.9 | 24091.2 |
| | | | | | | | | | | |
| Solid Waste Management | | | | | | | | | | |
| Collection of Solid Wastes (Separating and storing recyclables, payment of disposal fees) | 111931.9 | 25699.5 | 17274.7 | 34550.1 | 17274.7 | 17274.7 | 17274.7 | 8637.3 | 22891.4 | 272809 |
| Obtaining and Maintaining landfill permits (closure plans, monitoring, record-keeping, etc.) | 481.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 481.8 |
| | | | | | | | | | | |
| OTHER | | | | | | | | | | |
| Managing AST and UST (RCRA reporting, maintaining leak detection, monitoring corrosion control systems, etc.) | 8126.5 | 1953.5 | 0 | 1953.5 | 0 | 4144.4 | 1953.5 | 1953.5 | 1072.1 | 21157 |
| Performing ECAMP (to include pre-audit and post-audit activities) | 5528.2 | 1861.4 | 1140.8 | 2402 | 2402 | 1861.4 | 2402 | 1211.6 | 10170.7 | 28980.1 |
| | | | | | | | | | total = | 820027 |
| | | | | | check: total should be = ratio *sum of labor and contracts = | | | | | 820027.116 |
| | | | | | total yr 1 = | | | | | |

| BENEFIT | Time=2 | Year =3 | yr3 | | | using a benefit ratio= | | 0.4 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | pv factor | 0.92978 | | | | | | | |
| Activities | CES | SVS | SPS | EMS | CRS | SUPPLY | TRANS | MED | OPS | TOTAL |
| Air Management | | | | | | | | | | |
| Obtain and Maintain Air Permits | 1556.7 | 18.8 | 0 | 10422.6 | 7567.8 | 9.5 | 1704.7 | 9.5 | 742 | 22031.6 |
| New Source Performance Rvw | 45.8 | 9.5 | 0 | 3552.3 | 2631.2 | 4 | 669.3 | 4 | 4 | 6920.1 |
| CFC and Halon Management | 48297.9 | 0 | 0 | 1096.2 | 0 | 0 | 5842.8 | 0 | 0 | 55236.9 |
| Air Emission Inventory | 5098.2 | 1349.3 | 849.7 | 29682.8 | 5947.9 | 1100.2 | 4700.9 | 249.1 | 2003.7 | 50981.8 |
| Record-Keeping | 864.5 | 479.3 | 452.5 | 3514.5 | 1317 | 466 | 1248.2 | 13.5 | 288.1 | 8643.6 |
| | | | | | | | | | | |
| Hazardous Material Management | | | | | | | | | | |
| Prepare Toxic Release Inventory | 366.2 | 0 | 0 | 0 | 0 | 549.4 | 0 | 0 | 0 | 915.6 |
| Prepare Emergency Planning and Community Right to Know Reports | 3964.3 | 0 | 0 | 0 | 183.2 | 0 | 0 | 0 | 0 | 4147.5 |
| Prepare Emergency Plan (SPCC) | 824.1 | 0 | 0 | 0 | 0 | 1922.9 | 0 | 0 | 0 | 2747 |
| Respond to spills | 2392.9 | 1444.9 | 1444.9 | 3206.2 | 3206.2 | 1761.3 | 3206.2 | 0 | 948 | 17610.6 |
| Procurement of hazardous material facility | 3503.8 | 0 | 0 | 0 | 0 | 15940.8 | 0 | 0 | 0 | 19444.6 |
| Labeling requirements | 183.2 | 0 | 0 | 0 | 0 | 549.4 | 0 | 183.2 | 0 | 915.8 |
| Perform audits | 457.8 | 457.8 | 457.8 | 457.8 | 457.8 | 915.7 | 457.8 | 457.8 | 457.8 | 4578.1 |
| | | | | | | | | | | |
| Hazardous Waste Management | | | | | | | | | | |
| Hazardous waste identification | 27654.8 | 13638.2 | 11213 | 36442.6 | 25229.6 | 13638.2 | 19433.9 | 19433.9 | 27654.8 | 194339 |
| RCRA reporting of waste activities | 4062.6 | 572.3 | 572.3 | 1865.1 | 1865.1 | 1304.8 | 1218.6 | 646.4 | 2597.5 | 14704.7 |
| Obtaining EPA hazardous waste generator number | 915.7 | 801.2 | 801.2 | 984.4 | 801.2 | 801.2 | 801.2 | 801.2 | 618.1 | 7325.4 |
| Obtaining and Maintaining TSDF permits | 14823.2 | 266.6 | 399.9 | 1144.6 | 931.8 | 9321.1 | 931.8 | 3995.3 | 719.1 | 32533.4 |
| Preparation of hazardous waste manifest | 1327.7 | 1144.6 | 1144.6 | 1144.6 | 1144.6 | 1144.6 | 1144.6 | 1190.4 | 1144.6 | 10530.3 |
| Paying hazardous waste transporation and disposal fees | 40308.6 | 34934.4 | 40308.6 | 55358.1 | 34934.4 | 34934.4 | 34934.4 | 33322.5 | 34934.4 | 343969.8 |
| Procurement of hazardous waste storage containers | 2209.7 | 698.8 | 698.8 | 973.6 | 744.6 | 927.8 | 744.6 | 320.4 | 927.8 | 8246.1 |
| Oversee (training and inspections) hazardous waste SAP's | 7542.2 | 1236.2 | 686.8 | 2734.9 | 2528.9 | 1236.2 | 1882.6 | 1791 | 3307.2 | 22946 |
| Prepare SPCC Plan | 8272.1 | 229 | 343.4 | 892.8 | 663.8 | 663.8 | 663.8 | 572.3 | 1030.1 | 13331.1 |
| Prepare Biennial 'Waste Activities' report | 3575.2 | 229 | 343.4 | 892.8 | 663.8 | 663.8 | 663.8 | 572.3 | 663.8 | 8267.9 |
| Preparation of closure and post-closure plans for TSDF | 5958.7 | 270.6 | 270.6 | 270.6 | 270.6 | 902.2 | 270.6 | 539.9 | 270.6 | 9024.4 |
| | | | | | | | | | | |
| POL Management | | | | | | | | | | |
| Prepare SPCC Plan | 11674.9 | 45.8 | 45.8 | 183.2 | 22.8 | 4578.4 | 7096.5 | 114.4 | 45.8 | 23807.6 |
| Monitoring Used Oil | 45.8 | 45.8 | 22.8 | 229 | 22.8 | 9.5 | 59.3 | 0 | 22.8 | 457.8 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Wastewater Management | | | | | | | | | | |
| Obtain and Maintain NPDES permit | 3606.1 | 311.1 | 311.1 | 311.1 | 311.1 | 311.1 | 311.1 | 2102.1 | 1504.2 | 9079 |
| Prepare SPCC Plan | 1121.7 | 320.4 | 320.4 | 1281.9 | 1281.9 | 160.2 | 160.2 | 160.2 | 435 | 5241.9 |
| Obtain and Maintain Stormwater permit | 4578.4 | 4578.4 | 2289.2 | 11446 | 0 | 2289.2 | 4578.4 | 0 | 16024.4 | 45784 |
| | | | | | | | | | | |
| Solid Waste Management | | | | | | | | | | |
| Collection of Solid Wastes (Separating and storing recyclables, payment of disposal fees) | 212721.1 | 48840.6 | 32829.7 | 65660.8 | 32829.7 | 32829.7 | 32829.7 | 16414.8 | 43504 | 518460.1 |
| Obtaining and Maintaining landfill permits (closure plans, monitoring, record-keeping, etc.) | 915.7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 915.7 |
| | | | | | | | | | | |
| OTHER | | | | | | | | | | |
| Managing AST and UST (RCRA reporting, maintaining leak detection, monitoring corrosion control systems, etc.) | 15444 | 3712.5 | 0 | 3712.5 | 0 | 7876.2 | 3712.5 | 3712.5 | 2037.4 | 40207.6 |
| Performing ECAMP (to include pre-audit and post-audit activities) | 10506.1 | 3537.5 | 2168 | 4564.9 | 4564.9 | 3537.5 | 4564.9 | 2302.6 | 19328.9 | 55075.3 |
| | | | | | | | | | total = | 1558420.3 |
| | | | | | | | | | | |
| | | | | | check: total should be = ratio *sum of labor and contracts = | | | | | 1558421.38 |
| | | | | | total yr 1 = | | | | | |

| BENEFIT - COST | | TIME =0 | YEAR =1 | | | output for benefit = | | 0.4 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | % time for ABC data = | | 0.1 | | |
| Activities | CES | SVS | SPS | EMS | CRS | SUPPLY | TRANS | MED | OPS | |
| Air Management | | | | | | | | | | |
| Obtain and Maintain Air Permits | 295.8 | 3.2 | 0 | 1866 | 1359 | 1.1 | 309.8 | 1.1 | 142.3 | |
| New Source Performance Rvw | 7.2 | 1.1 | 0 | 631.4 | 471.2 | 0.9 | 119.1 | 0.9 | 0.9 | |
| CFC and Halon Management | 14211.1 | 0 | 0 | 323.2 | 0 | 0 | 1715.7 | 0 | 0 | |
| Air Emission Inventory | 1468.8 | 389 | 244.6 | 8555.6 | 1713.4 | 317 | 1353.1 | 72 | 574.6 | |
| Record-Keeping | 155.6 | 85.8 | 80.8 | 634 | 237.4 | 82.8 | 226.1 | 2 | 55.2 | |
| | | | | | | | | | | |
| Hazardous Material Management | | | | | | | | | | |
| Prepare Toxic Release Inventory | 70.6 | 0 | 0 | 0 | 0 | 105.4 | 0 | 0 | 0 | |
| Prepare Emergency Planning and Community Right to Know Reports | 720.2 | 0 | 0 | 0 | 34.8 | 0 | 0 | 0 | 0 | |
| Prepare Emergency Plan (SPCC) | 158.6 | 0 | 0 | 0 | 0 | 369.4 | 0 | 0 | 0 | |
| Respond to spills | 643.4 | 391.2 | 391.2 | 866.6 | 866.6 | 475.4 | 866.6 | 0 | 253.2 | |
| Procurement of hazardous material facility | 916.6 | 0 | 0 | 0 | 0 | 4190.4 | 0 | 0 | 0 | |
| Labeling requirements | 34.8 | 0 | 0 | 0 | 0 | 105.4 | 0 | 34.8 | 0 | |
| Perform audits | 88 | 88 | 88 | 88 | 88 | 176 | 88 | 88 | 88 | |
| | | | | | | | | | | |
| Hazardous Waste Management | | | | | | | | | | |
| Hazardous waste identification | 7861.4 | 3888 | 3206.8 | 10386 | 7179.2 | 3888 | 5533.6 | 5533.6 | 7861.4 | |
| RCRA reporting of waste activities | 746.1 | 92.5 | 92.5 | 324.5 | 324.5 | 232.7 | 208.5 | 116 | 464.7 | |
| Obtaining EPA hazardous waste generator number | 148 | 129.5 | 129.5 | 158.3 | 129.5 | 129.5 | 129.5 | 129.5 | 99.7 | |
| Obtaining and Maintaining TSDF permits | 2833.7 | 48.2 | 72.3 | 205.9 | 168.3 | 1680.8 | 168.3 | 720.8 | 129.7 | |
| Preparation of hazardous waste manifest | 213.8 | 185 | 185 | 185 | 185 | 185 | 185 | 192.2 | 185 | |
| Paying hazardous waste transporation and disposal fees | 11856.9 | 10276 | 11856.9 | 16284.5 | 10276 | 10276 | 10276 | 9801.7 | 10276 | |
| Procurement of hazardous waste storage containers | 401.4 | 112.8 | 112.8 | 157 | 120 | 155.8 | 120 | 51.4 | 155.8 | |
| Oversee (training and inspections) hazardous waste SAP's | 1273.3 | 216.4 | 111 | 481.3 | 448.4 | 216.4 | 332.4 | 317 | 590.8 | |
| Prepare SPCC Plan | 1494.9 | 37 | 55.5 | 143.9 | 106.9 | 106.9 | 106.9 | 92.5 | 177.5 | |
| Prepare Biennial 'Waste Activities' report | 634.5 | 37 | 55.5 | 143.9 | 106.9 | 106.9 | 106.9 | 92.5 | 106.9 | |
| Preparation of closure and post-closure plans for TSDF | 1591.2 | 74 | 74 | 74 | 74 | 243 | 74 | 147.6 | 74 | |
| | | | | | | | | | | |
| POL Management | | | | | | | | | | |
| Prepare SPCC Plan | 2024 | 7.2 | 7.2 | 29.8 | 4.1 | 879 | 1145 | 18.5 | 7.2 | |
| Monitoring Used Oil | 7.2 | 7.2 | 4.1 | 37 | 4.1 | 1.1 | 9.2 | 0 | 4.1 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Wastewater Management | | | | | | | | | | |
| Obtain and Maintain NPDES permit | 841.8 | 74.2 | 74.2 | 74.2 | 74.2 | 74.2 | 74.2 | 490.6 | 351.2 | |
| Prepare SPCC Plan | 200.9 | 51.4 | 51.4 | 206.6 | 206.6 | 25.7 | 25.7 | 25.7 | 78.9 | |
| Obtain and Maintain Stormwater permit | 739 | 739 | 369 | 1846 | 0 | 369 | 739 | 0 | 2585 | |
| | | | | | | | | | | |
| Solid Waste Management | | | | | | | | | | |
| Collection of Solid Wastes (Separating and storing recyclables, payment of disposal fees) | 60642.4 | 13875.4 | 9379 | 18758.4 | 9379 | 9379 | 9379 | 4690 | 12376.4 | |
| Obtaining and Maintaining landfill permits (closure plans, monitoring, record-keeping, etc.) | 176 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | | | | | | | | | | |
| OTHER | | | | | | | | | | |
| Managing AST and UST (RCRA reporting, maintaining leak detection, monitoring corrosion control systems, etc.) | 3939.9 | 956.9 | 0 | 956.9 | 0 | 2005.9 | 956.9 | 956.9 | 509.2 | |
| Performing ECAMP (to include pre-audit and post-audit activities) | 2781.6 | 930.1 | 575 | 1201 | 1201 | 930.1 | 1201 | 605 | 5142.2 | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

| BENEFIT - COST | | TIME =1 | YEAR = 2 | | output for benefit = | | 0.4 | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | pv factor = | 0.964252 | | % time for ABC data = | | 0.1 | | | |
| Activities | CES | SVS | SPS | EMS | CRS | SUPPLY | TRANS | MED | OPS | |
| Air Management | | | | | | | | | | |
| Obtain and Maintain Air Permits | 541 | 6.2 | 0 | 3508 | 2551.2 | 2.7 | 578.3 | 2.7 | 259.2 | |
| New Source Performance Rvw | 14.4 | 2.7 | 0 | 1191 | 885.7 | 1.4 | 224.6 | 1.4 | 1.4 | |
| CFC and Halon Management | 25194.6 | 0 | 0 | 573.1 | 0 | 0 | 3041 | 0 | 0 | |
| Air Emission Inventory | 2609.4 | 691.6 | 434.7 | 15200.4 | 3044.1 | 563.5 | 2403 | 128.1 | 1019.6 | |
| Record-Keeping | 291.8 | 161.2 | 152.1 | 1187.6 | 444.9 | 156.2 | 422.7 | 4.1 | 100.5 | |
| | | | | | | | | | | |
| Hazardous Material Management | | | | | | | | | | |
| Prepare Toxic Release Inventory | 128.3 | 0 | 0 | 0 | 0 | 192 | 0 | 0 | 0 | |
| Prepare Emergency Planning and Community Right to Know Reports | 1344.7 | 0 | 0 | 0 | 63.7 | 0 | 0 | 0 | 0 | |
| Prepare Emergency Plan (SPCC) | 288.4 | 0 | 0 | 0 | 0 | 672.3 | 0 | 0 | 0 | |
| Respond to spills | 1148.9 | 699.2 | 699.2 | 1548.5 | 1548.5 | 849.3 | 1548.5 | 0 | 450.7 | |
| Procurement of hazardous material facility | 1637.3 | 0 | 0 | 0 | 0 | 7497.1 | 0 | 0 | 0 | |
| Labeling requirements | 63.7 | 0 | 0 | 0 | 0 | 192 | 0 | 63.7 | 0 | |
| Perform audits | 160.1 | 160.1 | 160.1 | 160.1 | 160.1 | 320.2 | 160.1 | 160.1 | 160.1 | |
| | | | | | | | | | | |
| Hazardous Waste Management | | | | | | | | | | |
| Hazardous waste identification | 13987.7 | 6921.3 | 5710.6 | 18486.7 | 12776 | 6921.3 | 9848.6 | 9848.6 | 13987.7 | |
| RCRA reporting of waste activities | 1386.1 | 182.6 | 182.6 | 618.4 | 618.4 | 438.3 | 400.4 | 217.8 | 873.9 | |
| Obtaining EPA hazardous waste generator number | 292.2 | 255.7 | 255.7 | 313.4 | 255.7 | 255.7 | 255.7 | 255.7 | 197 | |
| Obtaining and Maintaining TSDF permits | 5280 | 92.9 | 139.3 | 397.7 | 324.4 | 3243 | 324.4 | 1390.4 | 250.2 | |
| Preparation of hazardous waste manifest | 422.9 | 365.3 | 365.3 | 365.3 | 365.3 | 365.3 | 365.3 | 379.8 | 365.3 | |
| Paying hazardous waste transporation and disposal fees | 21031.8 | 18227.7 | 21031.8 | 28884.9 | 18227.7 | 18227.7 | 18227.7 | 17386.5 | 18227.7 | |
| Procurement of hazardous waste storage containers | 749.5 | 222.9 | 222.9 | 310.4 | 237.3 | 302 | 237.3 | 101.9 | 302 | |
| Oversee (training and inspections) hazardous waste SAP's | 2461.4 | 411.2 | 219.2 | 912.2 | 846.8 | 411.2 | 629 | 599.2 | 1111.8 | |
| Prepare SPCC Plan | 2798.1 | 73.1 | 109.6 | 284.6 | 211.5 | 211.5 | 211.5 | 182.6 | 339.7 | |
| Prepare Biennial 'Waste Activities' report | 1197.7 | 73.1 | 109.6 | 284.6 | 211.5 | 211.5 | 211.5 | 182.6 | 211.5 | |
| Preparation of closure and post-closure plans for TSDF | 2835.3 | 132.7 | 132.7 | 132.7 | 132.7 | 433.3 | 132.7 | 264.7 | 132.7 | |
| | | | | | | | | | | |
| POL Management | | | | | | | | | | |
| Prepare SPCC Plan | 3863.2 | 14.4 | 14.4 | 58.7 | 7.7 | 1600.3 | 2262.9 | 36.5 | 14.4 | |
| Monitoring Used Oil | 14.4 | 14.4 | 7.7 | 73.1 | 7.7 | 2.7 | 18.5 | 0 | 7.7 | |

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|---|---|---|---|---|---|---|---|---|---|---|
| Wastewater Management | | | | | | | | | | |
| Obtain and Maintain NPDES permit | 1517.3 | 135.7 | 135.7 | 135.7 | 135.7 | 135.7 | 135.7 | 883.8 | 633.6 | |
| Prepare SPCC Plan | 377.6 | 101.9 | 101.9 | 408.5 | 408.5 | 50.9 | 50.9 | 50.9 | 147.5 | |
| Obtain and Maintain Stormwater permit | 1460.3 | 1460.3 | 729.7 | 3649.2 | 0 | 729.7 | 1460.3 | 0 | 5109.4 | |
| | | | | | | | | | | |
| Solid Waste Management | | | | | | | | | | |
| Collection of Solid Wastes (Separating and storing recyclables, payment of disposal fees) | 107976.2 | 24693.2 | 16705 | 33410.7 | 16705 | 16705 | 16705 | 8352.9 | 22030.3 | |
| Obtaining and Maintaining landfill permits (closure plans, monitoring, record-keeping, etc.) | 320.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | | | | | | | | | | |
| OTHER | | | | | | | | | | |
| Managing AST and UST (RCRA reporting, maintaining leak detection, monitoring corrosion control systems, etc.) | 7100.1 | 1730.6 | 0 | 1730.6 | 0 | 3612.4 | 1730.6 | 1730.6 | 910.5 | |
| Performing ECAMP (to include pre-audit and post-audit activities) | 4992.1 | 1666.7 | 1032.3 | 2151.5 | 2151.5 | 1666.7 | 2151.5 | 1083.4 | 9240.2 | |
| | | | | | | | | | | |
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| | | | | | | | | | | |

| BENEFIT - COST | | | TIME =2 | YEAR =3 | | output for benefit = | | 0.4 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | pv factor = | 0.92978 | | % time for ABC data = | | 0.1 | | |
| Activities | CES | SVS | SPS | EMS | CRS | SUPPLY | TRANS | MED | OPS | |
| Air Management | | | | | | | | | | |
| Obtain and Maintain Air Permits | 1055.5 | 12.5 | 0 | 6952.7 | 5052.4 | 5.9 | 1141.7 | 5.9 | 504.5 | |
| New Source Performance Rvw | 29.5 | 5.9 | 0 | 2365 | 1755.3 | 2.6 | 445.8 | 2.6 | 2.6 | |
| CFC and Halon Management | 47911.3 | 0 | 0 | 1089.9 | 0 | 0 | 5782.5 | 0 | 0 | |
| Air Emission Inventory | 4969.8 | 1317.7 | 828 | 28950.6 | 5797.8 | 1073.6 | 4575.7 | 244.1 | 1940.8 | |
| Record-Keeping | 577.5 | 319.5 | 301.7 | 2349.1 | 880.2 | 310.2 | 835.2 | 8.5 | 195.7 | |
| | | | | | | | | | | |
| Hazardous Material Management | | | | | | | | | | |
| Prepare Toxic Release Inventory | 249.3 | 0 | 0 | 0 | 0 | 373.6 | 0 | 0 | 0 | |
| Prepare Emergency Planning and Community Right to Know Reports | 2654.9 | 0 | 0 | 0 | 124.3 | 0 | 0 | 0 | 0 | |
| Prepare Emergency Plan (SPCC) | 560.8 | 0 | 0 | 0 | 0 | 1307.8 | 0 | 0 | 0 | |
| Respond to spills | 2197 | 1337.5 | 1337.5 | 2961.8 | 2961.8 | 1624.4 | 2961.8 | 0 | 860.5 | |
| Procurement of hazardous material facility | 3133 | 0 | 0 | 0 | 0 | 14357.6 | 0 | 0 | 0 | |
| Labeling requirements | 124.3 | 0 | 0 | 0 | 0 | 373.6 | 0 | 124.3 | 0 | |
| Perform audits | 311.4 | 311.4 | 311.4 | 311.4 | 311.4 | 622.9 | 311.4 | 311.4 | 311.4 | |
| | | | | | | | | | | |
| Hazardous Waste Management | | | | | | | | | | |
| Hazardous waste identification | 26669.3 | 13199.5 | 10892.2 | 35253.3 | 24361 | 13199.5 | 18780.3 | 18780.3 | 26669.3 | |
| RCRA reporting of waste activities | 2728.8 | 371.8 | 371.8 | 1234.8 | 1234.8 | 869.5 | 803.2 | 431.5 | 1732.3 | |
| Obtaining EPA hazardous waste generator number | 594.9 | 520.5 | 520.5 | 638.7 | 520.5 | 520.5 | 520.5 | 520.5 | 401.3 | |
| Obtaining and Maintaining TSDF permits | 10401.6 | 186.4 | 279.6 | 798.9 | 651.1 | 6511.2 | 651.1 | 2791.3 | 502.3 | |
| Preparation of hazardous waste manifest | 861.7 | 743.6 | 743.6 | 743.6 | 743.6 | 743.6 | 743.6 | 773.2 | 743.6 | |
| Paying hazardous waste transporation and disposal fees | 40007.4 | 34673.3 | 40007.4 | 54945.1 | 34673.3 | 34673.3 | 34673.3 | 33073.3 | 34673.3 | |
| Procurement of hazardous waste storage containers | 1479.9 | 453.9 | 453.9 | 632.3 | 483.5 | 608.7 | 483.5 | 207.8 | 608.7 | |
| Oversee (training and inspections) hazardous waste SAP's | 4954.1 | 819.7 | 446.2 | 1816.1 | 1682.6 | 819.7 | 1251.2 | 1191.1 | 2204.8 | |
| Prepare SPCC Plan | 5532 | 148.8 | 223.1 | 579.7 | 430.9 | 430.9 | 430.9 | 371.8 | 680.2 | |
| Prepare Biennial 'Waste Activities' report | 2379.3 | 148.8 | 223.1 | 579.7 | 430.9 | 430.9 | 430.9 | 371.8 | 430.9 | |
| Preparation of closure and post-closure plans for TSDF | 5415.8 | 254.3 | 254.3 | 254.3 | 254.3 | 828 | 254.3 | 507.4 | 254.3 | |
| | | | | | | | | | | |
| POL Management | | | | | | | | | | |
| Prepare SPCC Plan | 7721.8 | 29.5 | 29.5 | 119.3 | 15.2 | 3113.5 | 4608.3 | 74.3 | 29.5 | |
| Monitoring Used Oil | 29.5 | 29.5 | 15.2 | 148.8 | 15.2 | 5.9 | 38.1 | 0 | 15.2 | |

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|---|---|---|---|---|---|---|---|---|---|---|
| Wastewater Management | | | | | | | | | | |
| Obtain and Maintain NPDES permit | 2924.1 | 263.4 | 263.4 | 263.4 | 263.4 | 263.4 | 263.4 | 1702.6 | 1221.6 | |
| Prepare SPCC Plan | 748.3 | 207.8 | 207.8 | 832.2 | 832.2 | 103.8 | 103.8 | 103.8 | 291.3 | |
| Obtain and Maintain Stormwater permit | 2973.5 | 2973.5 | 1486.2 | 7432.1 | 0 | 1486.2 | 2973.5 | 0 | 10405.5 | |
| | | | | | | | | | | |
| Solid Waste Management | | | | | | | | | | |
| Collection of Solid Wastes (Separating and storing recyclables, payment of disposal fees) | 205944.1 | 47086.3 | 31866.3 | 63734 | 31866.3 | 31866.3 | 31866.3 | 15933.6 | 42013 | |
| Obtaining and Maintaining landfill permits (closure plans, monitoring, record-keeping, etc.) | 622.9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | | | | | | | | | | |
| OTHER | | | | | | | | | | |
| Managing AST and UST (RCRA reporting, maintaining leak detection, monitoring corrosion control systems, etc.) | 13659.8 | 3335.4 | 0 | 3335.4 | 0 | 6947.2 | 3335.4 | 3335.4 | 1744.6 | |
| Performing ECAMP (to include pre-audit and post-audit activities) | 9575.9 | 3194.8 | 1980.4 | 4123.4 | 4123.4 | 3194.8 | 4123.4 | 2076 | 17735.7 | |
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## Vita

First lieutenant Tony Gutterman was born in Cottage Grove, Minnesota, on June 10, 1971. He graduated from Park Senior High School, Cottage Grove, Minnesota in 1989 and attended the United States Air Force Academy where he graduated in 1994. At the Academy, he earned a bachelor's degree in Civil Engineering with an Environmental Option.

After graduation from the Academy, he was assigned to 7 CES, Dyess AFB, in Abilene, Texas, where he worked in the Environmental Management Flight primarily in Compliance section. While in Abilene, he was sent on Temporary Duty assignments to El Salvador as part of Joint Task Force Builder and to Dhahran, Saudi Arabia as part of Operation Southern Watch, where he served as the Readiness Chief for the area of responsibility. In June of 1996, he entered the School of Engineering, Air Force Institute of Technology.

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**13. ABSTRACT** *(Maximum 200 words)*

The purpose of this thesis was to develop a tool that would allow the user the ability to determine the activities an organization should track using Activity Based Costing (ABC). This was accomplished through the assignment of costs to the maintenance of ABC data and the determination of the benefit received as a result of using ABC. While obtaining the information pertinent to the cost of ABC was relatively straightforward and well documented, the information regarding the value of the benefit of ABC was not available. Therefore, using information provided in the literature concerning savings resulting from making the polluter pay for the amount of pollution generated, a benefit ratio was established based on the idea that when an organization is given both the financial ability and responsibility to pay for its actions, savings will immediately occur.

Current tools and techniques available in the ABC literature concerning the cost and benefit of ABC focus on the development of cost drivers. Nothing is available which focuses on the activities that should be used by an ABC system. This thesis expands the body of knowledge on ABC by developing such a tool. In addition, nothing currently is available which allows an ABC practitioner to know what value of benefit must be received from ABC in order to recoup the financial investment involved in using such a system. Success stories have been written citing 10 to 100 times the investment gained as a result of using ABC. This thesis fills the gap between hoping to receive a 10 or 100 times payback and knowing what the expected payback must be in order to use ABC beneficially (in terms of dollars invested).

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