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Tracking Overhead ORTA Costs in Technology Transfer Activities

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THESIS

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TRACKING OVERHEAD ORTA COSTS

IN TECHNOLOGY TRANSFER ACTIVITIES

THESIS

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Master of Science in Cost Analysis

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Preface

This study determined the indirect cost of performing technology transfer activities through the examination of several key Offices of Research and Technology Applications (ORTAs). A comparison was made among the three categories of ORTAs used in this research effort (Laboratories, Logistics Centers, and Test Centers) to identify differences in the activities performed both by category and between separate ORTAs within a specific category.

I would like to address several key individuals who were instrumental in providing support and guidance to help me complete this thesis. First, I would like to thank my thesis advisor, Major Richard M. Franza, for his immense assistance by recommending me to perform this research, and for his insight and feedback during the entire research process. I would also like to thank my thesis reader, Dr. David Christensen, for his valuable suggestions and aid in directing my research, and especially for his knowledge in the application of activity-based costing . I would also like to thank my thesis sponsor, AFRL/TTO, in particular Mr. Steve Guilfoos, whose aid in data collection allowed me to complete this effort on time. Finally, Captain Jamie Boyd deserves much thanks for providing a solid foundation for this research with his 1996 thesis.

The love and patience of my wife, Sherri, and my son, Christopher, were indispensable to the completion of this thesis. I deeply appreciate their unceasing tolerance and support throughout not only this effort, but also my entire time at AFIT.

Thomas S. Van Egeren

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Abstract

An ever shrinking Research and Development (R&D) budget, coupled with a widespread perception in industry and government that the nation is not realizing an adequate return from its substantial investment in the federal laboratory system, has paved the way for an increase in the transfer of technology from the federal laboratories to the private sector. However, the increase in technology transfer comes at a price as each federal laboratory with 200 or more scientific, engineering, or related positions is required to have at least one full time Office of Research and Technology Applications (ORTA) position. The objective of this research is to determine the indirect cost of performing technology transfer by identifying the resources consumed by several key ORTA organizations and the activities performed within these organizations.

A previous research effort into the direct labor side of technology transfer activities identified several steps of the Transfer Master Process which had little or no resources expended. It was hypothesized that the ORTA organizations, which are considered indirect labor by most costing methods, would expend considerable portions of their resources on these activities. This hypothesis was proven true, as all but two of the identified steps consumed a significant portion of the ORTA resources. The two steps that were insignificant deal with the collection of revenues, which either take little time to complete or were performed by the financial management branch of the laboratory instead of at the ORTA.

It was also hypothesized that comparisons could be made among the various ORTAs to determine a "step-wise" level of resources expended based on the amount of technology being transferred. This hypothesis was proven false, however, as there was too much variance in resources consumed to technology transfer activity level among the ORTAs researched.

TRACKING OVERHEAD ORTA COSTS

IN TECHNOLOGY TRANSFER ACTIVITIES

I. Introduction

Overview

A significant portion of the United States' federal budget is spent on research and development (R&D) in federal laboratories. The federal government contributed 36 percent of the United States' total R&D budget in 1995 (Healy, 1996: 2828). However, the percentage contributed by the government has declined in recent years. The government's share of the U.S.'s overall R&D budget will be the lowest on record for 1997 (Holden, 1996: 1471). The 1997 federal R&D budget approved by Congress did increase slightly from 1996 (to $74 billion), but it did not keep up with inflation, a trend that started in the late 1980s. The outlook for the future is even worse. Projected R&D cuts to obtain a balanced budget by the year 2002 are approaching 20 percent (Long, 1996: 24).

As federal R&D dollars continue to dwindle, the agencies that use these funds for research must obtain the "biggest bang for their buck". One way to reap the biggest returns from the R&D dollar is through technology transfer (TT) activities. The Air Force Material Command Technology Transfer Handbook defines TT as the movement of technologies developed for or by the government to the private sector for commercialization (AFMC, 1995: B-1). The goal of TT is to promote the use of technology originally obtained for military applications in the commercial sector.

Although this goal is shared by a related term, defense conversion, TT should not be mistaken as such. Defense conversion includes the shifting of resources, including funding, from the military to the private sector.

Despite originating as early as the 1950s, TT has only recently been emphasized, particularly within the federal laboratories. A survey of 1,000 US companies found that government laboratories were among the least important sources of leads for new products, and among the least likely to be chosen as a partner for cooperative R&D efforts (Healy, 1996: 2828). The challenge then, is to make the government's investment more valuable to commercial industry, and this can be achieved through TT activities.

However, these activities come at a price. Each federal laboratory with 200 or more scientific, engineering, or related positions is required to have at least one full time Office of Research and Technology Applications (ORTA) position (AFMC, 1995: C-2). It is the function of the ORTA to determine which R&D projects may have potential commercial applications and engage in TT activities for those projects. It is within the ORTA that the majority of overhead costs related to TT activities reside. An objective of this thesis will be to track these overhead ORTA costs, so that a better realization of the costs involved in TT can be obtained. These costs can best be tracked through activity-based costing.

Activity-based costing (ABC) is an accounting system that allocates costs to a product or service (in this case TT activities) based on the resources they consume. It is particularly useful when dealing with overhead costs, which have been traditionally assigned to a product by some physical aspect, such as size, number of parts, or

production volume. It is hoped that ABC will help to determine which TT activities are the largest consumers of ORTA resources.

The Issue

Why the need for TT? The main reason is to generate the best return from research dollars, especially in light of the probable huge budget cuts anticipated in the forthcoming years. Federal spending on R&D in fiscal 1995 was the lowest in real terms (adjusted for inflation) since 1983 (Healy, 1996: 2828). The outlook is not any better. At a recent Science and Technology Policy Colloquium, it was reported that non-defense R&D funding will be reduced by 11.7 percent by the year 2002 under the Clinton administration's proposed budget plan (Agres, 1996: 10). Areas hit hardest by this proposed decrease would be Department of Energy (18 percent reduction by 2002), NASA non-defense programs (17 percent), and the Interior Department (28 percent). These proposed non-defense R&D budget cuts will be felt in the defense laboratories also. According to Carey, there is real potential for fratricide among military and non-military users of R&D dollars over the few dollars that remain. Companies might be tempted to make a grab for national laboratory dollars to offset cuts in federally funded private sector industry R&D (Carey, 1996: 51).

The defense laboratories are not slated for such drastic cuts as non-defense R&D programs, but it will not be long before the battle begins between civilian industry, non-defense, and defense R&D programs for federal funding. The federal government has come under increasing pressure to spend each technology dollar more effectively. The

push has been for less defense-oriented research, in which a large portion can be termed as basic research, and more emphasis on applied research, which results in a quicker payoff in the marketplace. There is a widespread perception in industry and government that the nation is not realizing an adequate return from the substantial investment in the federal laboratory system (Carr, 1992: 8). Therefore, it is up to the federal laboratories to get the maximum amount of return from every research dollar.

This is where TT can help. The Federal Laboratory Consortium defines TT as "the process by which existing knowledge, facilities, or capabilities developed under federal R&D are utilized to fulfill public or private domestic needs (Carr, 1992: 9)." In order to optimize the return on tax dollars spent on defense related R&D, the technologies developed by federal laboratory research can be effectively utilized by users other than those originally intended. The benefits of transferring these technologies to other users, particularly commercial companies, come in two forms. First, there are spin-offs, in which the commercial company uses the technology for its own application, which results in improvement in the overall US industrial technological base. One example of a spin-off is Marchon's new Flexon eyeglass frames which are made of nitinol, an elastic nickel-titanium combination invented by the Naval Ordnance Laboratory (Wilson, 1996: 20). The other form is spin-backs, in which the government benefits by using the commercial application developed from the technology for its own applications. A good example is provided by Lockheed-Martin, in which the company demonstrated that combining a composite fabrication process derived from the US/Japan FS-X program with proprietary manufacturing techniques can produce significant cost savings in advanced fighter

construction (Anonymous, 1996: 57). However, the federal laboratories lag far behind their civilian counterparts when it comes to TT.

Weijo reports that the federal government must consider ways to more effectively transfer new technologies between the laboratories and private industry since only five percent of the nearly 30,000 patents owned by the government are licensed for commercial use (1987: 43). University TT programs, although operating in a different environment than the federal laboratories, have much better performance. For instance, MIT granted nearly the same number of licenses in 1990 as the entire Department of Energy (DOE) laboratory system, and its royalties from those licenses were twice as high (Carr, 1992: 9). This was obtained even though the DOE laboratories' R&D budgets were over 10 times the amount of MIT's. Other major research universities such as Stanford and the University of California have similar performances. It is estimated that an order of magnitude increase in TT from the federal laboratory system is probably feasible at the current levels of R&D. Therefore, through the last decade there has been much emphasis on TT from the federal laboratory system.

The increased emphasis began in 1980 with the Bayh-Dole Act and the Stevenson-Wydler Technology Innovation Act. Both of these acts paved the way for the private sector to gain access to government technology. The Bayh-Dole Act, also known as the University and Small Business Patent Procedure Act, gives non-profit organizations, particularly universities, and small businesses the right to retain patents for technology developed with government funding. The Stevenson-Wydler Act mandates that federal laboratories pursue TT activities. Additional legislation enacted to increase

TT from the federal laboratories is the Federal Technology Transfer Act of 1986, which established the Federal Laboratory Consortium (FLC) for Technology Transfer. This law gives laboratories the authority to engage in cooperative research with outside parties and to negotiate patent licenses. Executive Order 12591 (1987), directs the head of each executive department and agency to promote cooperative R&D efforts, to the extent permitted by law, among the federal laboratories, state and local governments, universities, and the private sector. The Domestic Technology Transfer Program Regulation (1988), establishes requirements for an ORTA and defines the responsibilities of several organizations. Several other acts followed, such as the Defense Authorization Act of 1991, which further defines the responsibilities of organizations involved in the TT process. It is clear that the emphasis lately has been on the transfer of technology from the federal laboratories in order to gain the most benefits from the R&D dollar.

However, there is a cost associated with the activities performed in technology transfer. The cost of ORTA positions, mostly salaries, is paid for from the laboratory's budget. It would be wise to consider the payback potential of the dollars spent on the ORTA positions while performing TT activities. Thus, one of the primary goals of this thesis is to determine the cost to the laboratories in filling the ORTA positions. The labor associated with the ORTA positions is considered to be overhead, because the personnel filling the ORTA positions do not perform activities directly tied to the transfer of a specific technology. Their work is considered indirect, as they generally support the overall TT process. Although there has been much research conducted addressing the transfer of technologies from the government laboratories, it has focused mainly in the

area of identifying the most efficient methods to perform TT activities. There has been limited research accomplished in addressing the costs associated with performing technology transfer. The work of this thesis will be the first to attempt to determine the costs of the ORTA positions and allocating these costs to the TT activities performed by ORTA personnel. The most logical method to allocate these overhead costs to the TT activities, especially in light of recent government and private sector emphasis on its use, is activity-based costing.

Miller defines activity-based costing (ABC) as:

> a methodology that measures the cost and performance of activities, resources, and cost objects. Resources are assigned to activities, and then activities are assigned to cost objects based on their use. (1996: 12)

ABC is unique in that, unlike traditional cost accounting systems, it is a cost management system that provides a matrix to accurately quantify consumed resources triggered by activities, and activities triggered by products and processes. An organization thus has clear insight into the efficiency with which it converts resources into value (Dean, 1995: 1). Traditional cost accounting methods allocated non-direct costs by a physical aspect of the product, such as size or production volume. ABC was originally viewed as being applicable only to manufacturing processes, but since activities are common throughout all organizations, ABC processes have been applied to other fields such as service organizations.

ABC also benefits an organization by not only determining the total amount of resources consumed, but in determining when those resources are consumed and at what level. This is of particular importance when labor costs are involved. An organization

can not only determine the total number of personnel involved during each activity performed, but the required types (such as engineer) and grades (e.g. GS-13) for each activity performed can now be identified as well. For this thesis, ABC principles will be used to capture and describe the cost of performing the activities of TT.

Research Objectives

The principal objective of this thesis is to provide insight into the costs associated with the management of technology transfer within Air Force laboratories. Much research has already been accomplished on determining the most efficient practices for TT and their associated benefits, but little has been performed in identifying the costs in performing these TT activities. A secondary objective will be to determine differences that exist, if any, among different Air Force laboratories, product centers, depots, and test centers, in the assignment of personnel within the ORTA and how those personnel allocate their time to the different TT activities.

The research objectives are to:

1. Using activity-based costing, develop an instrument that captures the resources expended by ORTA personnel in performing technology transfer activities. Wright AFB's Wright Laboratories will be used as the principal data source.
2. Identify the activities being performed by the ORTA personnel in terms of resources expended. This will be accomplished as a percentage of the total resources expended. Previous research on direct costs of TT (Boyd, 1996)

found several TT activities that had consumed virtually no resources, and it is believed that these activities are the ones performed by the ORTA personnel.

3. Provide a comparison of Wright Laboratories' ORTA organization and allocation of resources, given its TT activity level, to the other Air Force laboratories (Armstrong, Rome, and Phillips Laboratories), in an attempt to determine a "right-size" expenditure of ORTA resources for a given level of TT activity. Comparisons are made to several Air Force logistics centers and test centers that have ORTA personnel assigned.

Tentative Hypothesis

The principles of ABC can be used to determine the ORTA overhead costs of performing technology transfer projects. Additionally, the activities performed by ORTA personnel can be identified and costs allocated to these activities. Finally, a comparison can be made among the various ORTA organizations.

Thesis Overview

Chapter 2 is devoted to the literature review of the topics pertaining to this thesis. In particular, it indicates that although there has been much research into TT activities, a significant portion of it has been in identifying the most efficient means of performing the TT or in determining the TT benefits. The other main topic discussed in Chapter 2 is ABC, along with the research performed that shows it can be applied to other fields besides the manufacturing sector. Chapter 3 describes the methodology used in performing the thesis. It includes sections on data collection and analysis. Chapter 4

presents the results of the analysis, and the thesis concludes with a summary of the research's managerial implications and recommended follow-on research in Chapter 5.

II. Literature Review

Introduction

A great deal of funding is directed towards federal research and development. With the recent push towards eliminating the federal deficit, the R&D budget has steadily decreased in real dollars and will likely face significant cuts in the future. Since the late 1980s, the R&D budget has failed to keep up with inflation, thus the real value of the budget has declined in recent years. Faced with even smaller budgets in the future, it is up to the federal laboratories to obtain the maximum benefit from each dollar spent on R&D. One way to obtain this is through technology transfer. However, the transfer of technology is not free, and measures of effectiveness of the TT process must be utilized in order to access the true value of the program.

This chapter provides a review of the literature addressing past research of the measurements of TT effectiveness which show that although abundant, research regarding the identification of the cost to conduct technology transfer is lacking. Next, a review of activity-based costing literature is presented. This shows how ABC and its principles have been effectively integrated with non-manufacturing concepts. The results of the literature review will be summarized and lead into the analysis of Wright Laboratory's TT process using the principles of ABC. Initially, a review of the technology transfer policy that paved the road to increased use of TT within the Air Force along with the basic technology transfer process is provided as a foundation.

Technology Transfer Policy

Before describing the technology transfer process, it is important to address the policies that led to the importance of TT. There is a widespread perception in industry and government that the nation is not realizing an adequate return from its substantial investment in the federal laboratory system. New technology is widely considered a critical element in improving productivity, and such improvements are, in the long run, the only way to improve a nation's competitiveness and standard of living (Carr, 1992: 8). Although TT has been around since the 1950s, the federal laboratories have only become increasingly active since the 1980s, when legislation dealing with TT activities started to occur with due frequency.

Papadakis reports that the policies of the first decade were designed to induce TT and overcome legal constraints on the laboratories (1995: 54-55). After 15 years, expectations that the laboratories should contribute to national economic competitiveness have not waned, but there has been a subtle shift in policy tone. With increasing fiscal constraints, the policies of the second decade are designed to aggressively extract the desired policy changes. Pressures for realignment and reconfiguration of the laboratory system are high.

An Army report on TT activities states that recent global shifts are changing the way that the Army R&D community does business. In addition to continuing to support the soldier in the field, the U.S. must now also use American defense technology in new ways to strengthen and expand the national economy. The Clinton administration has identified TT as a key to stimulating and sustaining long-term economic growth. The

Army Research Laboratory (ARL) TT program is really a partnership between ARL scientists and engineers and the private sector and academic counterparts based on technical curiosity, mutual economic benefit, and trust. The idea behind TT is to incorporate, reuse, and build on existing technologies (TT Activities, 1995: Webpage, unnumbered).

Finally, Shahidi and Xue reported that US science and technology (S&T) policy in the past four decades was largely designed to support one national security goal: achievement of military superiority through technology superiority. The collapse of the Berlin Wall in 1989 and the subsequent end of the Cold War have made such policy obsolete. What appears to have emerged from intense policy debate in recent years is a consensus to leverage four decades of US defense-oriented S&T know-how to strengthen the competitive positions of the US commercial industries and recapture global economic competitive superiority (1994: 149).

The Technology Transfer Process

The technology transfer (TT) process is extremely complex and not well defined. The many authors of TT research do not even use the same definition in their works. Carr uses the definition as stated by the Federal Laboratory Consortium: "the process by which existing knowledge, facilities, or capabilities developed under federal R&D are utilized to fulfill public or private domestic needs" (1992: 9). Schoenecker, Myers, and Schmidt define TT as the movement of technical ideas and know-how from a conceiving organization to a user organization at any stage of R&D (1989: 28). Others define TT as

the managed process of conveying a technology from one party to its adoption by another (Spann, Adams, and Souder, 1995: 19-20); or as simply putting something which is known into use, or for a new use or application (Creighton, Jolly, and Buckles, 1985: 65). Finally, there are those who refer to TT as a "contact sport." Foley states that people, not paper, transfer technology, and that TT is a grassroots effort; it requires active participation from those who are "in the trenches" (1996: 30). Also using the jargon of a contact sport is Schoenecker, et. al., who state that the transfer mechanism is one of agents, not agencies, and that it depends on the movement of people and not solely on the routing of information through communication systems (1989: 28). Geisler suggests that the exact definition of TT is not a critical matter, and that each definition offers a different wrinkle of a phenomenon generally called TT. The plurality of definitions is a strength of the field (1993: 90).

This research uses the activities of the Office of Research and Technology Applications (ORTA) located at Wright Laboratories, which is managed by the Air Force Material Command (AFMC), as the basis upon which other ORTAs will be compared. Therefore, the definition and steps of the TT process presented in the AFMC Technology Transfer Handbook is used as the basis used in this research. The handbook provides a simplistic definition of TT: the Air Force develops a technology, which is transferred to an outside partner; the outside partner then commercializes the technology (AFMC: D-1). Industry, academia, and state and local government agencies can greatly benefit from this sharing of technical knowledge and expertise. The AFMC handbook refers to that sharing of Air Force technology with the private sector as technology transfer. The TT

process provides the private sector with access to skilled and knowledgeable people, new processes and techniques, and equipment and facilities often not available elsewhere. AFMC can transfer technology in several ways: transfer intellectual property, as well as provide access to scientific, engineering and technical support through Cooperative Research and Development Agreements (CRDAs). TT also consists of providing products produced through specialized manufacturing, repair, and test capabilities, and services to include technical assistance with those capabilities (AFMC: vii).

The AFMC handbook relates the terms technology transfer with defense conversion (activities associated with alleviating the economic impact of downsizing of the DoD and its adverse effects on the private sector). Though they are not completely interchangeable, they do overlap, since they both share a common goal to promote the use of technology with military applications for commercial use. TT contains the movement of technologies developed for or by the government to the private sector for commercialization, while defense conversion includes the shifting of resources, including funding, from military only to dual use or commercial applications and assistance.

There are six major steps of the Master Process in TT: Strategy, Identify Technology, Market Technology, Identify Vehicle, Transfer Technology, and Post-transfer Administration (AFMC, 1995: D-2). Each is defined below:

Strategy: Purpose is to integrate TT into the organization's technology investment strategy. There are nine sub-steps that take the local technology strategies and the administration (overhead) requirements and coordinate them into a single strategy.

Identify Technology: Ascertain which technologies are available for transfer and which technologies have a greater potential for successful transfer. Technologies include products, processes, people, and unique facilities.

Marketing: Promote those technologies with high commercial potential.

Identify Vehicle: Match the best transfer agreement with the needs of the outside partner and the Air Force. Once the focal point of the laboratory or center understands the needs of the outside partner and the complexities of the technology to be transferred, they are in a better position to help determine the most appropriate transfer vehicle, such as a CRDA or license.

Transfer Technology: Execute the transfer of technology. Laboratory or center and partner comply with all the applicable public laws. Process formalizes the transfer in writing.

Post-transfer administration: Account for all the transfer activities within the organization, advertise the successful transfer, and reward and recognize the Air Force participants. Track success against the goals set in the organizational investment strategy and business plan.

Technology Transfer Related Research

Geisler identifies four main types of research into TT. Each type and a brief description follows (1993: 89-90):

1) Process of TT: The bulk of the literature considers TT as a process. One stream investigates the process itself, while a parallel stream explores ways to improve the process.

2) Process and Outcomes: This approach considers TT in terms of the process and its outcomes. This literature identifies some of the benefits of TT, but its studies are hindered by problems of measurement, disciplinary constraints, and the complexity of the phenomenon.

3) Component in a Larger System: Entails researching the phenomenon as a part of the innovative process, engineering management, and R&D/technology management. This type of research identifies what role TT has in the R&D conducted at the laboratories.

4) Case in a Discipline: Viewed as a process and as mechanisms or techniques to transfer, diffuse, or transform technology. The literature explains how the information is exchanged and transferred.

Research of the TT Process. As stated previously, the bulk of TT research falls into the first category identified by Geisler, and either describes the process or recommends ways to improve it. Most works of this nature identify problems with the current methods of TT within the federal laboratories. Weijo's research was one such attempt at describing the process, in which he recognized that the federal government must consider ways to more effectively transfer new technologies between federal R&D laboratories and private industry. Only five percent of the nearly 30,000 patents owned by the federal government are licensed for commercial use in the private sector (1987:

43). He believes that marketing theory can contribute to improving the transfer of technology to the private sector. He identifies the process itself by describing the two most popular approaches used in TT strategies: demand-pull and technology push (1987: 44). Demand-pull is considered a passive method (very diffuse audience), in which an identified need in the marketplace drives the need for technological innovation. The goal of the federal agency is to make information accessible to private sector firms who are searching for solutions to a customer problem. The more active method is the technology-push strategy, in which a technological innovation is flowed out to functional areas, in which they incorporate it into an identification of a need for the technology. This technology-push is further broken into role-directed (middle ground), in which the technology is directed to individuals employed in important roles in corporate new product development activities, and organization-directed (focused audience), in which the technology is directed to innovator and early adopter organizations in specific industries. Weijo's main thrust at improving the process is to narrow the target audience as much as possible to most effectively use the resources available to a government agency.

Carr's work is also primarily devoted to describing the TT process. He states that most responding companies (to a recent survey) thought that promising payoffs from interactions with federal laboratories would not come from licensing, but from visits to laboratories, information dissemination, technical consultation, workshops, seminars, and cooperative research, in that order (1992: 10). However, most TT programs tend to focus on technology licensing and cooperative R&D, which are the two most measurable

forms of TT. The current focus in federal TT is on industry-led or market-pull transfer. There are often fewer problems with conflict of interest and fairness of opportunity, since most programs are usually initiated by the private sector, not the laboratory or its employees. However, most new technologies, particularly breakthroughs, have emerged through technology-push transfer strategies. Successful handling of transfers based on technology-push requires a significant marketing effort. Therefore, Carr concluded that the explanation for the major portion of the gap (between university and federal laboratory TT success) almost certainly lies in the TT process (1992: 21).

Spann, Adams, and Souder also provide research using the technology-push or technology-pull strategies. They note that the success of government-to-private sector transfers has generally been less than satisfactory. The perception is growing that the nation is not getting an adequate return from its federal R&D budget, and there is a growing demand for more measurable results of TT (1995: 19). Their study focuses on defining and describing the measures used in the process of transferring government-funded technologies to private sector firms. They indicate that technology-push strategies emphasized by federal laboratories result from technical capabilities and are means-motivated, whereas technology-pull strategies often result from demand and are needs-motivated. Technology-push strategies focus on making technologies available for transfer to justify expenditures of federal dollars on R&D while competing with other programs for resources. They conclude that managers of TT programs need to define clearly the goals and related measures of performance for each specific transfer project at a project's inception (1995: 27).

Creighton, Jolly, and Buckles' research effort identifies another approach. Instead of describing various procedural models, they identify nine elements present in the descriptions of successful transfers, because each transfer is procedurally different from all others. The elements are broken into four formal elements (organization, project, documentation, and distribution of information) and five informal elements (linking, capacity, credibility, willingness, and reward) (1985: 68). They point out that a considerable volume of work has been done on the importance of liaison (linking - an informal element) in the TT process, but stress that responsibility for transfer is seldom tied to the liaison function, but rather to the managerial and production functions, which fall under the formal elements.

Research of the Process and Outcomes. This area of research mainly stresses the benefits gained from performing TT activities, but does not address the costs associated with attaining those benefits. This is best summed up by Scott, whose work identifies the vast knowledge bank contained within the federal laboratory system. An estimated 70 percent of active U.S. scientists and engineers holding masters and Ph. D. degrees are in defense-related positions (1993: 64). A sweeping closure of federal laboratories could easily debilitate the nation's "brain trust." These facilities house unique equipment, resources, and skills that either are irreplaceable or would take millions of dollars to reconstitute in the event of a future national emergency. Therefore, large U.S. federal laboratories, faced with sharp cutbacks, consolidation, and possible closure as a result of defense drawdowns, have embraced TT as a high-priority mission. However, taking advantage of a government "tax rebate" in the form of TT is not a simple or inexpensive

process. Also, private sector executives have a long list of complaints about trying to work with government agencies and their laboratories. These include: setting up CRDAs and other partnership tools with a national laboratory are cumbersome and can take years to consummate; there is too much emphasis on technology-push and not enough on market-pull; and not enough information about laboratory resources and capabilities gets out to industry (Scott, 1993: 65).

Limited benefits of federal laboratory TT are identified by Roessner, whose recently conducted survey of chief technical officers (CTOs) and laboratory or R&D division directors of companies that belong to the Industrial Research Institute found that federal laboratories and government data bases are considered only somewhat significant as sources to their companies (1993: 38). This is an improvement over a similar survey conducted in 1988, which indicated the same leaders paid little attention to work at the federal laboratories. The dominant positive incentive a CTO or division director has for interacting with a federal laboratory was access to unique technical resources. Strong disincentives include administrative requirements, assignment of intellectual property rights, protection of proprietary information, and potential conflicts of interest. The most significant conclusion is that companies tend to interact with federal laboratories for reasons that have far more to do with long-term, less tangible pay-offs than with expectations of short-term business opportunities or technology commercialization (Roessner, 1993: 41).

A GAO report is another good example in which identifying the costs associated with obtaining TT benefits has not been adequately addressed. The report specifically

states that they did not attempt to assess the costs of these collaborations (1994: 1). The report mentioned that TT between federal laboratories and industry is increasingly viewed as a significant factor in the economic growth and well-being of the United States. Therefore, they performed an observation of 10 CRDAs, and found that the CRDAs have provided opportunities for laboratories and companies to share expertise and resources, advance R&D programs, and transfer technology resulting in commercial products.

An interesting work on benefits was conducted by Jung, who presented some general ideas and concepts of how benefits of TT can be evaluated. In particular, where benefits are too complex to be measured in dollars, as is especially the case for externalities, he describes two methods (Input Criterion and Substitution Concept) which provide information about tendencies of TT benefits, but no absolute values (1980: 46-49).

Research in the Component of a Larger System. This area of research identifies the role that TT has in the R&D conducted at the laboratory. It also addresses the problems that the federal laboratories have in transferring technology to industry, especially considering the missions of the laboratories. Papadakis' analysis suggests that the vast majority of the system (about 80 percent of the laboratories) has no meaningful role in American competitiveness, while the remaining laboratories are characterized by powerfully entrenched agency missions with circumscribed economic roles (1995: 55). Profiling the national laboratory system is difficult, given the institutional variety of government-sponsored R&D. She goes on to state that with perhaps the singularly

exception of the USDA, the primary R&D missions of the federal laboratory system do not include enhancing the performance of the economy generally or any one sector specifically (1995: 57). Since the government itself is the actual user of most federal laboratory R&D, an important characteristic of the national laboratory system is the scope of the government mission that it serves. It would not be unwarranted to assume that the commercial potential of defense-related R&D is limited, since it is frequently alleged that the DoD is a net technology consumer, and the amount of DoD spinoffs does not really compensate for the total defense R&D investment.

Papadakis observes that the laboratory system is simply not charged with producing industrially relevant, useful science and technology. A 1989 GAO study notes that of the 330 federal R&D institutions that had budgets greater that 100,000 dollars, only 54 may be considered as commercially active using even the most relaxed criteria. Further analysis of the data in 1995 found that barely 50 laboratories met any one of the low thresholds for commercial activity. It was found that the DoD had 18 of 54, or one-third of the laboratories, which were commercially active (Papadakis, 1995: 60).

Spann, Adams, and Souder, in an earlier work, investigate the degree to which barriers to TT and measures of TT differed among the roles played by the various parties, at each stage of the transfer process. They noticed that the low rate of transfer (from federal laboratories to private sector) may be the result of inability to reach consensus on how to define, track, or measure transfer progress and success (Spann, et. al., 1993: 63). It was found that the role of the sponsor (who funds technology development, disseminate information about government technologies, and/or facilitate their transfer)

averaged 23 hours per week on TT activities. The role of the sponsor fits well with the ORTA personnel assigned to each laboratory, and it would be interesting to compare the average ORTA time spent on TT activities with the results of this research. The results of the study indicate that the major barrier to TT is an educational one that can be solved by improved communication initiatives, i.e., identifying the correct method to transfer the technology. Spann, et. al. stated that while sponsors agreed with adopters that long-term outcome measures were important, sponsors also relied on input measures of effort and intermediate outcome measures (1993: 73), thus further enforcing the need to identify the costs associated with providing TT.

Another way that TT affects the role of R&D in federal laboratories is identified by Bozeman. He identifies four models of TT effectiveness, the fourth of which is the opportunity-cost model. This model focuses on the alternative uses of TT resources, not only funds, but human resources and time as well. By devoting more attention to TT, it is likely that less will be devoted to other core missions of the laboratory (Bozeman, 1991: 142).

Research into Case in a Discipline. This final type of research identifies the methods used in transferring the technology from the federal laboratories to the private sector. Carr recognized that laboratory CRDAs may be the vehicle by which the industry comes to fully realize the value of the federal laboratory system. But, he states that a number of industrial partners who work primarily with DOE laboratories complain that current delays for approving CRDAs and funds for laboratory R&D efforts are too long for the CRDA process to be of value (Carr, 1992: 13). Carr identifies three TT models or

methods used to transfer technology: legal, administrative, and marketing. Legal model TT programs are generally run by the organization's legal staff and focus exclusively on patenting inventions. Administrative model TT programs are created as part of an administrative or support organization. The federal laboratories began to move towards the administrative models following the TT legislation of the 1980s. Marketing efforts used by administrative model offices tend to be limited to advertising in publications. In the marketing model, the TT office must accumulate and have on hand a large inventory of technologies to market to industry. The offices actively market technologies available with the objective of finding an appropriate licensee and concluding a license agreement expeditiously.

The amount of research in the area of TT is indeed quite extensive, but very little research has been performed in identifying the cost of performing TT. In particular, research in identifying the indirect costs associated with TT activities has not been performed, and the main objective of this research is to identify such costs. Since indirect costs are to be identified, the most logical method to do so is activity-based costing (ABC). A brief definition of ABC along with a review of past ABC literature follows.

Activity-Based Costing

As with TT, the definition of activity-based costing (ABC) varies by author. One of the reasons attributing to the vague definition is the increased role of ABC. Originally designed for use by manufacturing companies, ABC has been found to be well adapted for use by the service industries. Only recently has the DoD instituted use of ABC. Alex

Dean, of the U.S. Navy Acquisition reform Office, defines ABC as an accounting system that assigns costs to products based on the resources they consume. Overhead costs are also traced to a particular product rather than spread arbitrarily across all product lines (1995: 1). Noreen defines an ABC system as one that assign costs to products on the basis of multiple cost drivers, which may or may not be proportional to the volume of output. This is in contrast to most traditional cost systems which use only one allocation base (usually direct labor or machine hours) that is proportional to volume (1991: 159). He also stated in his work that the term ABC is itself subject to varying interpretation and its definition appears to be evolving over time.

Why ABC?. ABC was developed to replace traditional costing methods in which overhead costs were allocated to products by a physical dimension such as batch size or product size. This leads to products which are produced in large batches or are of larger sizes being allocated a disproportionate amount of overhead costs. For purposes of costing products, ABC systems assign overhead to products using multiple allocation bases, some of which are related to unit volume and some are not. An ABC system is a two stage allocation process that fully allocates costs to products, customers, or some other ultimate cost object. Costs are allocated into cost pools which are in turn allocated to products based upon cost drivers or activity measures unique to each pool. ABC accommodates costs that are fixed with respect to changes in batch size, such as machinery set-up cost.

Salafatinos reported that traditional cost accounting leads to the build-up of unreal inventory profits, the use of economic order quantities that are not economical, and the

encouragement of local efficiency at the expense of overall performance (1995: 59). This result occurs because traditional cost accounting leads factory managers to focus their attention on the maximization of individual resources instead of the performance of the systems as a whole. ABC was developed in response to the inadequacies of traditional costing methods.

Estrin, Kantor, and Albers identify ten mediating factors to determining if ABC is suitable for a company. The first five address the potential advantages of ABC versus traditional costing methods, and the second five deal with management's need and ability to react to product costing distortions. These 10 factors are (1994: 40-44):

1) Product diversity: the quantity or range of distinct products or the variety of product families offered.
2) Support diversity: the range or variation of support overhead given to products.
3) Common process: the degree of commonality of processes among the different product offerings.
4) Period cost allocation: the existing costing system's conceptual ability to allocate period costs properly.
5) Rate of growth of period costs: the growth in period costs as an indicator of the dynamism required by the costing system.
6) Pricing freedom: the company's degree of power and freedom to set prices.
7) Period expense ratio: addresses the possible materiality of product cost distortions directly.
8) Strategic considerations: refer to the constraints imposed upon management's decisions by its explicit or implicit strategies.
9) Cost reduction: the relationship between internal cost-related decisions and the indirect component of the total cost of products.
10) Analysis frequency: refers to the frequency of product cost analysis.

A grid analysis is then used to determine if ABC is warranted.

Increased Role for ABC. The use of ABC has gone beyond its traditional manufacturing role. Dean stated that an ABC system gives visibility to how effectively

resources are being used and how activities contribute to the cost of a product. Besides determining a competitive price for a product, the information obtained from an ABC system is now used for developing budgets, future cost estimating, and measuring performance (1995: 1). In DoD, the Joint Advanced Strike Technology (JAST) program is planning on using ABC to ensure the most cost effective decisions are being made during development and production phases of the program. The Engineering Manufacturing and Development Request for Proposal will include incentives for the bidding contractors to establish ABC for the JAST program (Dean, 1995: 3).

Other uses of ABC have been identified by Hubbell. He states that recent years have seen an extraordinary increase in the use of ABC and Activity-Based Management (ABM) systems to track activity costs, improve the accuracy of product costing, and report on critical financial and non-financial performance measures (1996: 18). For internal management systems to serve the best interests of both shareholders and managers, they must identify, collect, and routinely report the information that is critical to making decisions about resource allocations. Hubbell noted that traditional ABC/ABM systems fail to identify critical capital drivers as a means of managing capital. He suggests integrating ABC with measures of shareholder value such as economic value added.

In a modified version of ABC, Noreen found that ABC can also be used to determine relevant costs for product drop decisions and product design decisions (1991: 159). This differs from traditional ABC in that not all costs are allocated, only relevant costs, which are those that can be avoided if the decision is not adopted. Being able to

identify relevant only costs is also of value for life cycle costing, in which the costs of alternatives are compared using their relevant costs.

How to Use ABC. This research effort will not try to fully explain the methodology of ABC, there are numerous texts available for that. But there are certain steps which can be identified to help the reader understand the process of ABC. Lawson identifies five steps in the design of an ABC system (1994: 33):

1) Aggregate actions into activities
2) Report the costs of activities
3) Identify activity centers
4) Select the first-stage cost drivers
5) Select second-stage cost drivers

In the first step, all the actions required to produce a product or service are categorized by activities. ABC models are based on the assumption that the activities performed consume costs. Thus, costs are attributed based on the consumption of activities, which defines the second step. The third step identifies which departmental costs are allocated to each activity or cost center. In the fourth step, the departmental costs are allocated to cost pools using an allocation basis. In the final step, the costs in these pools are allocated to products or customers through the use of the second-stage cost drivers.

ABC Combined with other Management Tools. ABC has also been found to be useful when applied in concert with other management tools. One such tool is theory of constraints, which was developed to identify potential bottlenecks (a resource that is being pressed beyond its capacity) in such things as a production or service line. Salafatinos used activity mapping to expand the definition of the cost object can to

include the business process itself (1995: 58). Activity mapping is essentially a flowchart of activities that displays the vertical relationships between activities in a department, horizontal connections between departments, and cycle times necessary to perform each activity. Activity mapping for ABC has normally been applied to overhead activities such as quality control, setup, material handling, and purchasing. The mapping of these activities as well as the production activities can provide the three-dimensional view of a company necessary to find bottlenecks. The theory of constraints has brought a new dimension to production philosophy and has stimulated an interesting challenge to the traditional ways of looking at a company's profitability. A company is not a mere aggregation of separate investments that can be managed independently, but rather a complex system of resources that require coordination. The theory of constraints thus focuses on the flow of production through the system to increase throughput, which is accomplished by eliminating bottlenecks to reduce inventory and cut inventory expenses (Salafatinos, 1995: 67). ABC can complement the theory of constraints because it brings new insight into how resources are consumed. Increased throughput can be achieved more efficiently by focusing on the coordination of activities rather than on the physical resources. The linking of production and non-production activities through activity mapping can contribute to finding bottlenecks and isolating their causes.

ABC for Service Activities. ABC was originally developed for use in the manufacturing sector. However, recent efforts have been made to adapt its use in the service sector. The DoD is no exception. According to Baseman, the Assistant Secretary of the Air Force for Financial Management (SAF/FM) recognizes the potential of ABC in

several areas, especially in the recent Outsourcing and Privatization (O&P) initiatives. ABC can be used to complete nearly 95 percent of the Performance Work Statement requirements of the A-76 studies which result from the O&P initiatives (Baseman, 1997: 27). ABC can also be used by base-level commanders to improve operations. ABC will provide the commanders with the cost and performance of processes, products, and services within their organization needed to make important decisions. ABC has been deemed so important in the Air Force that SAF/FM sponsors classes on it throughout the year and has a home page devoted to only ABC issues on the worldwide web.

Walters looked into the increased use of ABC in the local and state governments, and where they should go from here. He feels that ABC can be used to determine costs of providing services to the general public, such as filling potholes. In this way, a local government can determine if they are operating efficiently or if the private sector can actually perform the task at a lesser cost (1996: 45). However, he points out the two main reasons why the public-sector accounting community has not begun to use ABC. First, and this is the reason stated by most accountants, public or private, is ABC's perceived difficulty. The other reason is that the public-sector accounting community has refused to embrace ABC as an official part of its practice (Walters, 1996: 46). They feel that ABC is more of a form of budgetary reporting and therefore, although the public-sector accounting community is happy to advocate ABC, they do not feel the need to push for its use. Walters suggests that local and state governments use ABC in bite size pieces, as it is with the manufacturing community. They should start with any services that are being considered for outsourcing, and work from there.

A final look into service activity oriented ABC is provided by Rao. Although he didn't specifically address it as such, his research included distribution organizations and a food company, all of which provide a service to the civilian market. One use of ABC in the distribution market discovered potential savings of $2 million for a company that distributes nearly $7 billion in products to five depots (Rao, 1995: 63). Although $2 million is a very small proportion of the total sales, it is a lot when compared to the profit line. This example can be related directly to the logistics organizations of the U.S. Air Force, in which the five depots of the Air Force Material Command handle billions of dollars of equipment. Although the Air Force is not in it for profit, there is surely room for cost savings.

Processes Similar to ABC. There are various management processes and tools which are very similar to ABC. One such method, described by Greenwood and Reeve, is Process Cost Management (PCM), which they define as explicitly determining the cost of the processes by which goods and services are designed, procured, delivered, and supported (1994: 4). PCM can be used to determine the cost of existing processes for the purposes of benchmarking, activity cost analysis, or product costing. It is much more closely aligned with process simulation than it is to historical activity tracking. ABC leads to more accurate product costs and a much better understanding of the long-term relationships between activity drivers and resource levels. However, there is no tool for linking changes in products or processes to potential changes in resource levels. This is where PCM comes in. It focuses on the process hierarchy for both product costing and resource spending simulations. The flow of information for resource spending simulation

is reverse direction (cost objects to activities to resource levels). PCM requires more specification than a typical ABM implementation. Activity-based cost management has moved away from concerns about product costing to broader issues dealing with improving competitiveness. PCM can help companies improve competitiveness by providing a method for evaluating the impact of product and process cost drivers on resource spending (Greenwood and Reeve, 1994: 18).

Miller looks into the need for a Cost Management System (CMS). Relevant information to plan, direct, and manage an organization's activities and operations is essential. The development of a new CMS is the most efficient and activist response to this business need for information (1992: 41). The new paradigm for cost management is focused on managing processes and activities. Cost and performance measurements for quality, cycle time, customer satisfaction, and productivity are established at the business process and activity levels. The purpose of a CMS is to provide management with relevant information needed to judge how well cost management efforts are working. A CMS assesses at least four elements when measuring the total performance of activities: productivity, quality, cycle time, and customer satisfaction (Miller, 1992: 43).

Research of TT Activities Costs

As mentioned previously, little work has been accomplished in the field of the costs associated with performing TT activities. One exception is a study performed by Captain Jamie Boyd, USAF, at the Air Force Institute of Technology, Wright-Patterson

AFB, Ohio. His work analyzes the activities performed by the scientists and engineers (S&E) working on TT projects at Wright Laboratories. The S&E portion of the laboratories would be categorized as direct labor by most costing methods. His analysis found that 92 percent of the S&E resources were being consumed by just one major TT step (Transfer) and over 79 percent specifically by the transfer sub-step (Boyd, 1996: 5-7).

However, his analysis did not consider any indirect costs associated with TT. The largest portion of indirect, or overhead, costs is performed by the ORTA. In order to look at the complete picture of the cost of performing TT activities, one must look into both direct and indirect costs. Therefore, the main effort of this thesis will be directed towards identifying the activities performed by the ORTA personnel, and the costs associated with performing them. A sub-effort of this research will be to analyze multiple laboratories, product centers, and test centers that have ORTAs, to compare differences among ORTA staffing. By comparing staffing levels to the amount of TT being performed it is hoped that "step-wise" ORTA organization can be determined, which would indicate an appropriate staffing level based on TT activity level. The final sub-effort will be to determine whether TT steps not being performed by S&E personnel are being performed by ORTA personnel. If not, then who is, or is the step even required.

III. Methodology

Introduction

This chapter presents the methodology used in conducting this research. It begins with a discussion on the selection of the overall research design. Next, the data collection plan is presented and then followed by the process to be utilized in the development of the data collection instrument. It concludes with the method of data analysis employed.

Research Design

As stated in Chapter I, the primary objective of this research is to develop an instrument that captures the resources expended by ORTA personnel in performing technology transfer activities. Other objectives that support the primary objective are to identify the activities being performed by ORTA personnel and the costs associated with these activities. Previous research (Boyd, 1996) found several activities that had virtually no resources consumed by the scientists and engineers (who would be considered as direct labor by most costing methods) working on TT projects at Wright Laboratories, and it is believed that these activities will be the ones performed by the ORTA personnel. Another objective is to provide a comparison of Wright Laboratories' ORTA organization and allocation of resources, given its TT activity level, to other Air Force laboratories in an attempt to determine an appropriate "step-wise" ORTA organization size for a given level of TT activity. Comparisons are also made to several Air Force logistics centers and test centers that have ORTA personnel assigned. The main item of

interest in all the objectives is to determine the amount of resources consumed by ORTA personnel in performing TT activities.

According to Cooper and Emory, a number of different design approaches exist in performing a research study, but no simple classification system defines all the variations that must be considered. They list eight perspectives which can be used to classify the research design that is appropriate for the research at hand:

1) The degree to which the research problem has been crystallized (an exploratory or formal study).
2) The method of data collection (using observation or survey).
3) The power of the researcher to produce effects in the variables under study.
4) The purpose of the study (descriptive or causal).
5) The time dimension (cross-sectional or longitudinal).
6) The topical scope - or breadth and depth - of the study (a case or statistical study).
7) The research environment (field setting, laboratory, or simulation).
8) The subjects' perceptions of the research (do they perceive deviations from their everyday routines).

(Cooper and Emory, 1995: 114-115)

Each of these perspectives will be discussed individually in determining the overall research design, using the definitions of each perspective's classification as used by Cooper and Emory.

In the first perspective, degree of problem crystallization, one can view a study as either exploratory or formal. An exploratory study is less structured than a formal study, since its primary purpose is to develop hypothesis or questions for further research, where a formal study would then continue the research. Since this research is a first attempt to determine the resources consumed of an ORTA organization in performing TT activities, it can be classified as an exploratory study.

There are two general methods of collecting data, observation and survey. In observation, the researcher monitors the activities of his subject, and it is therefore a concurrent data collection method. In the survey method, the researcher questions subjects and collects their responses. It can be used for collecting past, present, or future (expectant) data. Since an ongoing technology transfer exchange can take over a year to complete, the observational method would be illogical to attempt.

In the third perspective, one considers the researcher's ability to manipulate the variables. There are two methods used by Cooper and Emory to differentiate, the experimental and ex post facto designs. In an experimental design, the researcher attempts to control or manipulate the variables, such as the temperature of a chemical reaction, where as in an ex post facto design, the researcher has no control. In this research, there is no control over variables such as the number of technology transfers being conducted or the activities being performed by ORTA personnel. Therefore, an ex post facto design is appropriate.

The next perspective, purpose of the study, has characteristics of both types of studies, descriptive and causal. Since the primary objective is to determine the cost of the performing TT activities by ORTA personnel, it is descriptive. However, a secondary objective is to determine differences between various sizes of ORTA organizations (and perhaps why they are different), which has the characteristics of a causal study.

In classifying the time dimension, a cross-sectional study is performed once and represents a "snapshot" of one point in time. A longitudinal study is repeated and has the advantage of tracking changes over time. Since this study is concerned with a one time

collection of resources consumed by ORTA personnel in performing TT activities, a cross-sectional study is appropriate.

The topical scope of a research effort can be classified by either a statistical or case study. A statistical study tries to describe a population's characteristics by making inferences from a sample. A case study places more emphasis on fully analyzing fewer events or conditions and their interrelations. Since the objectives of this research are exploratory and no attempt to infer about other ORTAs will be made from the information obtained from the ORTAs researched, this research falls more in line with a case study.

The research environment can be easily classified as field conditions, since the information obtained will simply represent the resources used while ORTA personnel performed their TT activities on the job.

The final perspective, subject's perceptions, doesn't actually classify the research design, but places the burden on the researcher not to influence the responses of the subjects in order to obtain a specific result. Therefore, some effort is required in the design of the data gathering method since the subjects will be aware that the research is being conducted.

Based on the eight perspectives required to classify a research design, this research effort is an exploratory, cross-sectional case study which will use ex post facto questionnaires of ORTA personnel in the field. The research attempts to describe the amount of resources consumed by ORTA personnel in performing TT activities, while

also allowing the researcher to determine why any differences may be present between the sizes of different ORTA organizations.

Methodology

As stated in Chapter I and further defined in Chapter II, Activity-Based Costing (ABC) is the primary method used to allocate the resources used by ORTA personnel to the TT activities they perform. There are certain steps which can be identified to help the reader understand the process of ABC. Since this is the first attempt to use ABC principles to cost out ORTA resources, a new ABC system is developed. As mentioned in Chapter II, Lawson identifies five steps in the design of an ABC system (1994: 33). These five steps are repeated here for reference:

1) Aggregate actions into activities
2) Report the costs of activities
3) Identify activity centers
4) Select the first-stage cost drivers
5) Select second-stage cost drivers.

In the first step, all the actions required to produce a product or service are categorized by activities. In this research effort, the product or service is the transfer of technology. The Air Force Material Command's Technology Transfer Handbook (TTHB) lists and describes the six major steps and their forty sub-steps of the Transfer Master Process (TMP) performed by various personnel in providing TT services. These six steps and their sub-steps, which have been included in Appendix A, are used to identify the ABC activities.

ABC models are based on the assumption that the activities performed consume costs. Thus, costs are attributed based on the consumption of activities, which defines the second step. It is in the performance of this step that the data collection will take place. A questionnaire was developed and sent to each ORTA personnel in order to identify these costs and to determine the actual activities being performed by ORTA personnel. A copy of this questionnaire can be found in Appendix B.

The remaining three steps define the principles of performing ABC. The third step identifies which departmental costs are allocated to each activity or cost center. For this research effort, the departmental costs are represented by the non-manpower expenses consumed by each ORTA organization in performing its technology transfer. A separate questionnaire was developed and sent to each ORTA organizational point of contact (POC, basically an organizational manager) for those ORTAs being researched. This questionnaire, which can be found in Appendix C, serves two purposes: to identify the organizational level costs, and to obtain a level of TT activity being performed at that organization.

In the fourth step, the ORTA organizational specific costs are allocated to cost pools using an allocation basis. The ORTA POCs identified, if necessary, the activity drivers associated with the various categories of overhead costs. These activity drivers represent the first-stage cost drivers, and were limited to the six major steps of the transfer master process.

In the final step, the costs in these pools (from step four) are allocated to the activities identified in the first step through the use of the second-stage cost drivers. The

second-stage cost drivers were identified in step two by determining which of the sub-steps (in terms of percentage of total time) are being performed by the ORTA personnel.

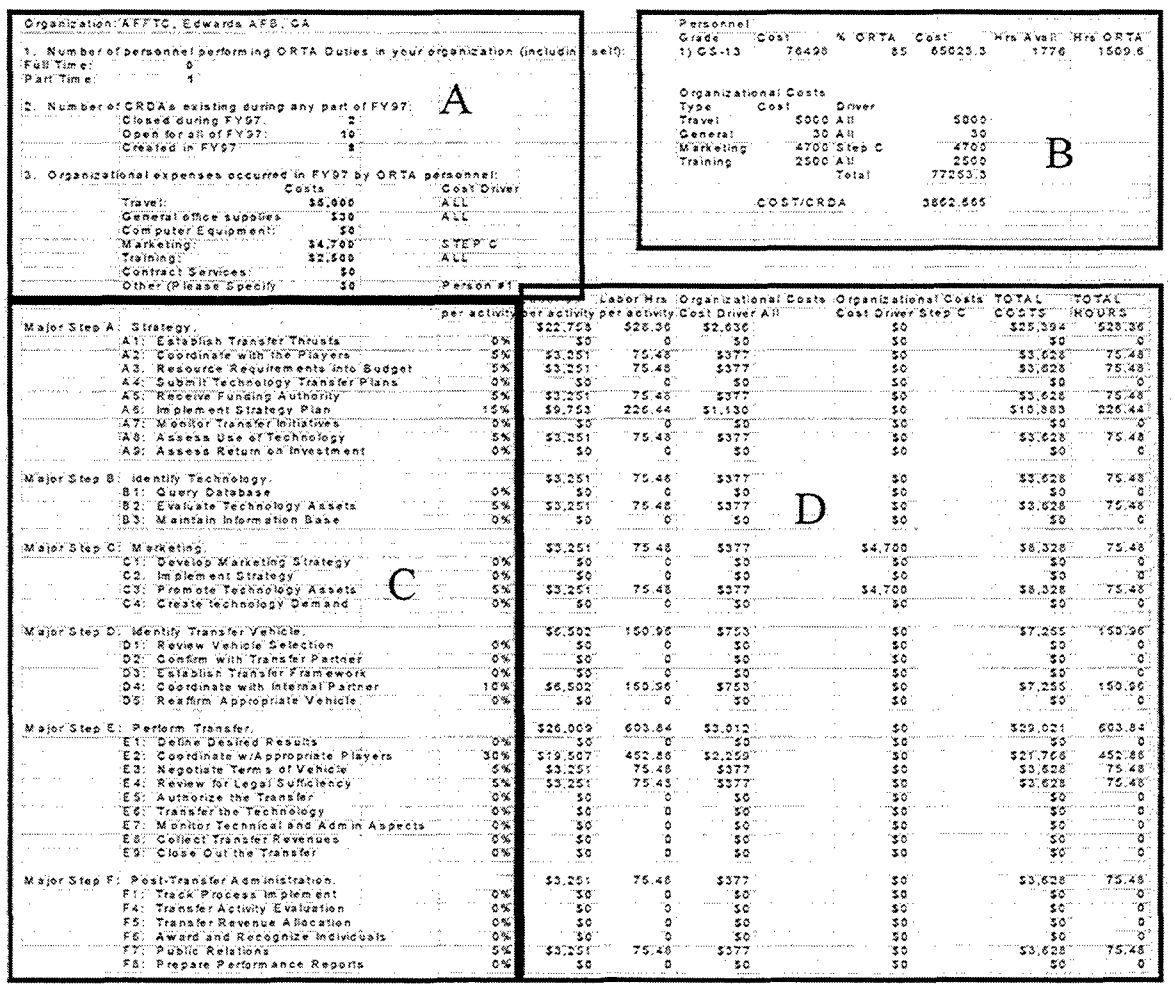
Based on the information required to implement the ABC system, a series of questions were developed which would capture the costs of the resources consumed by ORTA personnel. These questions were incorporated into two preliminary questionnaires, one for each ORTA personnel and one for each POC. Both questionnaires were reviewed by the research sponsor and other experts of the field.

Data Collection and Analysis

Using the six-step technology transfer master process as described in the TTHB and included in Appendix A as a guide, a single questionnaire was developed for every member of each ORTA being researched. The questionnaire addresses each of the activities of the TMP to capture both the quantity of time spent in each activity and to aid in the development of the second-stage cost drivers. The main purpose of this questionnaire is to determine the total amount of time spent by each ORTA person on the various TT activities, and to determine the cost of these resources. This questionnaire provides the bulk of the information required to develop the instrument which determines the costs associated with performing the various TT activities by ORTA personnel. A separate questionnaire was developed and sent to each ORTA POC to identify other indirect costs associated to that ORTA's TT activities and to determine the amount of technology transfer being performed. By matching the TT activity level for an ORTA to the costs identified from both questionnaires, an instrument can be developed that

indicates a "step-wise" manning level (and other costs) based on the amount of TT being performed.

Each respondent was directed to return the questionnaire to the researcher, where the data was entered into Microsoft Excel's spreadsheet program for analysis. ABC was used to allocate the costs among the various activities performed. Figure 1 is an example of one spreadsheet, with letter codes breaking out the various sections of the spreadsheet. Each section has been separated and enlarged for referencing in Figures 2 through 5.



Organization: AFFTC, Edwards AFB, CA

1. Number of personnel performing ORTA Duties in your organization (including self):
Full Time: 0
Part Time: 1

2. Number of CRDAs existing during any part of FY97:
Closed during FY97: 2
Open for all of FY97: 10
Created in FY97: 8

3. Organizational expenses occurred in FY97 by ORTA personnel:

	Costs	Cost Driver
Travel:	$5,000	ALL
General office supplies	$30	ALL
Computer Equipment:	$0	
Marketing:	$4,700	STEP C
Training:	$2,500	ALL
Contract Services:	$0	
Other (Please Specify	$0	Person #1

A

Personnel

Grade	Cost	% ORTA	Cost	Hrs Avail	Hrs ORTA
1) GS-13	76498	85	65023.3	1776	1509.6

Organizational Costs

Type	Cost	Driver	
Travel	5000	All	5000
General	30	All	30
Marketing	4700	Step C	4700
Training	2500	All	2500
		Total	77253.3
	COST/CRDA		3862.665

B

		per activity	Labor Hrs per activity	Organizational Costs Cost Driver All	Organizational Costs Cost Driver Step C	TOTAL COSTS	TOTAL HOURS
Major Step A:	Strategy.		$22,753	$28.36	$2,636	$0	$25,394	$28.36
	A1: Establish Transfer Thrusts	0%	$0	0	$0	$0	$0	0
	A2: Coordinate with the Players	5%	$3,251	75.48	$377	$0	$3,628	75.48
	A3: Resource Requirements into Budget	5%	$3,251	75.48	$377	$0	$3,628	75.48
	A4: Submit Technology Transfer Plans	0%	$0	0	$0	$0	$0	0
	A5: Receive Funding Authority	5%	$3,251	75.48	$377	$0	$3,628	75.48
	A6: Implement Strategy Plan	15%	$9,753	226.44	$1,130	$0	$10,883	226.44
	A7: Monitor Transfer Initiatives	0%	$0	0	$0	$0	$0	0
	A8: Assess Use of Technology	5%	$3,251	75.48	$377	$0	$3,628	75.48
	A9: Assess Return on Investment	0%	$0	0	$0	$0	$0	0
Major Step B:	Identify Technology.		$3,251	75.48	$377	$0	$3,628	75.48
	B1: Query Database	0%	$0	0	$0	$0	$0	0
	B2: Evaluate Technology Assets	5%	$3,251	75.48	$377	$0	$3,628	75.48
	B3: Maintain Information Base	0%	$0	0	$0	$0	$0	0
Major Step C:	Marketing.		$3,251	75.48	$377	$4,700	$8,328	75.48
	C1: Develop Marketing Strategy	0%	$0	0	$0	$0	$0	0
	C2: Implement Strategy	0%	$0	0	$0	$0	$0	0
	C3: Promote Technology Assets	5%	$3,251	75.48	$377	$4,700	$8,328	75.48
	C4: Create technology Demand	0%	$0	0	$0	$0	$0	0
Major Step D:	Identify Transfer Vehicle.		$6,502	150.96	$753	$0	$7,255	150.96
	D1: Review Vehicle Selection	0%	$0	0	$0	$0	$0	0
	D2: Confirm with Transfer Partner	0%	$0	0	$0	$0	$0	0
	D3: Establish Transfer Framework	0%	$0	0	$0	$0	$0	0
	D4: Coordinate with Internal Partner	10%	$6,502	150.96	$753	$0	$7,255	150.96
	D5: Reaffirm Appropriate Vehicle	0%	$0	0	$0	$0	$0	0
Major Step E:	Perform Transfer.		$26,009	603.84	$3,012	$0	$29,021	603.84
	E1: Define Desired Results	0%	$0	0	$0	$0	$0	0
	E2: Coordinate w/Appropriate Players	30%	$19,507	452.88	$2,259	$0	$21,766	452.88
	E3: Negotiate Terms of Vehicle	5%	$3,251	75.48	$377	$0	$3,628	75.48
	E4: Review for Legal Sufficiency	5%	$3,251	75.48	$377	$0	$3,628	75.48
	E5: Authorize the Transfer	0%	$0	0	$0	$0	$0	0
	E6: Transfer the Technology	0%	$0	0	$0	$0	$0	0
	E7: Monitor Technical and Admin Aspects	0%	$0	0	$0	$0	$0	0
	E8: Collect Transfer Revenues	0%	$0	0	$0	$0	$0	0
	E9: Close Out the Transfer	0%	$0	0	$0	$0	$0	0
Major Step F:	Post-Transfer Administration.		$3,251	75.48	$377	$0	$3,628	75.48
	F1: Track Process Implement	0%	$0	0	$0	$0	$0	0
	F4: Transfer Activity Evaluation	0%	$0	0	$0	$0	$0	0
	F5: Transfer Revenue Allocation	0%	$0	0	$0	$0	$0	0
	F6: Award and Recognize Individuals	0%	$0	0	$0	$0	$0	0
	F7: Public Relations	5%	$3,251	75.48	$377	$0	$3,628	75.48
	F8: Prepare Performance Reports	0%	$0	0	$0	$0	$0	0

C

D

Figure 1. Example of Spreadsheet.

Section A of Figure 1 contains the organizational information obtained from the questionnaires sent to each ORTA POC. This section is shown for reference in Figure 2. It includes data on the number of people performing ORTA duties in each organization, which is used as a reference to determine if all personnel in that organization returned a questionnaire.

Organization: AFFTC, Edwards AFB, CA

1. Number of personnel performing ORTA Duties in your organization (including

Full Time:	0
Part Time:	1

2. Number of CRDAs existing during any part of FY97:

Closed during FY97:	2
Open for all of FY97:	10
Created in FY97:	8

3. Organizational expenses occurred in FY97 by ORTA personnel:

	Costs	Cost Driver
Travel:	$5,000	ALL
General office supplie	$30	ALL
Computer Equipment:	$0	
Marketing:	$4,700	STEP C
Training:	$2,500	ALL
Contract Services:	$0	
Other (Please Specify	$0	

Figure 2. Expansion of Section A, Organization Data.

Section B, shown in Figure 3, identifies the personnel costs based on the grade or salary of the respondents, along with the organizational level costs from section A. All costs were totaled, and a cost per CRDA for each ORTA organization was calculated.

Figure 4 shows an expansion of section C, which contains the percentage of time each ORTA respondent spends on the various TT activities listed in Appendix A. The data from this section is transcribed directly off the respondent's questionnaire.

Section D is the data analysis section, and an expanded version of this section is found in Figure 5. Using the percentage of time for each activity from section C and the hours and personnel costs from section B, an hourly expenditure and personnel cost per activity is calculated for each respondent. These values are summed (if more than one person in the organization) to calculate the hourly expenditure and personnel cost per activity for each ORTA organization. Finally, the organizational level costs identified in section B are allocated among the activities using ABC and the appropriate cost drivers.

Personnel					
Grade	Cost	% ORTA	Cost	Hrs Avail	Hrs ORTA
1) GS-13	76498	85	65023.3	1776	1509.6

Organizational Costs			
Type	Cost	Driver	
Travel	5000	All	5000
General	30	All	30
Marketing	4700	Step C	4700
Training	2500	All	2500
		Total	77253.3
	COST/CRDA		3862.665

Figure 3. Expansion of Section B, Cost per CRDA

	Person #1 % of time per activity
Major Step A: Strategy.	
A1: Establish Transfer Thrusts	0%
A2: Coordinate with the Players	5%
A3: Resource Requirements into Budget	5%
A4: Submit Technology Transfer Plans	0%
A5: Receive Funding Authority	5%
A6: Implement Strategy Plan	15%
A7: Monitor Transfer Initiatives	0%
A8: Assess Use of Technology	5%
A9: Assess Return on Investment	0%
Major Step B: Identify Technology.	
B1: Query Database	0%
B2: Evaluate Technology Assets	5%
B3: Maintain Information Base	0%
Major Step C: Marketing.	
C1: Develop Marketing Strategy	0%
C2: Implement Strategy	0%
C3: Promote Technology Assets	5%
C4: Create technology Demand	0%

Figure 4. Expansion of Section C, Activity Percentages

Labor $s per activity	Labor Hrs per activity	Organizational Costs Cost Driver All	Organizational Costs Cost Driver Step C	TOTAL COSTS	TOTAL HOURS
$22,758	528.36	$2,636	$0	$25,394	528.36
$0	0	$0	$0	$0	0
$3,251	75.48	$377	$0	$3,628	75.48
$3,251	75.48	$377	$0	$3,628	75.48
$0	0	$0	$0	$0	0
$3,251	75.48	$377	$0	$3,628	75.48
$9,753	226.44	$1,130	$0	$10,883	226.44
$0	0	$0	$0	$0	0
$3,251	75.48	$377	$0	$3,628	75.48
$0	0	$0	$0	$0	0
$3,251	75.48	$377	$0	$3,628	75.48
$0	0	$0	$0	$0	0
$3,251	75.48	$377	$0	$3,628	75.48
$0	0	$0	$0	$0	0
$3,251	75.48	$377	$4,700	$8,328	75.48
$0	0	$0	$0	$0	0
$0	0	$0	$0	$0	0
$3,251	75.48	$377	$4,700	$8,328	75.48
$0	0	$0	$0	$0	0

Figure 5. Expansion of Section D, Data Analysis

There are several limitations with the use of these questionnaires. First, because of the lack of direct involvement between the researcher and respondent, some

respondents may have simply filled out the questionnaire in an effort to satisfy their requirement without accurately responding to the questions. It is hoped, by attempting to include all ORTA personnel of the organizations researched, that this error in accuracy is minimized. Another limitation is in determining a "step-wise" ORTA staffing level based on the level of TT being performed. The missions of the various laboratories varies significantly (not to mention the logistics centers and test centers), as does the type of research being performed. Therefore, it may be possible to identify an appropriate "step-wise" ORTA size based on the TT level. At best, such an instrument should be used as information to identify differences among the various ORTA organizations, and not as a tool to identify organizations that appear "fat."

Research Sample Population

The activities performed by ORTA personnel are generally considered as overhead to the actual transfer of technology itself. Therefore, instead of being assigned to one or a few technology transfer projects, an ORTA person can be considered to be assigned to all projects being transferred by their organization. Therefore, it is not necessary to identify representative technology transfer projects for each ORTA organization, since all ORTA personnel will be assumed to be performing their activities among all the projects completed at their laboratory.

Wright Laboratories was selected as the baseline ORTA organization in which other ORTAs will be compared to in determining the ORTA "right size." It was selected for the baseline because it was the only laboratory in which data was collected for a

previous research effort of the direct labor. Also, it is among the largest laboratories in terms of TT activity.

Due to the small number of personnel assigned to each ORTA, the population for this research includes all personnel who perform ORTA duties on a full or part time basis for each ORTA organization included in the research. A separate questionnaire was sent to each ORTA person through their respective ORTA Points of Contact (POC). Every effort was used to include the maximum number of personnel who performed ORTA activities in this research. The following ORTA organizations are included in this research effort:

Laboratories:
- Wright Laboratory, Wright-Patterson AFB, OH
- Phillips Laboratory, Kirtland AFB, NM
- Rome Laboratory, Rome, NY

Air Logistic Centers (ALC)
- Oklahoma City Air Logistics Center (ALC), Tinker AFB, OK
- Ogden ALC, Hill AFB, UT
- Warner-Robins ALC, Warner-Robins AFB, GA

Test Centers:
- Air Force Development Test Center, Eglin AFB, FL
- Air Force Flight Test Center, Edwards AFB, CA

Research Instrument Development

Development of the data collection instrument used in this research effort begins with an analysis of the steps and sub-steps of the TMP described in the TTHB and presented in Appendix A. Using the TMP as a guide, a preliminary questionnaire is developed to quantify the resources expended by the ORTA personnel in performing their

TT activities. In a meeting with the AFMC ORTA manager and the research sponsor, the questionnaire was refined and approved before being sent to all personnel assigned to the ORTA organizations considered for this research. Besides being able to determine the personnel costs associated with performing the ORTA TT activities, this questionnaire allows the researcher to determine the activities actually being performed by ORTA personnel. This questionnaire can be found in Appendix B.

A previous research effort identified several steps of the TTHB which were not being performed by the scientists and engineers (S&E), which comprise the direct labor portion of the laboratories (Boyd, 1996). That research found that very little expenditures were made by the S&E community in any of the sub-steps of the first three major steps of Strategy, Identify Technology, and Marketing. In fact, only sub-step B2, Evaluate Technology Assets, had a minor expenditure which accounted for less than 0.5 percent of the total direct resources consumed by the eight projects evaluated (Boyd, 1996: 4.44). Major step D, Identify Transfer Vehicle, accounted for less than three percent of the total resources consumed, and its sub-steps were performed in only two of the eight projects evaluated. Major step E, Perform Transfer, consumed the largest portion of resources (nearly 77 percent). However, sub-step E8, Collect Transfer Revenues, was not performed at all and sub-step E5, Authorize the Transfer, was performed in only one project. The final major step, Post-Transfer Administration, accounted for about five percent of the total resources consumed, but sub-steps F1 (Track Process Implement) and F5 (Transfer Revenue Allocation) were not performed at all, while F4 (Transfer Activity

Evaluation) and F6 (Award and Recognize Individuals) were performed in only one project.

In order to collect data of other costs specific to each laboratory expended by the ORTAs, and to determine the level of transfer activity being performed at each laboratory, another questionnaire was developed and sent to the director of each laboratory ORTA being researched. This questionnaire was also refined and approved by the AFMC ORTA manager and the research sponsor. The questionnaire allowed the researcher to identify other overhead costs, such as training or supplies, which might be specific to each ORTA. A copy of this questionnaire can be found in Appendix C.

Data Analysis and Interpretation

As the questionnaires are received from the respondents, each is checked for accuracy and completeness, and any further questions which arise are handled immediately. The questionnaires are separated by organization, then the data from them entered in Microsoft's Excel spreadsheet program for analysis, with a separate spreadsheet file used for each organization. All spreadsheet entries can be found in Appendix D.

For each ORTA personnel questionnaire respondent, the percentage of time spent performing ORTA duties (if not full time) is multiplied by the appropriate man hours of a full time employee to determine the total man hours consumed. The Office of Management and Budget (OMB) Circular A-76, Performance of Commercial Activities, states that a full time equivalent employee has 1,776 man hours available for productive

purposes; and this figure is used for all ORTA personnel. The total for each respondent is then allocated to each sub-step based on the percentage of time each respondent stated they performed. All the respondents of a particular ORTA organization are then aggregated and the percentage of total man hours consumed on ORTA activities for each sub-step is calculated for a specific ORTA organization. The salaries of each of these ORTA persons is calculated using the values listed in Air Force Instruction (AFI) 65-503 if military or civilian, or the salary as stated on the questionnaire will be used if a contractor. These salaries are also allocated to the various sub-steps for each respondent in the same manner as the man-hours, and then aggregated for each ORTA organization.

For each ORTA POC questionnaire respondent, the data is entered in the same spreadsheet file as the ORTA personnel responses. For each category of organizational level cost, an appropriate cost driver is identified. Using the principles of ABC, the organizational level costs of performing ORTA TT activities is allocated among the various sub-steps. For instance, say that a particular category of expense had the cost driver of major step C, Marketing. Then the value of this category's expenses are allocated to the four marketing sub-steps only, based on the percentage of time that ORTA organization's personnel spent in each sub-step of marketing. Likewise, the total amount of TT activity being performed (in terms of CRDA activity) is entered into the appropriate file and a "cost per CRDA" is calculated.

As stated earlier, each ORTA organization's responses is analyzed separately, so that further analysis can be made to compare the differences in resources consumed for the amount of TT being performed for each ORTA organization researched. Also,

references are made as to the differences in sub-steps being performed by each organization, but no reason as to why is stated because the mission and types of technologies being transferred differ among the various ORTA organizations.

Expected Results

The analysis of the data should reveal that the various sub-steps listed above as not being performed by S&E personnel are being performed by the ORTA personnel. Since the expenses of the ORTA organizations are considered indirect costs, it is expected that those organizations that have the highest amount of TT activity will have the lowest "cost per CRDA" based on economies of scale. The results of these analyses are presented in the following chapters.

Summary

This chapter presented the methodology used to conduct this research. First, a discussion on the selection of the overall research design was presented, followed by the data collection plan. Then, the process utilized in the development of the data collection instrument was presented. Finally, the method of data analysis was defined. Chapter IV presents the detailed analysis and results of the collected data, while Chapter V contains the conclusions of the research and recommendations for further research.

IV. Analysis and Results

Introduction

The objective of this research is to identify the indirect costs of performing technology transfer (TT) activities from the Unites States Air Force to the private sector. Other objectives include: determining the activities performed by the personnel who perform duties while assigned to Office of Research and Technology Applications (ORTA) offices, making comparisons among the ORTAs, and determining a "step-wise" manning and other resource consumption level based on the amount of TT being accomplished. The chapter begins with a brief overview of the collected data, discussing problems encountered during data collection. Then, an in-depth analysis is accomplished and the results provided, using an overall approach first and continuing with the examination of individual ORTAs. All references made to "activity or activities" refer to the various sub-steps of the Transfer Master Process (TMP) in Appendix A.

Data Overview

As stated in Chapter III, there were 8 ORTA organizations included in this research effort. However, it was originally intended that two product centers and one additional laboratory be included in the research, but problems with data collection forced the dropping of the two product centers: Electronic Systems Center at Hanscom AFB, MA, and Space and Missile Center at Los Angeles AFB, CA. Also, incomplete data from Armstrong Laboratory at Brooks AFB, TX, caused it to be dropped, but the personnel

costs of those personnel at Armstrong who did respond are included at the macro-analysis level portion of this research.

Of the eight ORTAs included in this research, one location, Phillips Laboratory, responded with a composite percentage of time per activity for the entire laboratory instead of individual responses. Although the net result is the same in terms of total resources consumed, a slight loss in accuracy does result when an estimate is used for an entire group. Two locations, Wright Laboratory and Rome Laboratory, had several personnel who did not respond to the questionnaire. In these cases, the grades of those personnel were obtained and their costs allocated to the activities based on a prorated percentage of the other respondents.

Finally, with the exception of the category of organizational level costs of marketing, no specific cost driver in terms of the major or sub-steps of Appendix A could be identified. This is not surprising, since the ORTA organizations perform duties considered as indirect or overhead, their organizational expenses would be consumed on the same activities that the personnel spent time on. Therefore, all non-marketing organizational expenses will be allocated among the various activities based on the organization's percentage of total man hours spent on that activity.

Data Entry and Computations

Referring to Figures 1 through 5 of Chapter III, a separate worksheet similar to Figure 1 was generated in Microsoft Excel for each ORTA organization. Each of the eight organizations used in this analysis returned their organizational questionnaire from

Appendix C, and the data was entered in section A (refer to Figure 2). Each respondent of an ORTA organization had a separate column developed similar to section C of Figure 4. The percentages per activity from each respondent to the questionnaire from Appendix B were entered in section C. For each respondent, the standard composite pay rates of Air Force Instruction 65-503 was used to determine an annual personnel cost if military or civil service, or the actual salary as stated on the questionnaire was used if a contractor. These personnel costs were entered in section B similar to Figure 3. Each person in the ORTA was given a full time equivalent man-year allocation of 1,776 hours, as stated in the Office of Manpower and Budget Circular A-76. If the respondent only performed duties in their respective ORTA on a part time basis, the percentage of time they spent performing ORTA work was multiplied by the man hours and personnel cost for that person in section B. The organizational level expenses were also entered in section B.

The available man hours per person, personnel costs, and organizational level expenses were totaled for each ORTA in section B. Then, the personnel costs were added to the organizational expenses to determine the total cost of resources consumed for each ORTA. In section D for each respondent, the percentage of time they spent per activity in section C was multiplied by their respective personnel cost and available man hours in section B to determine a personnel cost and man hour consumption per activity, similar to Figure 5. The total man hours and personnel costs per activity for all personnel were summed in each ORTA organization. A copy of each ORTA organization's worksheet can be found in Appendix D.

In-depth Analysis and Results

Using the principles of activity-based costing, the organizational level expenses were allocated among the various activities performed by the ORTA personnel. The organizational expense category of marketing had major step C, marketing, as its cost driver. The expenses for this category were allocated among the sub-steps C1 through C4 based on the percentage of man hours spent on these activities to the total man hours spent on major step C. All other organizational expenses had no specific step as its cost driver. Therefore, all other expenses were allocated to the various sub-steps based on the percentage of man hours spent on each sub-step to the total man hours used by the organization. These allocated expenses were added to the personnel costs per activity to calculate the ORTA organization's total cost per activity. Finally, the percentage of total costs for each activity was calculated.

Macro-Analysis of ORTAs. A separate spreadsheet was developed which combines each organization's total cost and man hours per activity into an overall look at all the ORTAs examined in this research effort. The percentage of total costs for each activity for all ORTAs was calculated. Two graphs of these percentages are presented as Figures 6 and 7 below. Figure 6 shows the percentage of all costs consumed by all ORTA organizations for each of the six major steps of the TMP in Appendix A. The additional category of "Other" was added to track activities performed by ORTA personnel which differed from those listed in Appendix A. Figure 7 breaks this down into the various sub-steps or activities performed by the ORTA personnel. For this analysis, any percentage above one-half of one percent was considered significant. Any

sub-step that had less than one-half of one percent of total costs consumed was considered as not being performed at a significant level by the ORTA organizations.

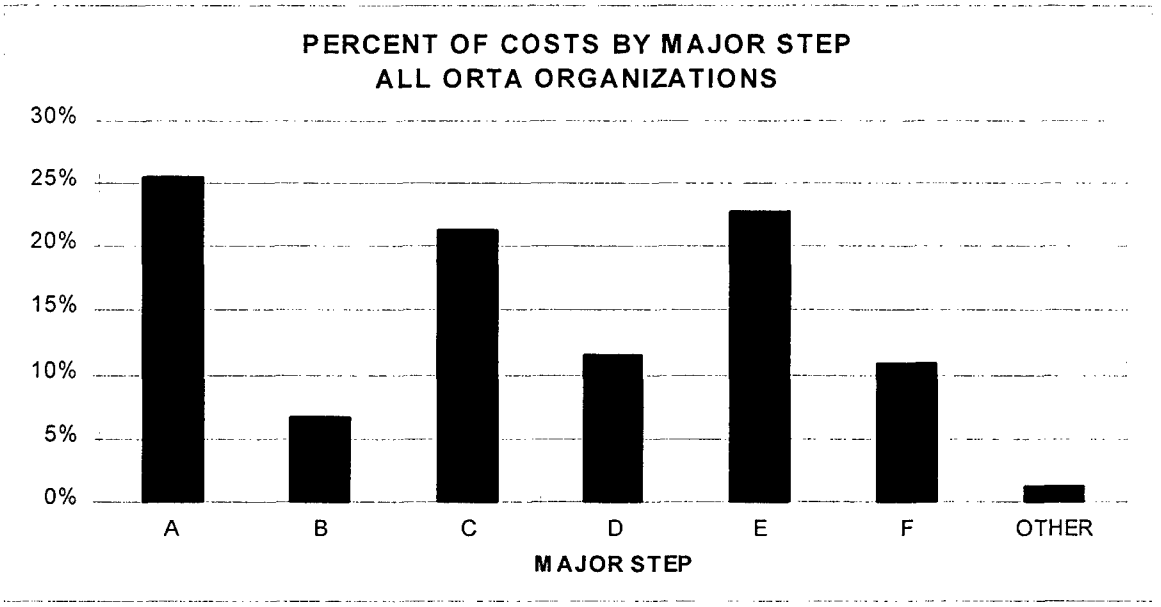


Figure 6. Percent of Costs by Major Step - All ORTA Organizations

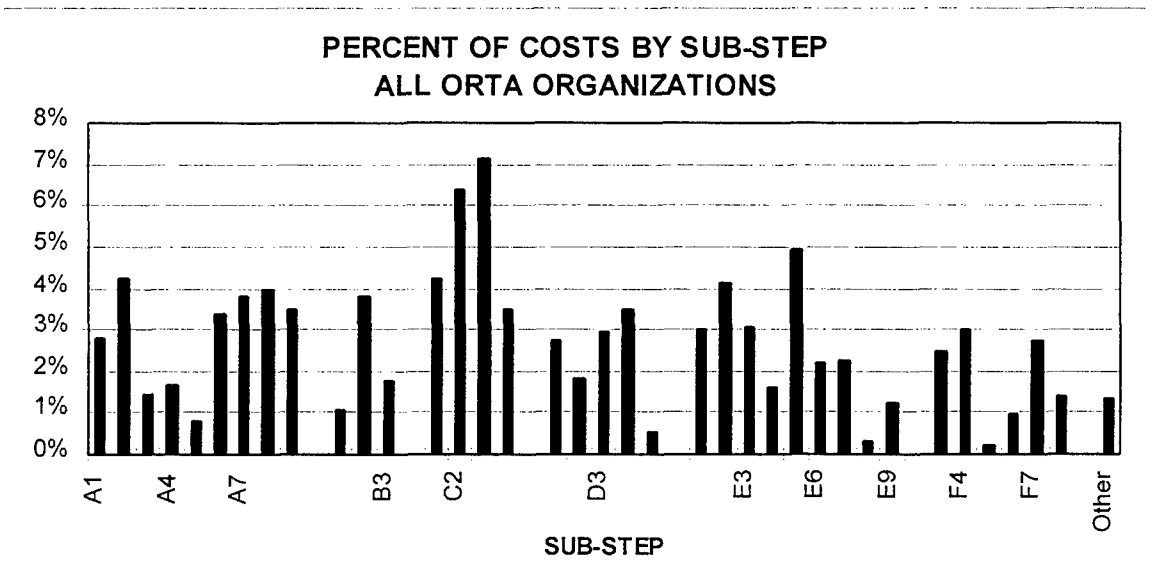


Figure 7. Percent of Costs by Sub-step - All ORTA Organizations

A quick view of Figure 6 finds two surprising results: the percentage of costs consumed in major step E, perform transfer, appears to be excessive, while the amount consumed by step F, post-transfer administration, appears to be low. An analysis of each step follows.

Major step A, strategy, had the highest percentage of total costs, consuming over one fourth of the total ORTA resources. This result is expected, since strategy is considered to be a management duty performed by overhead personnel. All of major step A's sub-steps had significant percentages; although sub-step A5, receive funding authority, came close to being insignificant at just under one percent of total costs.

Major step B, identify technology, consumed 6.7 percent of the total ORTA resources. Although this does appear to be low for a step considered to be part of the ORTA's responsibilities, there are only three sub-steps to this major step, and all three sub-steps came in with significant percentages.

Major step C, marketing, had the third highest percentage at 21.3 percent of total resources consumed. This result was expected even though there are only four sub-steps to marketing, since this is the only major step that was identified as a specific cost driver for any of the organizational level expenses. All of the four sub-steps were very significant, ranging from 3.5 to over seven percent of the total costs per activity.

Major step D, identify transfer vehicle, had 11.6 percent of the total ORTA resources consumed. With its five sub-steps, this puts it in line with major step B, identify technology, in terms of percentage per sub-step, which is expected, since these

two major steps are related. Sub-step D5, reaffirm appropriate vehicle, was almost insignificant, with just over one-half of one percent of total costs.

Major step E, perform transfer, had a surprisingly high 22.7 percent of the total ORTA resources consumed. It was expected that several of the sub-steps, in particular sub-step E6, transfer the technology, would have little, if any resources consumed. Sub-step E6 was the one sub-step in which a previous research effort on direct costs found the majority of resources to be expended. It is theorized that the 2.2 percent of ORTA resources consumed in sub-step E6 was the result of the fact that a good portion of ORTA personnel are from the scientist and engineering (S&E) community who are "doubling up" as ORTA personnel. Only one sub-step, E8, was insignificant with less than one half of one percent of total ORTA resources expended.

In direct contrast to major step E, major step F, post-transfer administration, had a surprising low 10.8 percent of the total ORTA resources expended among its various sub-steps. The various sub-steps of major step F are all activities considered to be accomplished by overhead personnel. However, sub-step F5, transfer revenue allocation was insignificant with less than one half of one percent of resources consumed, while sub-step F6 was nearly insignificant with just under one percent.

The Other category, which accounts for activities specified by respondents which did not match any of the sub-steps in Appendix A, consumed 1.3 percent of the total ORTA resources. The majority of these costs were identified as being expensed on coordinating TT activities with other ORTA organizations.

The previous research effort by Captain Jamie Boyd (1996) on the direct labor costs of performing TT activities at Wright Laboratories found that of all the sub-steps within the first major steps A, B, and C, only one sub-step (B2: evaluate technology assets) had any expenditures at all. This research effort found all such sub-steps to have expended a significant amount of ORTA resources. Only sub-step A5, receive funding authority, was even close to being insignificant at just under one percent of total ORTA resources consumed. Captain Boyd's research found the sub-steps of major step D accounted for less than three percent of total direct labor costs, and that the sub-steps were performed in only two of the eight projects evaluated. In comparison, all of major step D's sub-steps were significant users of ORTA resources with the exception of D5, which was almost insignificant at just over one half of one percent. Of the two sub-steps in major step E which had little or no direct resources consumed, sub-step E5, authorize the transfer, was very significant with nearly five percent of total ORTA resources consumed. However, sub-step E8, collect transfer revenues, was insignificant in terms of ORTA resources. Finally, Captain Boyd's work found sub-steps F1, F4, F5, and F6 to have consumed little or no direct resources expended. This research found F1, F4, and F6 to be significant, but sub-step F5, transfer revenue allocation, was insignificant with less than one half of one percent of total ORTA resources consumed.

The Laboratories. A separate spreadsheet was developed which accounted for all the laboratories total cost and man hours per activity to provide an overall look at the Laboratories' ORTAs examined in this research effort as a whole. The percentage of total costs for each activity for all Laboratories was calculated. Two graphs of these

percentages are presented below as Figures 8 and 9. Also, each laboratory has separate graphs pertaining to its percentage of costs by major step and by sub-step. These are presented as Figures 10 and 11 for Wright Laboratories, Figures 12 and 13 for Phillips Laboratory, and Figures 14 and 15 for Rome Laboratory.

Figures 8 and 9 are very similar to Figures 6 and 7, respectively. This is not surprising, since the laboratories conduct the majority of the Air Force's research. Therefore, they transfer the greatest amount of technology (in terms of Cooperative Research and Development Agreements - CRDAs), while expending the most resources in performing TT activities. The cost per activity by laboratory ORTAs drives the cost per activity for all the ORTAs.

Differences do exist among the separate laboratories, as shown in Figures 10 through 15. For instance, major step A, strategy, consumed the most total ORTA (and laboratory ORTA) resources, but it ranked third behind perform transfer (major step E) and marketing (major step C) in Wright Laboratory, and it was tied for fifth in Rome Laboratory. Wright Laboratory was the only laboratory that had sub-steps other than those identified in the total ORTA results which were also insignificant (A9, assess return on investment; C4, create technology demand; E4, review for legal sufficiency; and F8, prepare performance reports). It was also the only laboratory that identified resources expended in the "Other" category.

However, there were similarities among the laboratories also. The two sub-steps determined to be insignificant in terms of total ORTA resources (E8 and F5), were found to be insignificant in Wright and Phillips Laboratories and only consumed 1.2 percent of

Rome Laboratories ORTA resources. Likewise, sub-step D5, which was just barely significant in total ORTA resources with one half of one percent, had less than one percent for all three laboratories.

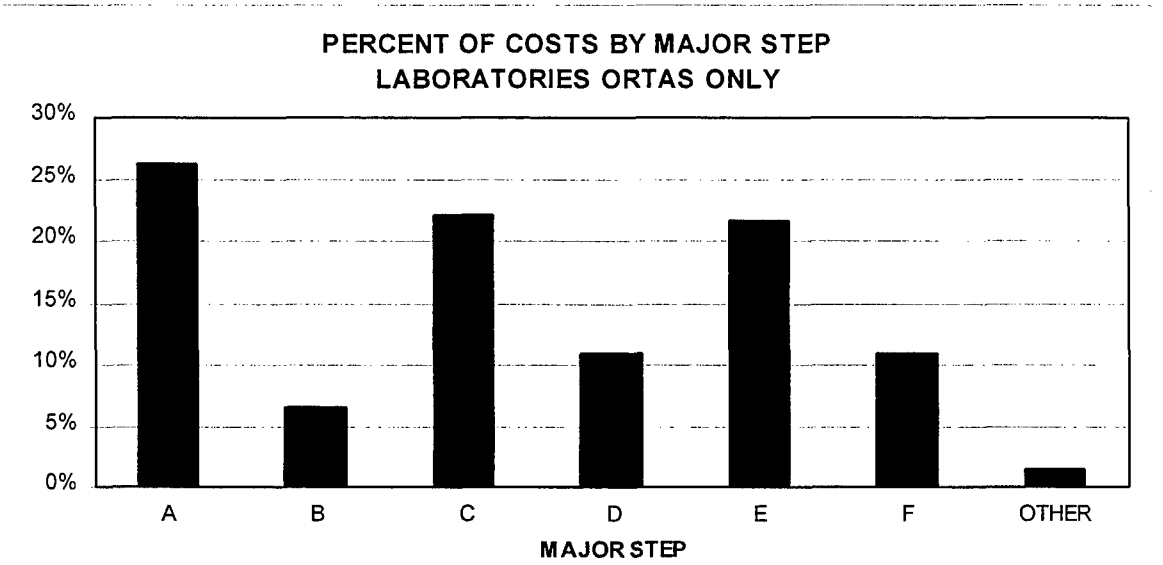


Figure 8. Percent of Costs by Major Step - All Laboratory ORTAs

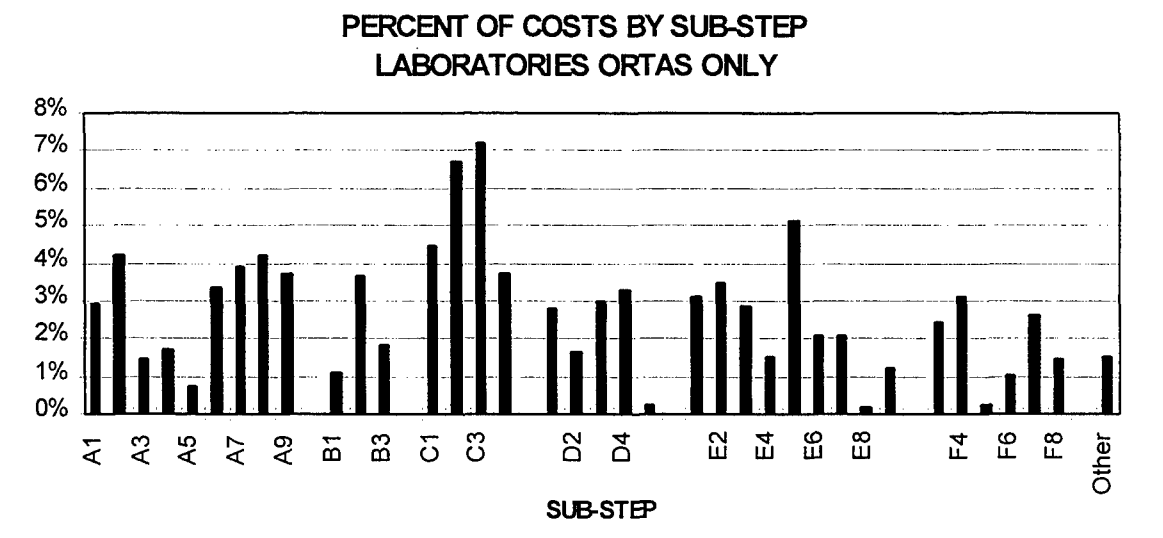


Figure 9. Percent of Costs by Sub-step - All Laboratory ORTAs

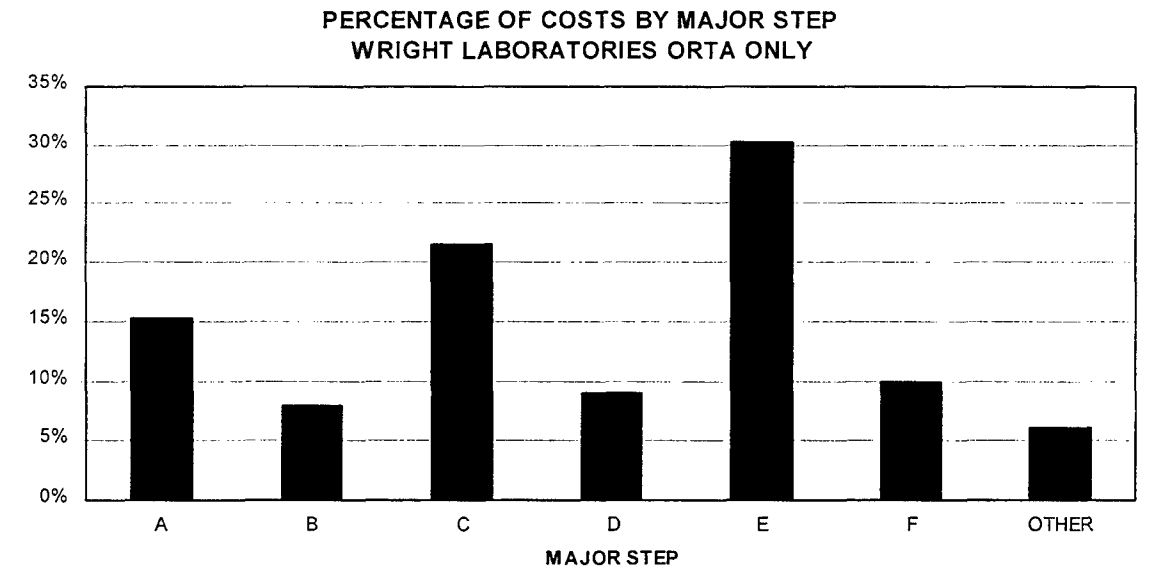


Figure 10. Percent of Costs by Major Step - Wright Laboratory ORTA

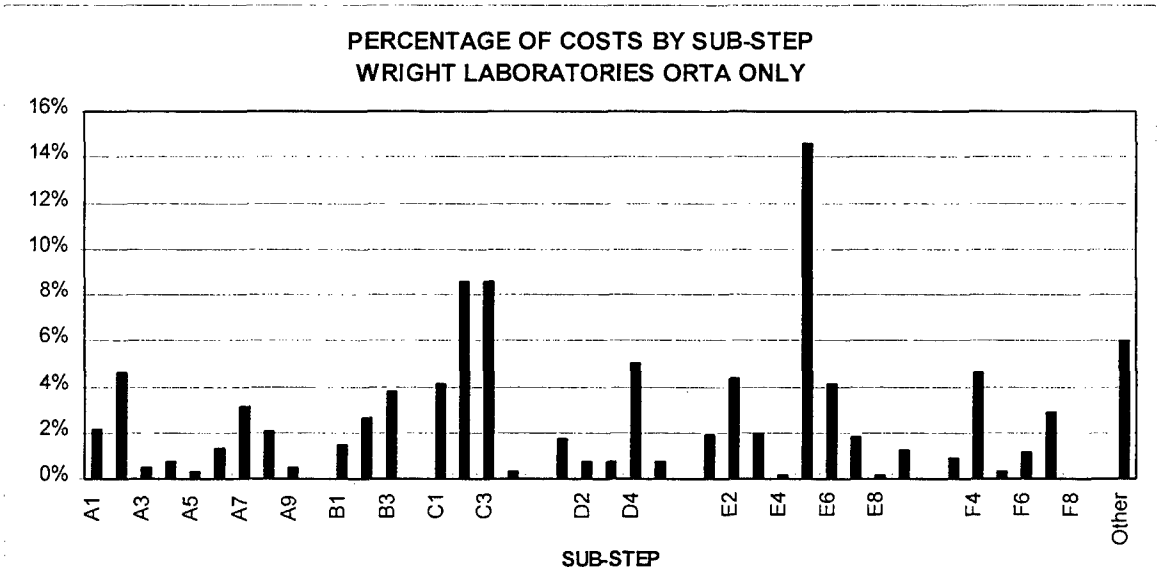


Figure 11. Percent of Costs by Sub-step - Wright Laboratory ORTA

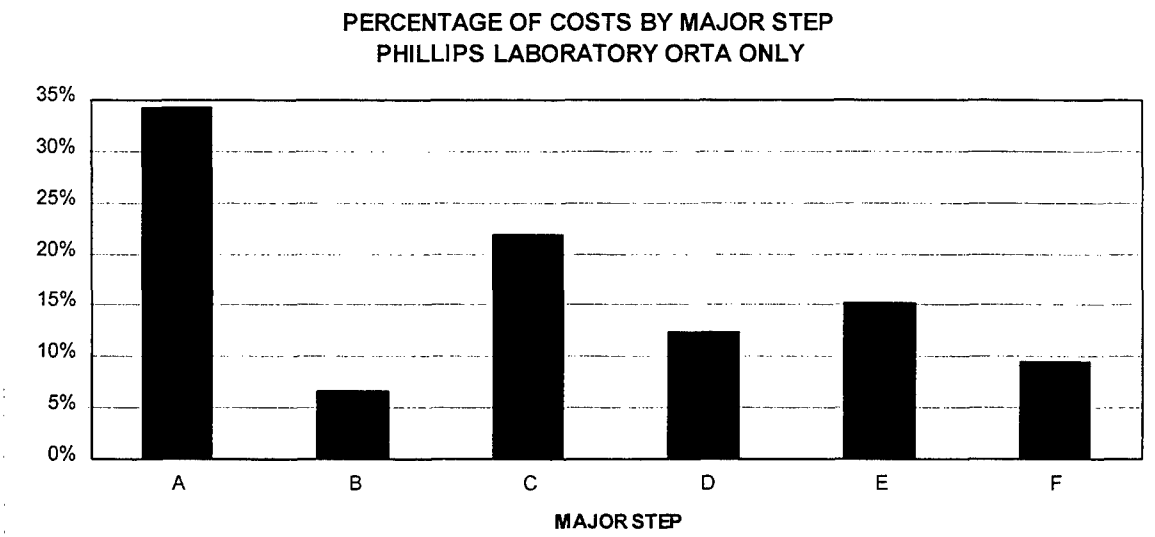


Figure 12. Percent of Costs by Major Step - Phillips Laboratory ORTA

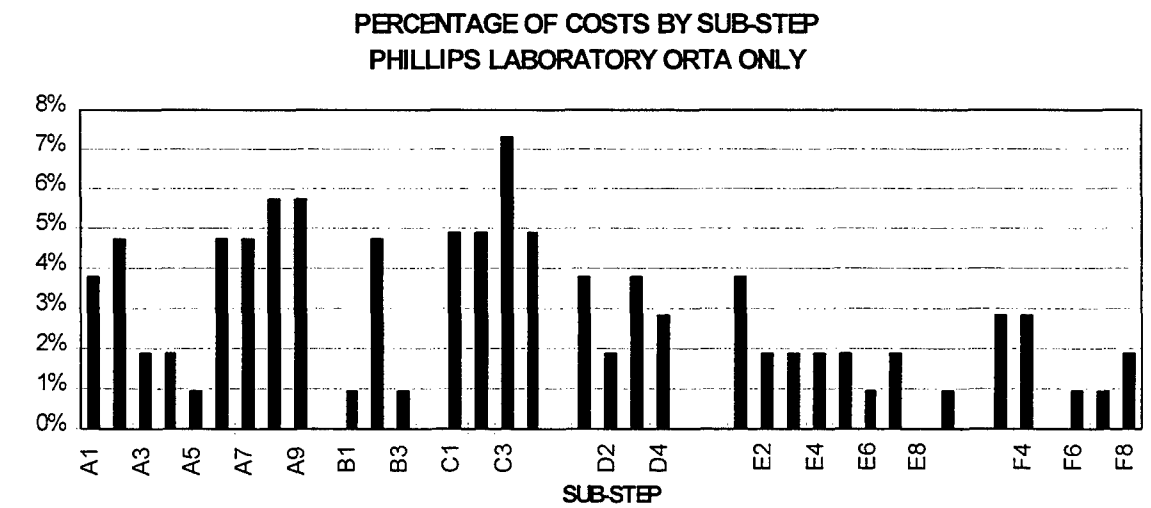


Figure 13. Percent of Costs by Sub-step - Phillips Laboratory ORTA

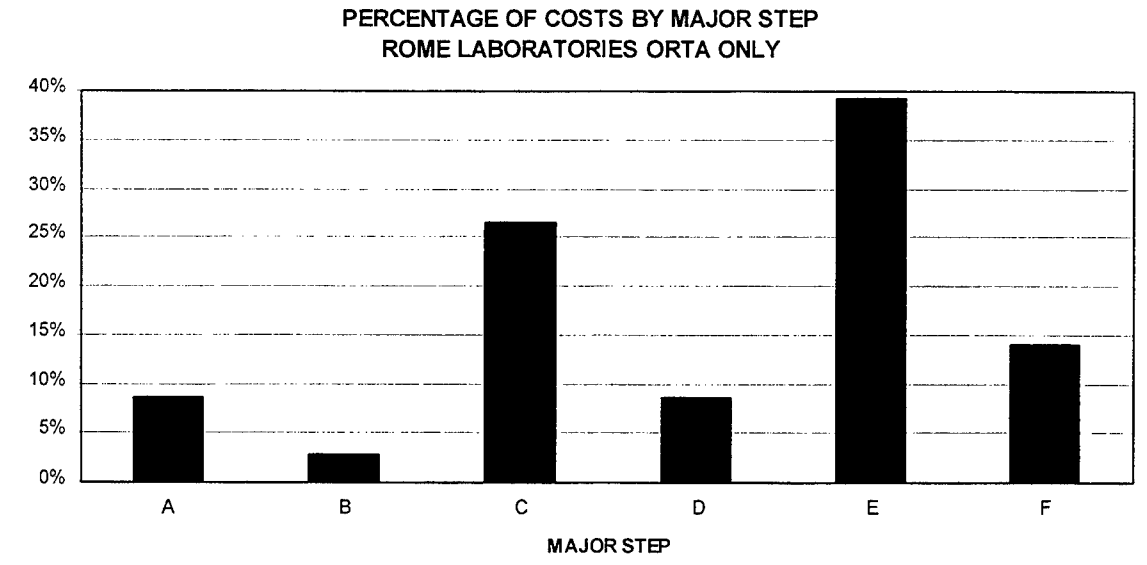


Figure 14. Percent of Costs by Major Step - Rome Laboratory ORTA

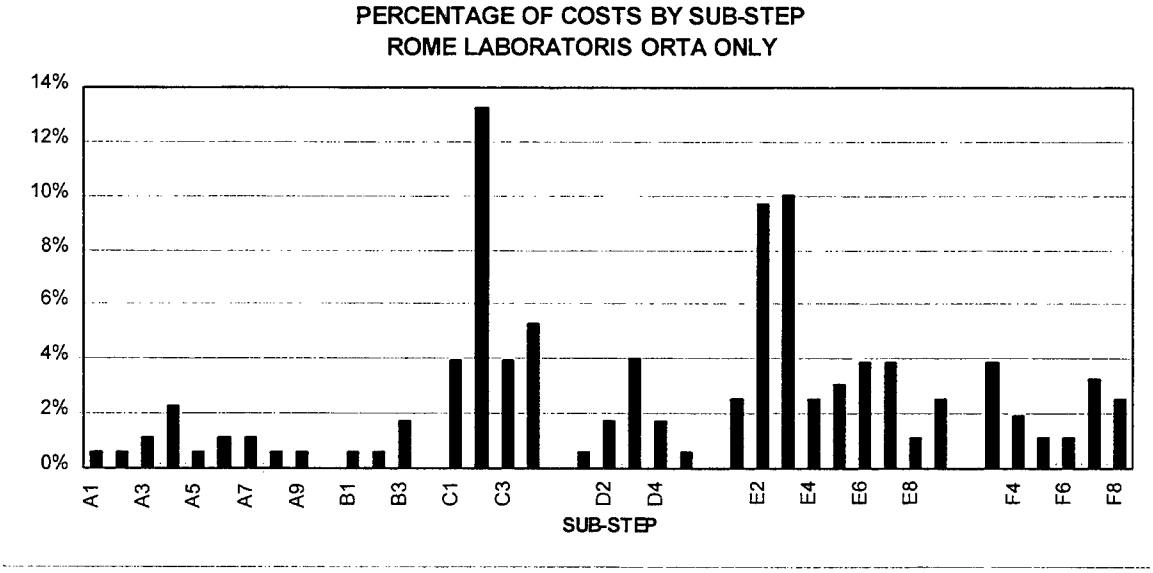


Figure 15. Percent of Costs by Sub-step - Rome Laboratory ORTA

The Air Logistics Centers. Using the same procedure as was accomplished with the laboratories, a spreadsheet was developed to track the cost and man hours expended

per activity for the three Air Logistics Centers (ALC). The percentage of cost per activity in terms of total ALC costs was calculated, and the results are shown in Figures 16 for major step expenditures and 17 for sub-step expenditures. Similar graphs are presented in Figures 18 through 23 for the separate ALCs.

Comparing Figures 16 and 17 to Figures 6 and 7, the ALC ORTAs, as a whole, differ significantly in resources consumed per activity from the overall ORTA consumption rate. Besides major step E, there is no major step that stands above the rest in expending resources. The only two sub-steps that have insignificant resources expended (less than one half of one percent) are A3, resource requirements into budget, and A5, receive funding authority. The two sub-steps identified as insignificant in total ORTA resources consumed E8 and F5) were both significant at the ALC level, although sub-step F5, transfer revenue allocation, expended less than one percent of the ALCs resources. The large percentage expended in major step E can be attributed to the small size of the ALC ORTAs, which are at most two persons deep. Even with such a high percentage, only 6.4 percent was spent performing sub-step E6, transfer the technology, which is considered an activity performed with direct labor. Since the laboratories had similar results to the combined total of all ORTA organizations, the ALCs have nearly the same differences among the laboratories as they do with the total ORTA activity consumption rate.

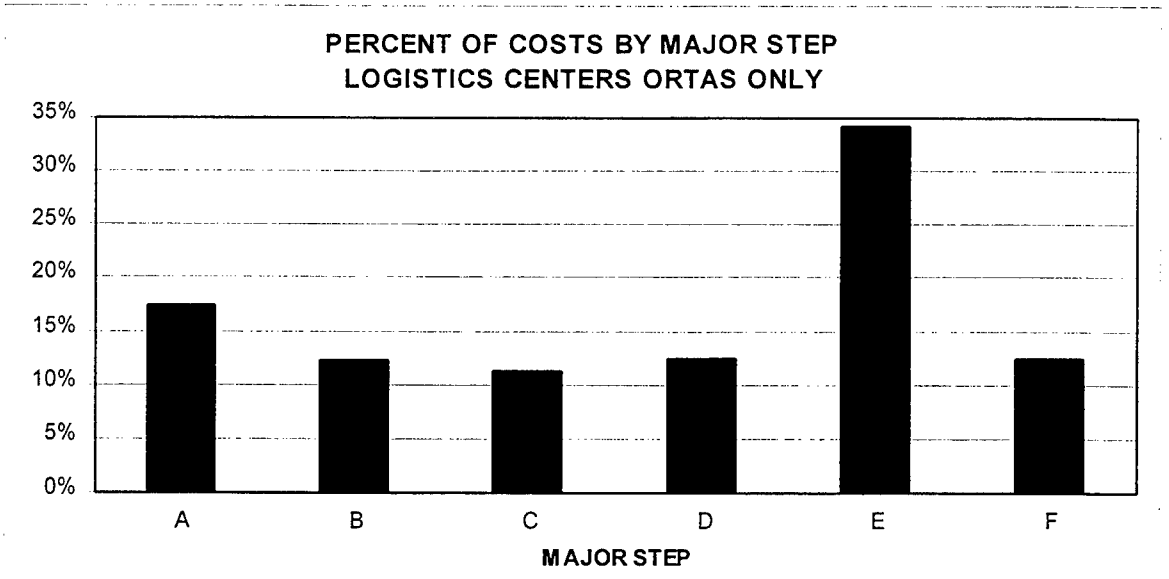


Figure 16. Percent of Costs by Major Step - All ALC ORTAs

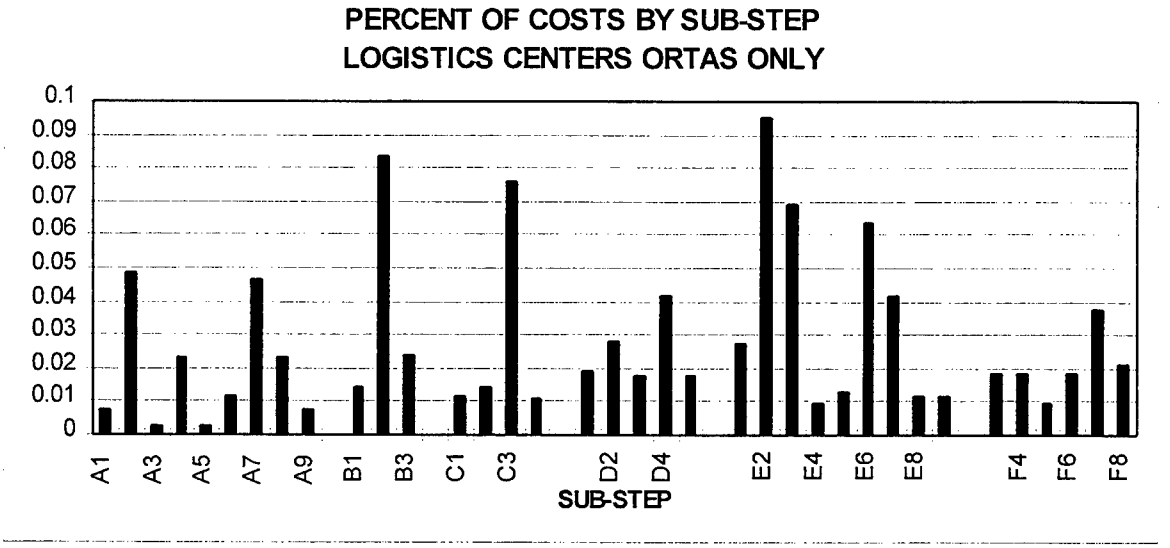


Figure 17. Percent of Costs by Sub-step - All ALC ORTAs

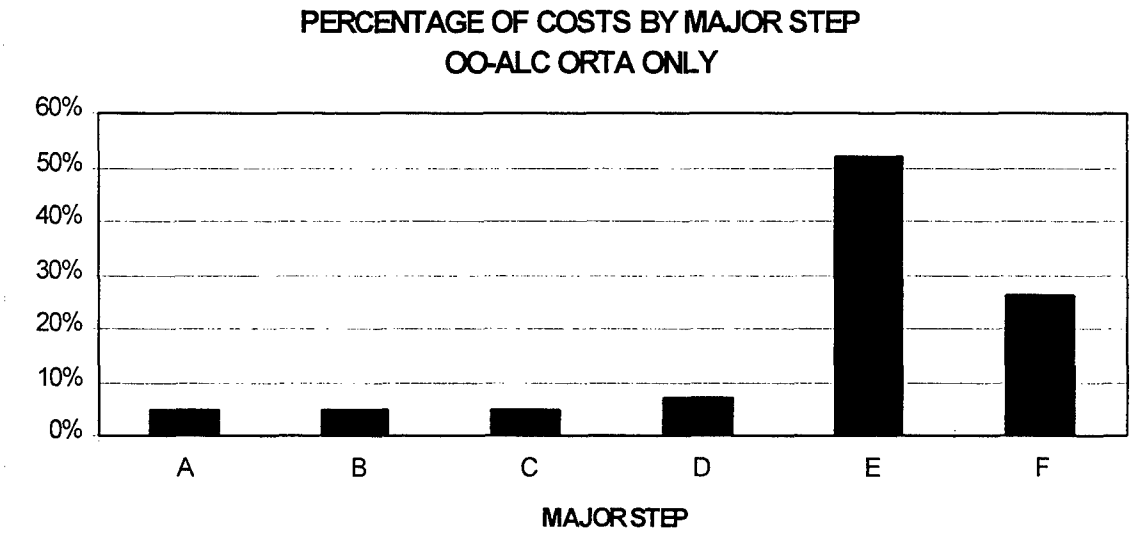


Figure 18. Percent of Costs by Major Step - Ogden ALC ORTA

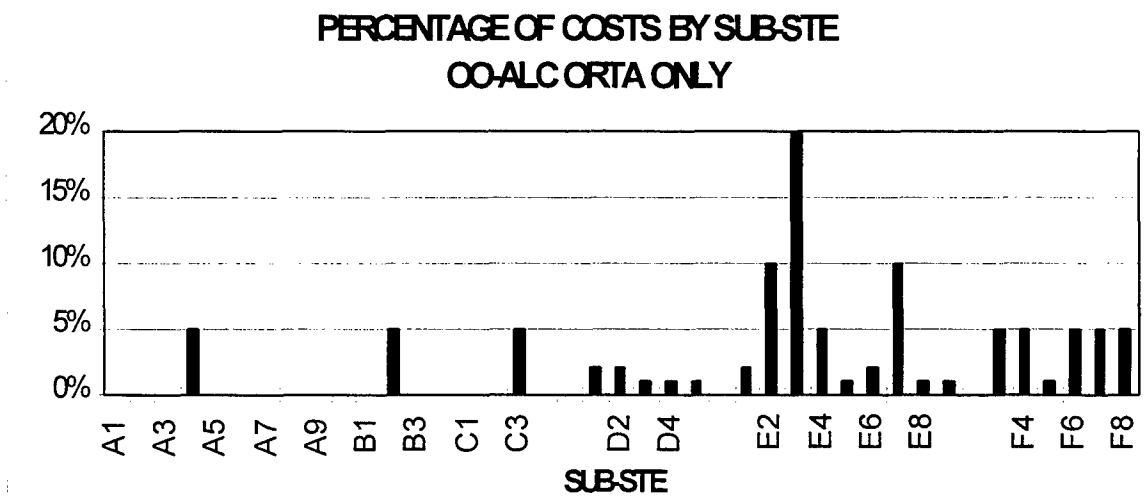


Figure 19. Percent of Costs by Sub-step - Ogden ALC ORTA

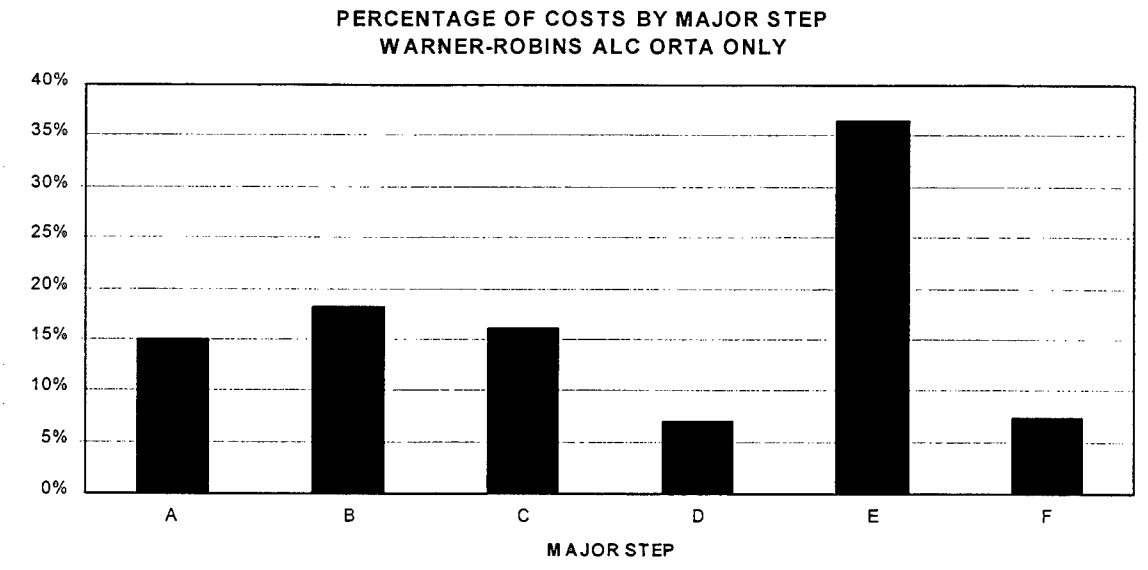


Figure 20. Percent of Costs by Major Step - Warner-Robins ALC ORTA

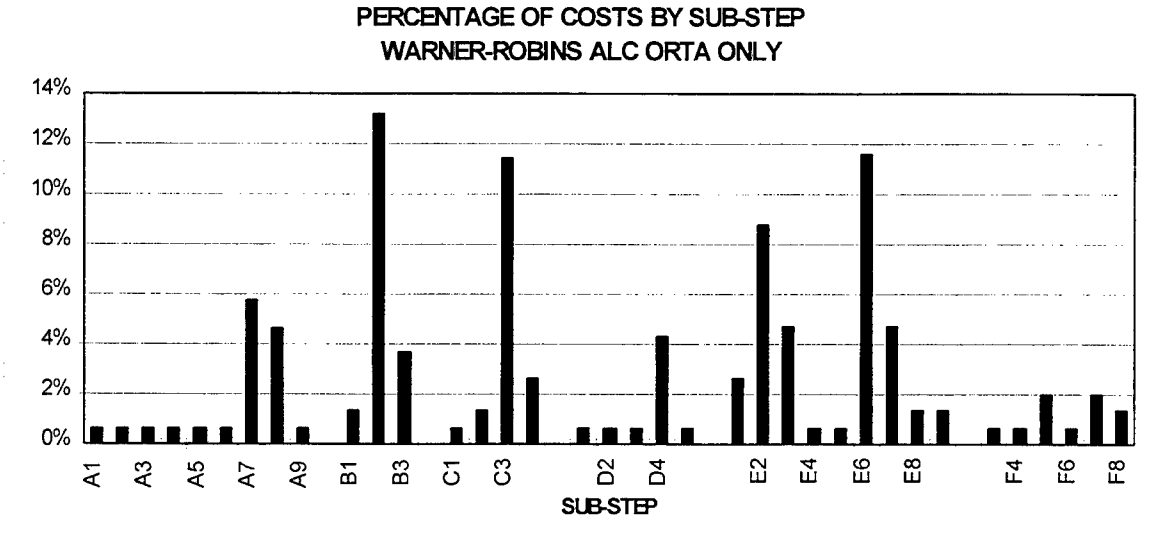


Figure 21. Percent of Costs by Sub-step - Warner-Robins ALC ORTA

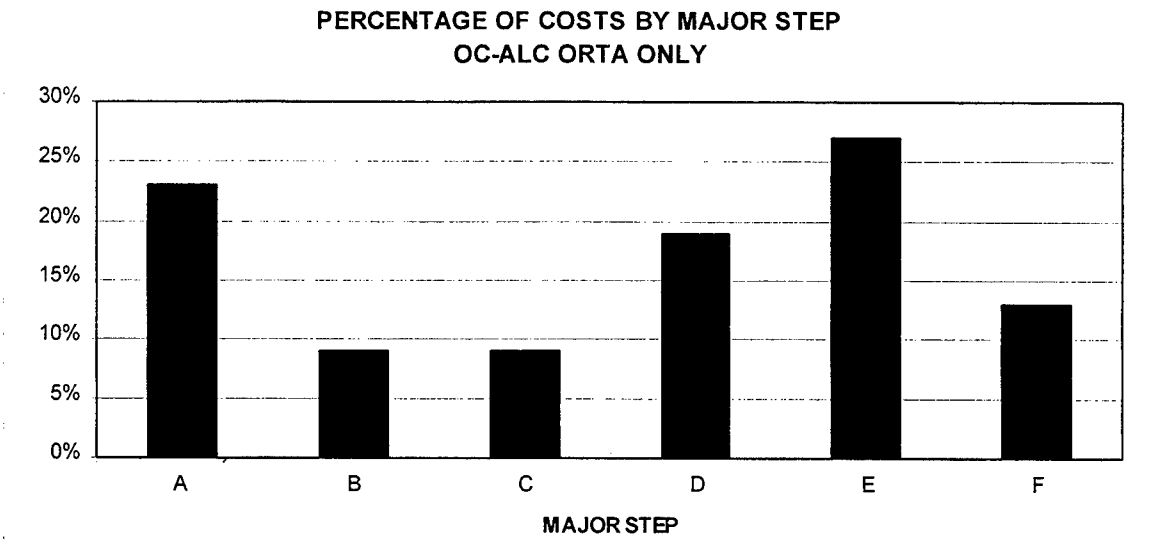


Figure 22. Percent of Costs by Major Step - Oklahoma City ALC ORTA

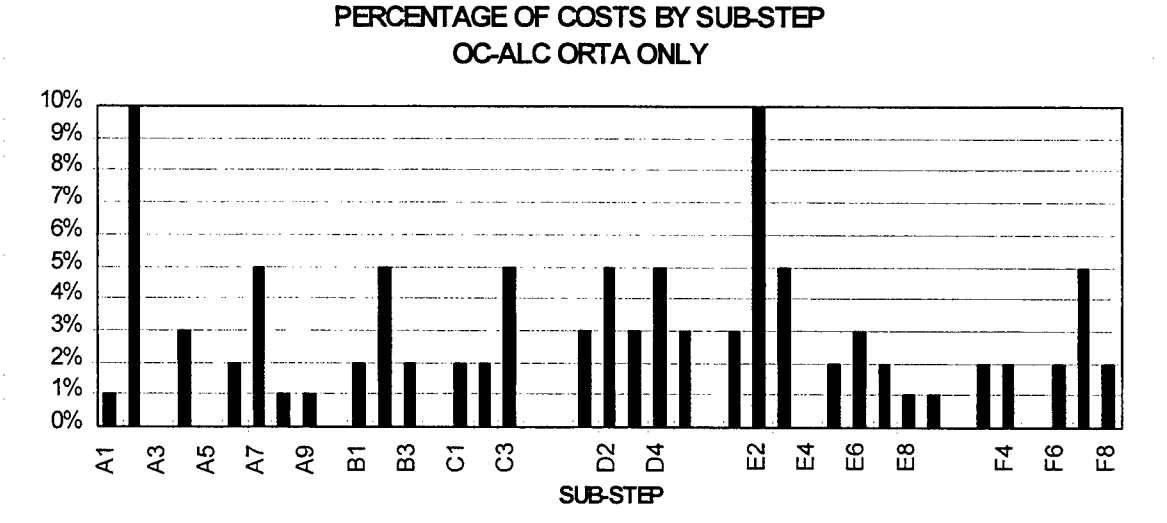


Figure 23. Percent of Costs by Sub-step - Oklahoma City ALC ORTA

Due to the small size of the ALC ORTAs, there was significant differences between the ALCs among the activities being performed. Ogden ALC expended 52

percent of its total resources in major step E, but surprisingly only two percent in sub-step E6. This is a very small percentage when compared to Warner-Robins ALC, in which nearly one third of the 36.4 percent (11.6 percent) consumed by major step E was expended in sub-step E6. Ogden ALC had no resources consumed in 13 sub-steps, while Oklahoma City ALC had only five sub-steps with no resources. Warner-Robins ALC reported significant expenditures in all the sub-steps, but 17 sub-steps were just barely so at 0.6 percent.

The Test Centers. A separate spreadsheet was also created for the two test centers in order to combine their cost and man hour expenditure per activity. The percentage of total test center resource cost per activity was calculated and the results are presented as Figures 24 for the major steps and 25 for the sub-steps. The two test centers' percentage of cost per activity was also calculated and their results can be found in Figures 26 through 29.

Figure 24 shows similar results to Figure 6, in that the test centers expend approximately the same percentage of resources in each major step as the total resources of all ORTAs. However, Figure 25 is quite different than Figure 7, which means the test centers do not expend their resources in the same sub-steps (activities) as all ORTAs combined. There were three sub-steps that had no resources consumed in the test center ORTAs and they all fell under major step F, post-transfer administration (F5, transfer revenue allocation; F6, award and recognize individuals; and F8, prepare performance reports). Two sub-steps which are significant in all other ORTA organization (B1, query

database and B3, maintain information base) were only slightly significant in the test centers, consuming only 0.6 percent of test center ORTA resources. The reason the major steps were similar and the sub-steps differed is that one test center (Air Force Development Test Center - AFDTC) closely resembled a laboratory in resources and TT activity. The other test center (Air Force Flight Test Center - AFFTC) was one person deep and resembled an ALC in resources and TT activity. Therefore, the Development Test Center drove the percentages of resources in the major steps, but the Flight Test Center influenced the results of the sub-steps ORTA resource consumption rate.

Because each of the two test centers closely resembled the two opposite ends of the ORTA spectrum, there were many differences between them. The AFDTC had no resources expended in the same three sub-steps as the combined test center ORTAs. It also had three sub-steps that were nearly insignificant; A5, receive funding authority; B1, query database, and B3, maintain information base. It did have a significant amount of resources expended in sub-step E8, collect transfer revenues, which was insignificant in most ORTA organizations and at the combined ORA level. The AFFTC, which resembled an ALC in resources and TT activity, had 24 sub-steps that consumed no resources. Being a one person ORTA, the activity resource consumption rate depended upon the activities performed by that individual.

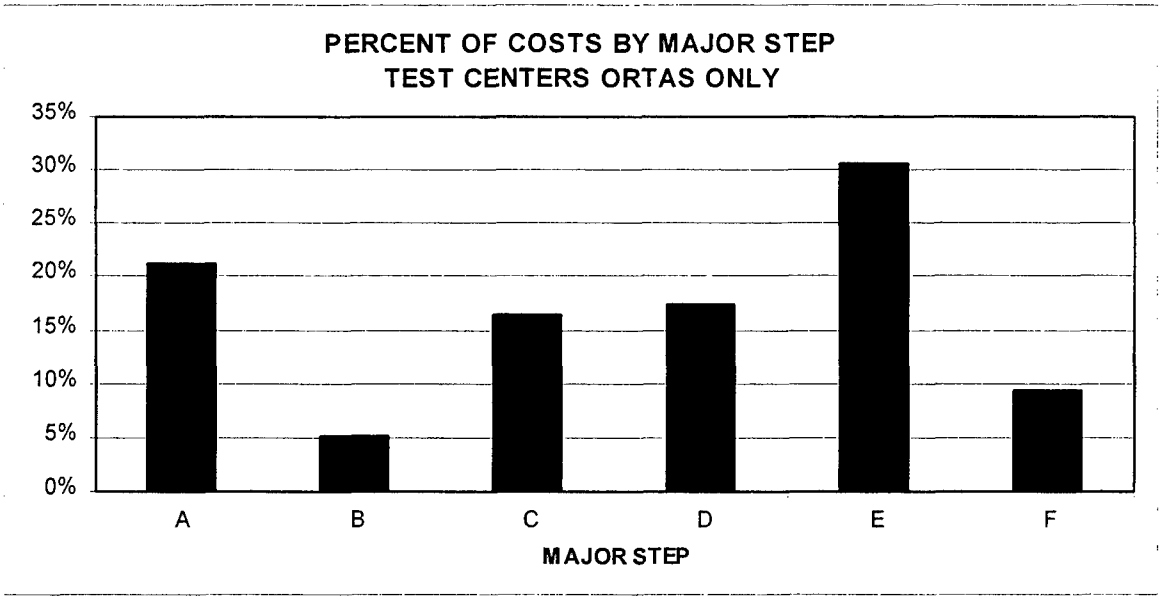


Figure 24. Percent of Costs by Major Step - All Test Centers ORTAs

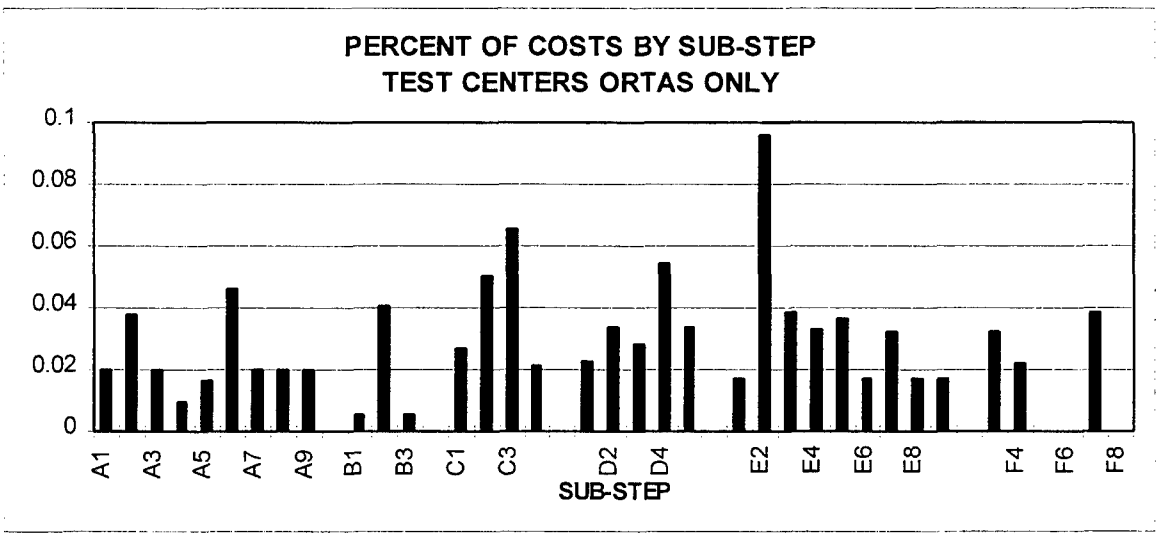


Figure 25. Percent of Costs by Sub-step - All Test Centers ORTAs

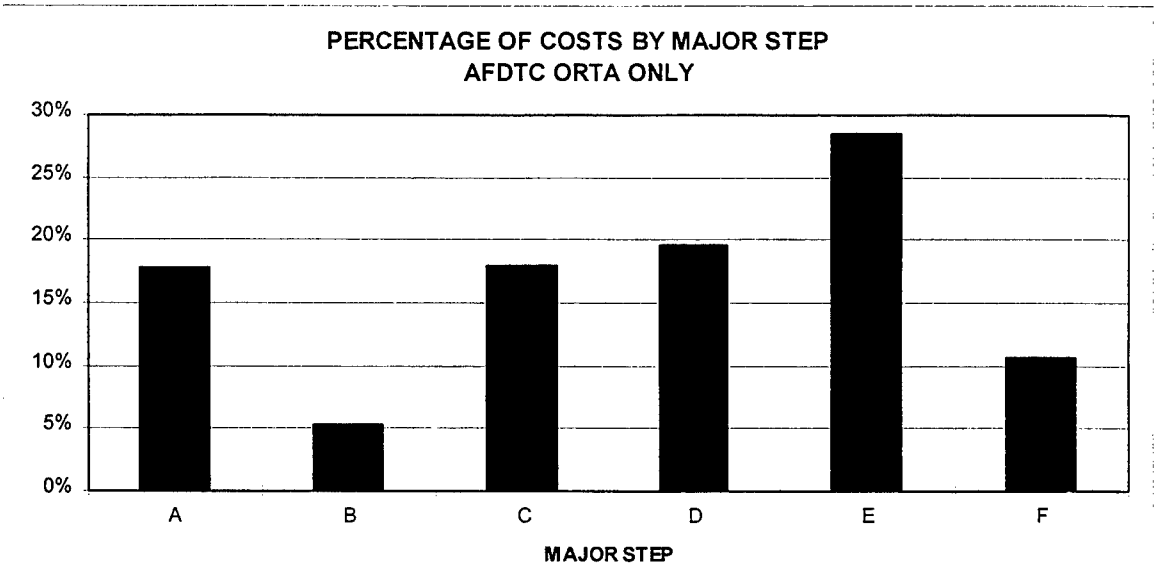


Figure 26. Percent of Costs by Major Step - AFDTC ORTA

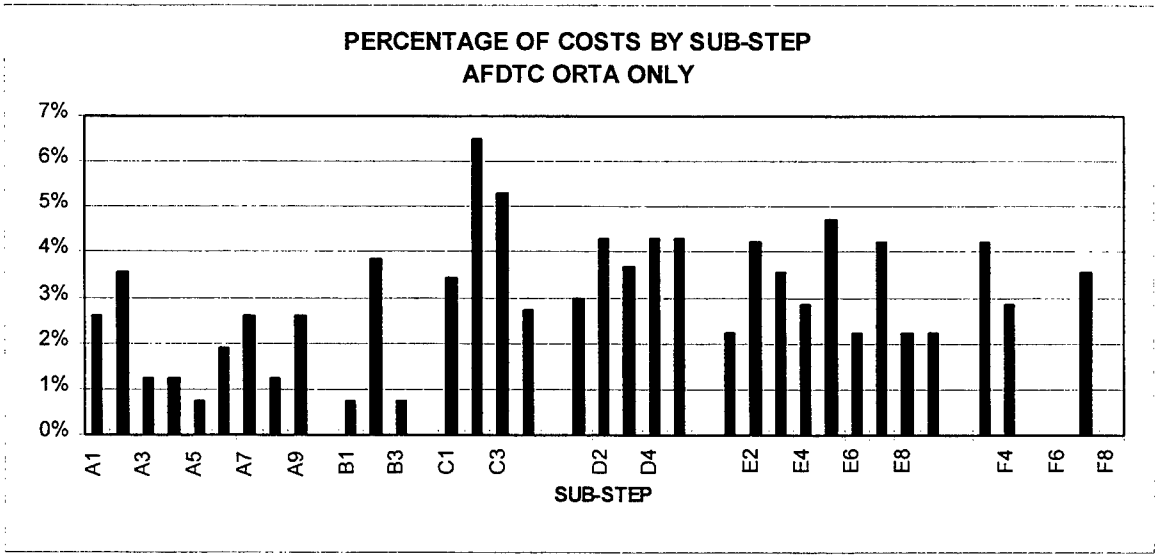


Figure 27. Percent of Costs by Sub-step - AFDTC ORTA

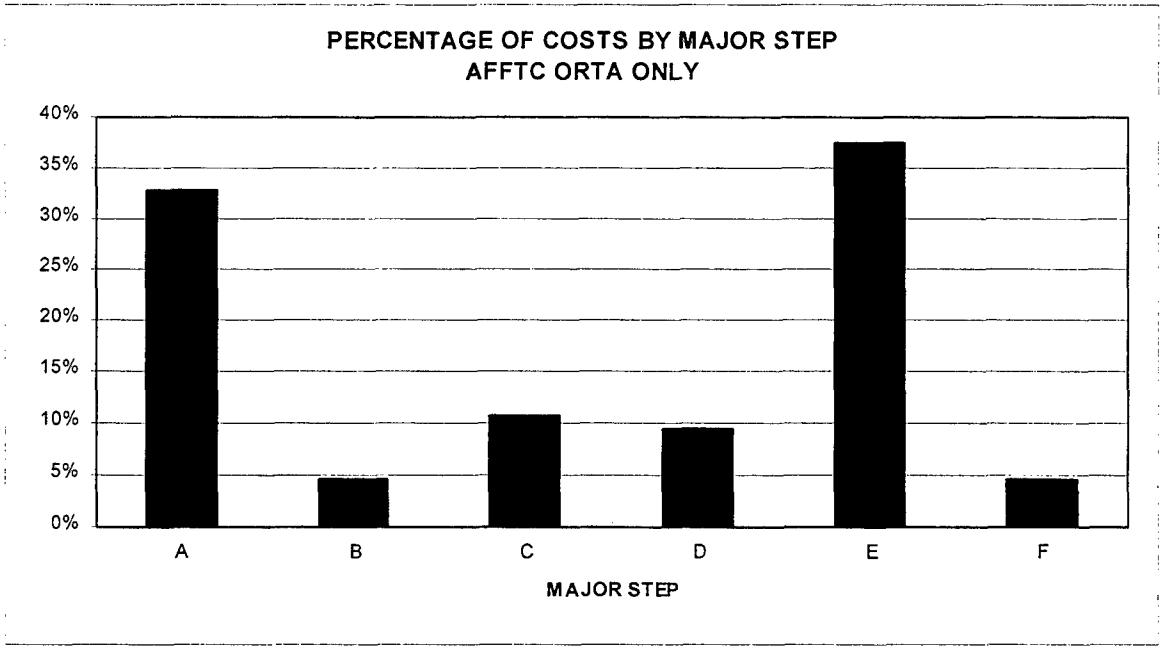


Figure 28. Percent of Costs by Major Step - AFDTC ORTA

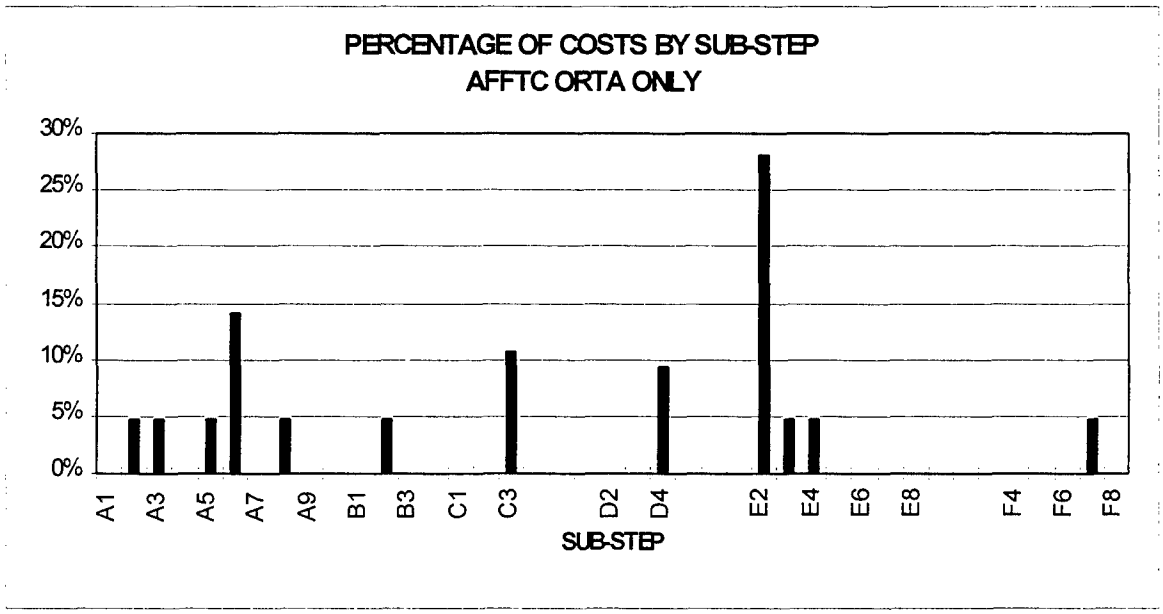


Figure 29. Percent of Costs by Sub-step - AFDTC ORTA

Cost per CRDA. The total costs of all resources at each ORTA organization was calculated, along with the TT activity level in terms of the number of CRDAs. From these figures, a cost per CRDA was calculated for each ORTA and presented in Table 1. It was originally hypothesized that a "step-wise" consumption of resources would become evident based on the activity level of the ORTA in terms of CRDAs. However, the results in Table 1 show huge differences not only between the laboratories, ALCs, and test centers, but also within them. Economies of scale is evident among the ALCs, where Ogden ALC had the lowest cost per CRDA and the most CRDAs of the ALCs. This was not the case at the laboratories, where increasing the number of CRDAs does not necessarily decrease the cost per CRDA.

It must be pointed out that although a CRDA does represent some form of TT, it does not imply what is being transferred, nor the value of technology being transferred. Differences in missions exists not only between the laboratories, ALCs, and test centers, but within them as well. For instance, both Phillips Laboratory and Oklahoma City ALC, which have two of the three highest costs per CRDA, stated they are heavily involved in Educational Partnership Agreements (EPAs) with local universities, and that the EPAs consume a substantial portion of the ORTAs resources. Therefore, better results may have been obtained if an economic value of the CRDAs and EPAs could have been obtained, and then a cost to value added calculated.

Table 1. ORTA Cost per CRDA

COST PER CRDA BY ORTA ORGANIZATION		
ORGANIZATION	# OF CRDAs	ORTA COST PER CRDA
WRIGHT LABORATORIES	82	$12,318
ROME LABORATORIES	56	$8,698
PHILLIPS LABORATORIES	74	$33,850
OGDEN ALC	15	$1,353
WARNER-ROBINS ALC	13	$4,695
OKLAHOMA CITY ALC	3	$23,089
AFFTC	20	$3,863
AFDTC	11	$24,442

Summary

This chapter presented the analysis of the data and the results obtained. First, the problems encountered with the data collection was discussed. This was followed with the data calculations performed in the various sections of the spreadsheets described in Chapter III. Then, the analysis of the data was presented, in which activity-based costing was used to allocate organizational level costs to the various activities performed by the ORTA personnel. Finally, the results of the analysis was presented, starting with the total of all ORTAs and working towards the individual ORTAs. Chapter V will provide a conclusion to the results including any managerial implications, along with recommendations to future research efforts in this area.

V. Conclusions and Recommendations

Introduction

The primary objective of this research is to identify the indirect cost of performing technology transfer (TT) activities by Office of Research and Technology Applications (ORTA) personnel. Secondary objectives are to identify the activities being performed by the ORTA personnel in performing TT and to determine a "step-wise" cost of resources consumed based on the amount of transfer being conducted in the form Cooperative Research and Development Agreements (CRDAs). This chapter begins with a review of the results found in Chapter IV, taking special note of any results which were unexpected. Then, a comparison will be made to the results of a previous effort on the direct labor portion of TT, followed by the results of the "step-wise" cost per CRDA. Next, a discussion on the limitations of this research will take place, along with the managerial implications of the findings. Finally, the chapter closes with proposed future studies that can further this research.

Results Review

Major step A, strategy, consumed the largest percentage of total ORTA resources at just over 25 percent. Strategy is considered to be a managerial tasking, performed with overhead or indirect labor personnel, such as those assigned to an ORTA organization. Therefore, this high percentage of resources consumed at the total ORTA level was expected. Major step C, marketing, consumed over one fifth of the total ORTA

resources, and each of its four sub-steps are highly significant, ranging from 3.5 to over seven percent per sub-step. This too was expected, as marketing was the only major step that was identified as a cost driver for any of the organizational level categories of expense. Other expected results were obtained with major steps B, identify technology, and D, identify transfer vehicle. These two steps are interrelated (D will always take place anytime B has occurred), and both steps consume nearly equal amounts of ORTA resources when compared at the sub-step level with an average of about two percent per sub-step.

Unexpected results occurred in major steps E, perform transfer, and F, post-transfer administration, for opposite reasons. The majority of sub-steps of major step E are considered direct labor type activities, but yet step E came in a surprising second in total ORTA resources consumed (22.7 percent). However, the only sub-step which can be categorized as a direct labor only activity is sub-step E6, transfer the technology, and this sub-step only expends 2.2 percent of the ORTA resources. On the opposite end of the spectrum, major step F consumed only 10.8 percent of the total ORTA resources, which is surprisingly low considering the six sub-steps are typically those categorized as being performed with indirect labor.

There were three different types of ORTA organizations evaluated in this research: laboratories, Air Logistics Centers (ALCs), and test centers. The laboratories perform the majority of research in the Air Force, therefore they have the highest amount of technology being transferred and the most resources expended by ORTA personnel. It was not surprising to find the activities being performed by laboratory ORTAs consume

nearly the same resources (percentage wise) as the activities considering all the ORTA resources combined. The activity consumption rate of the laboratories generally drove the consumption rate of the combined ORTAs due to the high percentage of resources belonging to the laboratories. Then there are the ALC ORTAs, with their one and two person deep ORTA organizations, whose consumption rates per activity differ significantly from the overall consumption rate. The ALC ORTAs had an extremely high portion of their resources being expended in major step E (over 34 percent), but this is attributed to the small size of their ORTA organization. Finally, there are the two test centers, whose percent of resources expended by major step followed the same pattern as the overall ORTA rate, but whose sub-step expenditures differ. This is caused by one test center resembling a laboratory ORTA in terms of TT activity and resources consumed, while the other test center, with its one person shop, resembled an ALC ORTA. With this combination, the laboratory styled test center drove the overall major step expenditures, but the ALC styled test center was able to influence the results at the sub-step level. Table 2 presents a comparison of the percentages of resource consumption for each ORTA category type and the overall ORTA results for the major steps, while Table 3 presents a comparison for the sub-steps. The sub-steps found to be insignificant uses of ORTA resources have their percentages in bold text in Table 3.

Comparison to Previous Research Findings

The previous research effort on the direct labor expenditure of resources on TT activities found little or no direct labor expenditures on major steps A, B, C, and D, and

sub-steps E5, E8, F1, F4, F5, and F6. This research found all of these sub-steps to be significant (over one half percent of total ORTA resources) users of ORTA resources except for E8, collect transfer revenues and F5, transfer revenue allocation. Since the objective of the ORTAs is to transfer technology, it can be expected that little time or resources will be expended in performing these steps. It is likely that these activities are being performed at the financial management branch of the organization and not at the ORTA at all. It would be interesting to find out if the same results would be obtained in the private sector, where revenues and profit play a much higher role than in government. Two other sub-steps are just barely significant: A5, receive funding authority, with just under one percent, and D5, reaffirm appropriate vehicle, with just over one half of one percent of total ORTA resources expended. It should be noted that being insignificant in resources consumed does not imply a sub-step is not being performed, it just means it requires very little time to complete or it is being performed at some other office other than the ORTA.

Table 2. Comparison by Major Step.

Major Step	All ORTAs	Laboratories	ALCs	Test Centers
A (Strategy)	25.6	26.2	17.3	21.2
B (Identify Technology)	6.7	6.6	12.2	5.2
C (Marketing)	21.3	22.1	11.3	16.4
D (Identify Vehicle)	11.6	11.1	12.5	17.3
E (Transfer Technology)	22.7	21.6	34.2	30.6
F (Post-Transfer Administration)	10.8	10.9	12.5	9.3
Other	1.3	1.5	0	0

Table 3. Comparison by Sub-step.

Sub-step	All ORTAs	Laboratories	ALCs	Test Centers
A1 (Establish Transfer Thrusts)	2.8	2.9	0.7	2.0
A2 (Coordinate with the Players)	4.2	4.2	4.9	3.8
A3 (Resource Requirements into Budget)	1.4	1.4	**0.2**	2.0
A4 (Submit TT Plans)	1.7	1.7	2.3	1.0
A5 (Receive Funding Authority)	0.8	0.7	**0.2**	1.6
A6 (Implement Strategy Plan)	3.4	3.4	1.2	4.6
A7 (Monitor Transfer Initiatives)	3.8	3.9	4.6	2.0
A8 (Assess Use of Technology)	4.0	4.2	2.3	2.0
A9 (Assess Return on Investment)	3.5	3.7	0.7	2.0
B1 (Query Database)	1.1	1.1	1.4	0.6
B2 (Evaluate Technology Assets)	3.8	3.6	8.3	4.1
B3 (Maintain Information Base)	1.7	1.8	2.4	0.6
C1 (Develop Marketing Strategy)	4.2	4.5	1.2	2.7
C2 (Implement Strategy)	6.4	6.7	1.5	5.0
C3 (Promote Technology Assets)	7.1	7.2	7.6	6.5
C4 (Create Technology Demand)	3.5	3.7	1.1	2.1
D1 (Review Vehicle Selection)	2.8	2.8	1.9	2.3
D2 (Confirm with Transfer Partner)	1.8	1.7	2.8	3.4
D3 (Establish Transfer Framework)	3.0	3.0	1.8	2.9
D4 (Coordinate with Internal Partner)	3.5	3.3	4.2	5.4
D5 (Reaffirm Appropriate Vehicle)	0.5	**0.3**	1.8	3.4
E1 (Define Desired Results)	3.0	3.1	2.7	1.7
E2 (Coordinate with Appropriate Players)	4.2	3.5	9.5	9.6
E3 (Negotiate Terms of Vehicle)	3.1	2.9	6.9	3.8
E4 (Review for Legal Sufficiency)	1.6	1.5	0.9	3.3
E5 (Authorize the Transfer)	4.9	5.2	1.3	3.7
E6 (Transfer the Technology)	2.2	2.1	6.4	1.7
E7 (Monitor Technical/Admin Aspects)	2.2	2.1	4.2	3.2
E8 (Collect transfer Revenues)	**0.3**	**0.2**	1.1	1.7
E9 (Close Out the Transfer)	1.2	1.2	1.1	1.7
F1 (Track Process Implement)	2.5	2.5	1.9	3.3
F4 (Transfer Activity Evaluation)	3.0	3.1	1.9	2.2
F5 (Transfer Revenue Allocation)	**0.2**	**0.2**	1.0	**0**
F6 (award and Recognize Individuals)	1.0	1.0	1.9	**0**
F7 (Public Relations)	2.8	2.6	3.8	3.8
F8 (Prepare Performance reports)	1.4	1.5	2.1	**0**
Other	1.3	1.5	**0**	**0**

Step-wise Cost per CRDA

The results of the ORTA cost per CRDA from Chapter IV are shown in Table 4 for reference.

Table 4. ORTA Cost per CRDA

COST PER CRDA BY ORTA ORGANIZATION		
ORGANIZATION	# OF CRDAs	ORTA COST PER CRDA
WRIGHT LABORATORIES	82	$12,318
ROME LABORATORIES	56	$8,698
PHILLIPS LABORATORIES	74	$33,850
OGDEN ALC	15	$1,353
WARNER-ROBINS ALC	13	$4,695
OKLAHOMA CITY ALC	3	$23,089
AFFTC	20	$3,863
AFDTC	11	$24,442

It was originally hypothesized that a "step-wise" cost of ORTA resources consumed based on the TT activity level in number of CRDAs could have been determined. However, the results indicate there is no economies of scale in comparing all the ORTA organizations. Increasing the number of CRDAs does not necessarily decrease the cost per CRDA as expected. The only area in which economies of scale are evident is within the ALCs.

A quick linear regression was performed on the data in Table 4 using Microsoft's Excel spreadsheet program to model the ORTA cost per CRDA. The ORTA cost per CRDA was used as the dependent variable and the number of CRDAs as the independent variable. The results of this analysis are presented in Table 5.

Table 5. Regression of Cost per CRDA Data.

Parameter	Value
Coefficient of Determination	0.064
F-score	0.41
Significance of F	0.545

The regression analysis results confirm the inability to estimate the expected resources consumed per CRDA when the number of CRDAs is known. The regression model is not significant, as its F-score of 0.41 shows. Generally, a significance of F of 0.10 or less is preferred, and the resultant significance of 0.545 represents a confidence that the model will accurately estimate the cost per CRDA of only 45.5 percent. There is too much variation in the cost per CRDA among the ORTA organizations to accurately predict it, as the coefficient of determination indicates. Its value of 0.064 means only 6.4 percent of the variation in the cost per CRDA can be explained by the change in the number of CRDAs, the remainder (93.6 percent) is simply variation of the cost per CRDA among the various ORTA organizations. A coefficient of determination of 0.70 or higher is generally considered acceptable.

Limitations

The limitations of this study must be known before the implications of the results can be stated.

First, the comparisons made among the three types of ORTA organizations was made to indicate the similarities and differences among them, not to indicate activities that specific ORTAs are not accomplishing. Only at the overall ORTA level should

activities be identified that are not being performed. Differences in the missions between the different types of ORTAs, and among the ORTAs of a specific type such as ALCs, makes identifying activities not performed at a specific ORTA organization in order to state "this ORTA is not doing its job in these areas" valueless.

Next, the cost per CRDA should not be used to identify efficient ORTA organizations over inefficient ones. Once again, the differences in missions among the various ORTAs play a part in this, as several ORTAs identified that a significant portion of their resources is expended in performing Educational Partnership Agreements (EPAs), which were not tracked in this study. Also, the number of CRDAs does not accurately measure the true economic value of the technology being transferred, it is simply an indicator of how much technology is being transferred. Determining the economic value of the technology transferred is beyond the scope of this study. With these two limitations in mind, the managerial implications of the results can be addressed.

Managerial Implications

There are two sub-steps identified as not being performed at a significant level at the ORTAs nor from a previous study on direct labor: E8, collect transfer revenues and F5, transfer revenue allocation. Both of these sub-steps are involved with the revenues obtained from the receiver of the technology. Should this activity ever become significant within the ORTA organizations, additional resources may be necessary, probably in the form of additional manpower.

A recent decision was made to merge the four laboratories at the headquarters level. This decision will not affect the location of the laboratories, but will effect their ORTAs, which will become a single entity (the Air Force Research Laboratory - AFRL) managing all four laboratories from one location. From the results of the cost per CRDA in Table 2, it is evident that the laboratories have a significantly higher number of CRDAs than the other ORTA types (ALCs and test centers). Also, their ORTA cost per CRDA is relatively higher. Therefore, in determining the staffing and resource requirement of the new single laboratory ORTA, these results should be used to indicate the differences among the various types of ORTAs, and not to cut resources so that it more closely resembles an ALC or test center. The economic value of the CRDAs being performed at the various ORTAs could not be determined in this research effort, which is the topic of the next section, future studies. Assuming the same economic value for all CRDAs (and not considering EPAs), it would appear that Wright or Rome Laboratories would be a better choice to approximate in terms of cost per CRDA for the new AFRL organization. Phillips Laboratory may be over-manned at its current level of TT activity.

Future Studies

Although a cost per CRDA was determined and it does indicate differences among the ORTA organizations, it can be misread into how efficient or inefficient an ORTA organization is. A better measure of an ORTA's efficiency would be to determine the economic value of the technology being transferred. Since the costs of transferring this technology within an ORTA have already been identified, it would be a simply task

to calculate the cost to economic value (or cost to benefits) ratio of each ORTA. This research stream would require a significant effort on the part of the researcher to identify not only who is receiving the technology, but what they are doing with it, the value they obtained from it, and any spinbacks the government may have received in the form of better products. It would also require a significant amount of traveling to the various ORTA locations and to the companies receiving the technology. A pilot study could be performed on several CRDAs at Wright Laboratory to determine the feasibility of expanding to all ORTAs.

Another proposed research effort is to repeat this research on a commercial TT organization such as a university that performs a significant amount of government research. It would be very interesting to discover the amount of time spent by the commercial activity on this efforts' two insignificant sub-steps relating to the collection of revenues. Unlike the government, the commercial sector is very concerned with profits. The methodology of this study would have to be changed to adapt it to the commercial sector, as they would not necessarily use the same activities identified in the Transfer Master Process of Appendix A.

Appendix A - Transfer Master Process (TMP)

Major Step A: Strategy.
- Sub-step A1: Establish Transfer Thrusts
- Sub-step A2: Coordinate with the Players
- Sub-step A3: Resource Requirements into Budget
- Sub-step A4: Submit Technology Transfer Plans
- Sub-step A5: Receive Funding Authority
- Sub-step A6: Implement Strategy Plan
- Sub-step A7: Monitor Transfer Initiatives
- Sub-step A8: Assess Use of Technology
- Sub-step A9: Assess Return on Investment

Major Step B: Identify Technology.
- Sub-step B1: Query Database
- Sub-step B2: Evaluate Technology Assets
- Sub-step B3: Maintain Information Base

Major Step C: Marketing.
- Sub-step C1: Develop Marketing Strategy
- Sub-step C2: Implement Strategy
- Sub-step C3: Promote Technology Assets
- Sub-step C4: Create technology Demand

Major Step D: Identify Transfer Vehicle.
- Sub-step D1: Review Vehicle Selection
- Sub-step D2: Confirm with Transfer Partner
- Sub-step D3: Establish Transfer Framework
- Sub-step D4: Coordinate with Internal Partner
- Sub-step D5: Reaffirm Appropriate Vehicle

Major Step E: Perform Transfer.
- Sub-step E1: Define Desired Results
- Sub-step E2: Coordinate w/Appropriate Players
- Sub-step E3: Negotiate Terms of Vehicle
- Sub-step E4: Review for Legal Sufficiency
- Sub-step E5: Authorize the Transfer
- Sub-step E6: Transfer the Technology
- Sub-step E7: Monitor Technical and Admin Aspects
- Sub-step E8: Collect Transfer Revenues
- Sub-step E9: Close Out the Transfer

Major Step F: Post-Transfer Administration.
- Sub-step F1: Track Process Implement
- Sub-step F4: Transfer Activity Evaluation
- Sub-step F5: Transfer Revenue Allocation
- Sub-step F6: Award and Recognize Individuals
- Sub-step F7: Public Relations
- Sub-step F8: Prepare Performance Reports

Appendix B - ORTA Personnel Questionnaire

Questionnaire for ORTA Personnel

Name:

Military Rank / Civilian Grade and Step / Contractor Annual Salary:

Organization:

1. Do you perform ORTA Duties on a Full or Part Time Basis:

2. If Part Time, what percentage of your time is spent performing ORTA duties:

3. The Master Transfer Process, as described in the AFMC Technology Transfer Handbook, section D will be used to identify the amount of time you spend performing each activity. Please estimate the portion of your time that is spent in performing each activity as a percentage of the total time spent performing ORTA activities. Therefore, the total should equal 100 percent.

Major Step A: Strategy.		
Sub-step A1:	Establish Transfer Thrusts	0%
Sub-step A2:	Coordinate with the Players	0%
Sub-step A3:	Resource Requirements into Budget	0%
Sub-step A4:	Submit Technology Transfer Plans	0%
Sub-step A5:	Receive Funding Authority	0%
Sub-step A6:	Implement Strategy Plan	0%
Sub-step A7:	Monitor Transfer Initiatives	0%
Sub-step A8:	Assess Use of Technology	0%
Sub-step A9:	Assess Return on Investment	0%
Major Step B: Identify Technology.		
Sub-step B1:	Query Database	0%
Sub-step B2:	Evaluate Technology Assets	0%
Sub-step B3:	Maintain Information Base	0%
Major Step C: Marketing.		
Sub-step C1:	Develop Marketing Strategy	0%
Sub-step C2:	Implement Strategy	0%
Sub-step C3:	Promote Technology Assets	0%
Sub-step C4:	Create technology Demand	0%

Major Step D: Identify Transfer Vehicle.

Sub-step D1: Review Vehicle Selection	0%
Sub-step D2: Confirm with Transfer Partner	0%
Sub-step D3: Establish Transfer Framework	0%
Sub-step D4: Coordinate with Internal Partner	0%
Sub-step D5: Reaffirm Appropriate Vehicle	0%

Major Step E: Perform Transfer.

Sub-step E1: Define Desired Results	0%
Sub-step E2: Coordinate w/Appropriate Players	0%
Sub-step E3: Negotiate Terms of Vehicle	0%
Sub-step E4: Review for Legal Sufficiency	0%
Sub-step E5: Authorize the Transfer	0%
Sub-step E6: Transfer the Technology	0%
Sub-step E7: Monitor Technical and Admin Aspects	0%
Sub-step E8: Collect Transfer Revenues	0%
Sub-step E9: Close Out the Transfer	0%

Major Step F: Post-Transfer Administration.

Sub-step F1: Track Process Implement	0%
Sub-step F4: Transfer Activity Evaluation	0%
Sub-step F5: Transfer Revenue Allocation	0%
Sub-step F6: Award and Recognize Individuals	0%
Sub-step F7: Public Relations	0%
Sub-step F8: Prepare Performance Reports	0%

4. Are there any other sub-steps not included above, which you feel should be included in the performance of ORTA activities? If so, please list them here along with the percentage of time spent performing that step if applicable:

Sub-step X:	0%
Sub-step Y:	0%
Total	0%

Appendix C- ORTA POC Questionnaire

Questionnaire for ORTA Director

Name:

Organization:

1. Number of personnel performing ORTA Duties in your organization (including self):

Full Time: **0**
Part Time: **0**

2. Number of CRADAs existing during any part of FY97:

Closed during FY97:	**0**
Open for all of FY97:	**0**
Created in FY97:	**0**

3. Organizational expenses occurred in FY97 by ORTA personnel while performing ORTA duties or otherwise related to ORTA activities:

Travel:	**$0**
General office supplies:	**$0**
Computer Equipment:	**$0**
Marketing:	**$0**
Training:	**$0**
Contract Services:	**$0**
Other (Please Specify):	**$0**

4. Any other comments:

Organization: **OO-ALC/TIE, Hill AFB, UT 84056-5713**

1. Number of personnel performing ORTA Duties in your organization (including self):
Full Time: **0**
Part Time: **1**

2. Number of CRDAs existing during any part of FY97:
Closed during FY97: **2**
Open for all of FY97: **12**
Created in FY97: **1**

3. Organizational expenses occurred in FY97 by ORTA personnel:

	Costs	Cost Driver
Travel:	**$5K**	ALL
General office supplies	**$0**	
Computer Equipment:	**$0**	
Marketing:	**$0**	
Training:	**$0**	
Contract Services:	**$0**	
Other (Please Specify)	**$0**	

Personnel

Grade	Cost	% ORTA	Cost	Hrs Avail	Hrs ORTA
1) GS-13	76498	20	15299.6	1776	355.2

Organizational Costs

Type	Cost	Driver	Total
Travel	5000	All	5000
		Total	20299.6
		COST/CRDA	1353.307

	Person #1 % of time per activity	Labor $s per activity	Labor Hrs per activity	Organizational Costs	TOTAL COSTS	TOTAL HOURS
Major Step A: Strategy.		$765	17.76	$250	$1,015	17.76
A1: Establish Transfer Thrusts	0%	$0	0	$0	$0	0
A2: Coordinate with the Players	0%	$0	0	$0	$0	0
A3: Resource Requirements into Budget	0%	$0	0	$0	$0	0
A4: Submit Technology Transfer Plans	5%	$765	17.76	$250	$1,015	17.76
A5: Receive Funding Authority	0%	$0	0	$0	$0	0
A6: Implement Strategy Plan	0%	$0	0	$0	$0	0
A7: Monitor Transfer Initiatives	0%	$0	0	$0	$0	0
A8: Assess Use of Technology	0%	$0	0	$0	$0	0
A9: Assess Return on Investment	0%	$0	0	$0	$0	0
Major Step B: Identify Technology.		$765	17.76	$250	$1,015	17.76
B1: Query Database	0%	$0	0	$0	$0	0
B2: Evaluate Technology Assets	5%	$765	17.76	$250	$1,015	17.76
B3: Maintain Information Base	0%	$0	0	$0	$0	0

Major Step C: Marketing.		$765	17.76	$250		$1,015	17.76
C1: Develop Marketing Strategy	0%	$0	0	$0		$0	0
C2: Implement Strategy	0%	$0	0	$0		$0	0
C3: Promote Technology Assets	5%	$765	17.76	$250		$1,015	17.76
C4: Create technology Demand	0%	$0	0	$0		$0	0
Major Step D: Identify Transfer Vehicle.		$1,071	24.864	$350		$1,421	24.864
D1: Review Vehicle Selection	2%	$306	7.104	$100		$406	7.104
D2: Confirm with Transfer Partner	2%	$306	7.104	$100		$406	7.104
D3: Establish Transfer Framework	1%	$153	3.552	$50		$203	3.552
D4: Coordinate with Internal Partner	1%	$153	3.552	$50		$203	3.552
D5: Reaffirm Appropriate Vehicle	1%	$153	3.552	$50		$203	3.552
Major Step E: Perform Transfer.		$7,956	177.6	$2,600		$10,556	177.6
E1: Define Desired Results	2%	$306	7.104	$100		$406	7.104
E2: Coordinate w/Appropriate Players	10%	$1,530	35.52	$500		$2,030	35.52
E3: Negotiate Terms of Vehicle	20%	$3,060	71.04	$1,000		$4,060	71.04
E4: Review for Legal Sufficiency	5%	$765	17.76	$250		$1,015	17.76
E5: Authorize the Transfer	1%	$153	3.552	$50		$203	3.552
E6: Transfer the Technology	2%	$306	7.104	$100		$406	7.104
E7: Monitor Technical and Admin Aspects	10%	$1,530	35.52	$500		$2,030	35.52
E8: Collect Transfer Revenues	1%	$153	3.552	$50		$203	3.552
E9: Close Out the Transfer	1%	$153	3.552	$50		$203	3.552
Major Step F: Post-Transfer Administration.		$3,978	92.352	$1,300		$5,278	92.352
F1: Track Process Implement	5%	$765	17.76	$250		$1,015	17.76
F4: Transfer Activity Evaluation	5%	$765	17.76	$250		$1,015	17.76
F5: Transfer Revenue Allocation	1%	$153	3.552	$50		$203	3.552
F6: Award and Recognize Individuals	5%	$765	17.76	$250		$1,015	17.76
F7: Public Relations	5%	$765	17.76	$250		$1,015	17.76
F8: Prepare Performance Reports	5%	$765	17.76	$250		$1,015	17.76

Percent by Sub-Step		Percent by Major Step	
A1	0	A	0.05
A2	0	B	0.05
A3	0	C	0.05
A4	0.05	D	0.07
A5	0	E	0.52
A6	0	F	0.26
A7	0		
A8	0		
A9	0		
B1	0		
B2	0.05		
B3	0		
C1	0		
C2	0		
C3	0.05		
C4	0		
D1	0.02		
D2	0.02		
D3	0.01		
D4	0.01		
D5	0.01		
E1	0.02		
E2	0.1		
E3	0.2		
E4	0.05		
E5	0.01		
E6	0.02		
E7	0.1		
E8	0.01		
E9	0.01		
F1	0.05		
F4	0.05		
F5	0.01		
F6	0.05		
F7	0.05		
F8	0.05		

Organization: **PL/XPI**

1. Number of personnel performing ORTA Duties in your organization (including self):

Full Time: **12**

Part Time: **8**

2. Number of CRDAs existing during any part of FY97:

		EPAs
Closed during FY97:	**8**	0
Open for all of FY97:	**48**	15
Created in FY97:	**18**	16

3. Organizational expenses occurred in FY97 by ORTA personnel:

	Costs	Cost Driver
Travel:	**$50,000**	ALL
General office supplies	**$15,000**	ALL
Computer Equipment:	**$25,000**	ALL
Marketing:	**$120,000**	STEP C
Training:	**$50,000**	ALL
Contract Services:	**$750,000**	ALL
Other (4 IPAs):	**$300,000**	ALL

Personnel Grade	Cost	% ORTA	Cost	Hrs Avail	Hrs ORTA
1) SES	123344	100	123344	1776	1776
2) 2xGS-5	59884	100	59884	3552	3552
3) 2xGS-9	87434	100	87434	3552	3552
4) 2xGS-11	105496	100	105496	3552	3552
5) 2xGS-13	152996	100	152996	3552	3552
6) 3xGS-13	229494	50	114747	5328	2664
7) 2xGS-14	184668	100	184668	3552	3552
8) 2xGS-14	184668	50	92334	3552	1776
9) GS-15	109608	100	109608	1776	1776
10) 3xGS-1	328824	50	164412	5328	2664
		TOTAL	1194923		28416

TOTAL COSTS	2504923
COST/CRDA	33850.31
COST/(CRDA+EPA)	23856.41

	% of time per activity	Labor $s per activit	Labor Hrs per activit	Organizational Costs Cost Driver ALL	Organizational Costs Cost Driver Step C	TOTAL COSTS	TOTAL HOURS
Major Step A: Strategy.		$430,172	10229.76	$428,400	$0	$858,572	10229.76
A1: Establish Transfer Thrusts	4%	$47,797	1136.64	$47,600	$0	$95,397	1136.64
A2: Coordinate with the Players	5%	$59,746	1420.8	$59,500	$0	$119,246	1420.8
A3: Resource Requirements into Budget	2%	$23,898	568.32	$23,800	$0	$47,698	568.32
A4: Submit Technology Transfer Plans	2%	$23,898	568.32	$23,800	$0	$47,698	568.32
A5: Receive Funding Authority	1%	$11,949	284.16	$11,900	$0	$23,849	284.16
A6: Implement Strategy Plan	5%	$59,746	1420.8	$59,500	$0	$119,246	1420.8
A7: Monitor Transfer Initiatives	5%	$59,746	1420.8	$59,500	$0	$119,246	1420.8
A8: Assess Use of Technology	6%	$71,695	1704.96	$71,400	$0	$143,095	1704.96
A9: Assess Return on Investment	6%	$71,695	1704.96	$71,400	$0	$143,095	1704.96
Major Step B: Identify Technology.		$83,645	1989.12	$83,300	$0	$166,945	1989.12
B1: Query Database	1%	$11,949	284.16	$11,900	$0	$23,849	284.16
B2: Evaluate Technology Assets	5%	$59,746	1420.8	$59,500	$0	$119,246	1420.8
B3: Maintain Information Base	1%	$11,949	284.16	$11,900	$0	$23,849	284.16

Major Step C: Marketing.		$215,086	5114.88	$214,200	$120,000	$549,286	5114.88
C1: Develop Marketing Strategy	4%	$47,797	1136.64	$47,600	$26,667	$122,064	1136.64
C2: Implement Strategy	4%	$47,797	1136.64	$47,600	$26,667	$122,064	1136.64
C3: Promote Technology Assets	6%	$71,695	1704.96	$71,400	$40,000	$183,095	1704.96
C4: Create technology Demand	4%	$47,797	1136.64	$47,600	$26,667	$122,064	1136.64
Major Step D: Identify Transfer Vehicle.		$155,340	3694.08	$154,700	$0	$310,040	3694.08
D1: Review Vehicle Selection	4%	$47,797	1136.64	$47,600	$0	$95,397	1136.64
D2: Confirm with Transfer Partner	2%	$23,898	568.32	$23,800	$0	$47,698	568.32
D3: Establish Transfer Framework	4%	$47,797	1136.64	$47,600	$0	$95,397	1136.64
D4: Coordinate with Internal Partner	3%	$35,848	852.48	$35,700	$0	$71,548	852.48
D5: Reaffirm Appropriate Vehicle	0%	$0	0	$0	$0	$0	0
Major Step E: Perform Transfer.		$191,188	4546.56	$190,400	$0	$381,588	4546.56
E1: Define Desired Results	4%	$47,797	1136.64	$47,600	$0	$95,397	1136.64
E2: Coordinate w/Appropriate Players	2%	$23,898	568.32	$23,800	$0	$47,698	568.32
E3: Negotiate Terms of Vehicle	2%	$23,898	568.32	$23,800	$0	$47,698	568.32
E4: Review for Legal Sufficiency	2%	$23,898	568.32	$23,800	$0	$47,698	568.32
E5: Authorize the Transfer	2%	$23,898	568.32	$23,800	$0	$47,698	568.32
E6: Transfer the Technology	1%	$11,949	284.16	$11,900	$0	$23,849	284.16
E7: Monitor Technical and Admin Aspects	2%	$23,898	568.32	$23,800	$0	$47,698	568.32
E8: Collect Transfer Revenues	0%	$0	0	$0	$0	$0	0
E9: Close Out the Transfer	1%	$11,949	284.16	$11,900	$0	$23,849	284.16
Major Step F: Post-Transfer Administration.		$119,492	2841.6	$119,000	$0	$238,492	2841.6
F1: Track Process Implement	3%	$35,848	852.48	$35,700	$0	$71,548	852.48
F4: Transfer Activity Evaluation	3%	$35,848	852.48	$35,700	$0	$71,548	852.48
F5: Transfer Revenue Allocation	0%	$0	0	$0	$0	$0	0
F6: Award and Recognize Individuals	1%	$11,949	284.16	$11,900	$0	$23,849	284.16
F7: Public Relations	1%	$11,949	284.16	$11,900	$0	$23,849	284.16
F8: Prepare Performance Reports	2%	$23,898	568.32	$23,800	$0	$47,698	568.32

Percent by Sub-step		Percent by Major Step	
A1	0.038084	A	0.342754
A2	0.047605	B	0.066647
A3	0.019042	C	0.219283
A4	0.019042	D	0.123772
A5	0.009521	E	0.152335
A6	0.047605	F	0.095209
A7	0.047605		
A8	0.057126		
A9	0.057126		
B1	0.009521		
B2	0.047605		
B3	0.009521		
C1	0.048729		
C2	0.048729		
C3	0.073094		
C4	0.048729		
D1	0.038084		
D2	0.019042		
D3	0.038084		
D4	0.028563		
D5	0		
E1	0.038084		
E2	0.019042		
E3	0.019042		
E4	0.019042		
E5	0.019042		
E6	0.009521		
E7	0.019042		
E8	0		
E9	0.009521		
F1	0.028563		
F4	0.028563		
F5	0		
F6	0.009521		
F7	0.009521		
F8	0.019042		

Organization **AFDTC/DRX**

1. Number of personnel performing ORTA Duties in your organization (including self):

Full Time: **1**
Part Time: **3**

2. Number of CRDAs existing during any part of FY97:

Closed during FY97:	**0**
Open for all of FY97:	**6**
Created in FY97:	**5**

3. Organizational expenses occurred in FY97 by ORTA personnel:

	Costs	Cost Driver
Travel:	**$20,000**	ALL
General office supplies:	**$2,000**	ALL
Computer Equipment:	**$5,000**	ALL
Marketing:	**$15,000**	STEP C
Training:	**$5,000**	ALL
Contract Services:	**$40,000**	ALL
Other (GEATT):	**$20,000**	ALL

Personnel Grade	Cost	% ORTA	Cost	Hrs Avail	Hrs ORTA
1) GS-13	76498	100	76498	1776	1776
2) GS-13	76498	60	45898.8	1776	1065.6
3) GM-14	92334	20	18466.8	1776	355.2
4) Contractor	70000	30	21000	1776	532.8
		TOTAL	161863.6		3729.6

TOTAL COSTS	268863.6
COST/CRDA	24442.1455

	Person #1			Person #2			Person #3		
	% of time per activity	Labor $s per activity	Labor Hrs per activity	% of time per activity	Labor $s per activity	Labor Hrs per activity	% of time per activity	Labor $s per activity	Labor Hrs per activity
Major Step A: Strategy.		$3,825	88.8		$11,475	266.4		$13,850	266.4
A1: Establish Transfer Thrusts	1%	$425	9.9	5%	$2,295	53.3	10%	$1,847	35.5
A2: Coordinate with the Players	1%	$425	9.9	10%	$4,590	106.6	0%	$0	0.0
A3: Resource Requirements into Budget	1%	$425	9.9	0%	$0	0.0	10%	$1,847	35.5
A4: Submit Technology Transfer Plans	1%	$425	9.9	0%	$0	0.0	10%	$1,847	35.5
A5: Receive Funding Authority	1%	$425	9.9	0%	$0	0.0	5%	$923	17.8
A6: Implement Strategy Plan	1%	$425	9.9	0%	$0	0.0	10%	$1,847	35.5
A7: Monitor Transfer Initiatives	1%	$425	9.9	5%	$2,295	53.3	10%	$1,847	35.5
A8: Assess Use of Technology	1%	$425	9.9	0%	$0	0.0	10%	$1,847	35.5
A9: Assess Return on Investment	1%	$425	9.9	5%	$2,295	53.3	10%	$1,847	35.5
Major Step B: Identify Technology.		$3,825	88.8		$2,295	53.3		$923	17.8
B1: Query Database	2%	$1,275	29.6	0%	$0	0.0	0%	$0	0.0
B2: Evaluate Technology Assets	2%	$1,275	29.6	5%	$2,295	53.3	5%	$923	17.8
B3: Maintain Information Base	2%	$1,275	29.6	0%	$0	0.0	0%	$0	0.0

Major Step C: Marketing.		$3,825	88.8		$9,180	213.1		$1,847	35.5
C1: Develop Marketing Strategy	1%	$956	22.2	5%	$2,295	53.3	5%	$923	17.8
C2: Implement Strategy	1%	$956	22.2	5%	$2,295	53.3	0%	$0	0.0
C3: Promote Technology Assets	1%	$956	22.2	5%	$2,295	53.3	5%	$923	17.8
C4: Create technology Demand	1%	$956	22.2	5%	$2,295	53.3	0%	$0	0.0
Major Step D: Identify Transfer Vehicle.		$19,125	444.0		$9,180	213.1		$923	17.8
D1: Review Vehicle Selection	5%	$3,825	88.8	0%	$0	0.0	1%	$185	3.6
D2: Confirm with Transfer Partner	5%	$3,825	88.8	5%	$2,295	53.3	1%	$185	3.6
D3: Establish Transfer Framework	5%	$3,825	88.8	5%	$2,295	53.3	1%	$185	3.6
D4: Coordinate with Internal Partner	5%	$3,825	88.8	5%	$2,295	53.3	1%	$185	3.6
D5: Reaffirm Appropriate Vehicle	5%	$3,825	88.8	5%	$2,295	53.3	1%	$185	3.6
Major Step E: Perform Transfer.		$34,424	799.2		$9,180	213.1		$923	17.8
E1: Define Desired Results	5%	$3,825	88.8	0%	$0	0.0	0%	$0	0.0
E2: Coordinate w/Appropriate Players	5%	$3,825	88.8	5%	$2,295	53.3	0%	$0	0.0
E3: Negotiate Terms of Vehicle	5%	$3,825	88.8	5%	$2,295	53.3	0%	$0	0.0
E4: Review for Legal Sufficiency	5%	$3,825	88.8	0%	$0	0.0	0%	$0	0.0
E5: Authorize the Transfer	5%	$3,825	88.8	5%	$2,295	53.3	5%	$923	17.8
E6: Transfer the Technology	5%	$3,825	88.8	0%	$0	0.0	0%	$0	0.0
E7: Monitor Technical and Admin Aspects	5%	$3,825	88.8	5%	$2,295	53.3	0%	$0	0.0
E8: Collect Transfer Revenues	5%	$3,825	88.8	0%	$0	0.0	0%	$0	0.0
E9: Close Out the Transfer	5%	$3,825	88.8	0%	$0	0.0	0%	$0	0.0
Major Step F: Post-Transfer Administration.		$11,475	266.4		$4,590	106.6		$0	0.0
F1: Track Process Implement	5%	$3,825	88.8	5%	$2,295	53.3	0%	$0	0.0
F4: Transfer Activity Evaluation	5%	$3,825	88.8	0%	$0	0.0	0%	$0	0.0
F5: Transfer Revenue Allocation	0%	$0	0.0	0%	$0	0.0	0%	$0	0.0
F6: Award and Recognize Individuals	0%	$0	0.0	0%	$0	0.0	0%	$0	0.0
F7: Public Relations	5%	$3,825	88.8	5%	$2,295	53.3	0%	$0	0.0
F8: Prepare Performance Reports	0%	$0	0.0	0%	$0	0.0	0%	$0	0.0

Person #4 % of time per activity	Labor $s per activity	Labor Hrs per activity	Organizational Costs Cost Driver ALL	Organizational Costs Cost Driver Step C	TOTAL COSTS	TOTAL HOURS
	$2,100	53.3	$16,648	$0	$47,897	674.9
0%	$0	0.0	$2,434	$0	$7,000	98.7
5%	$1,050	26.6	$3,529	$0	$9,594	143.1
0%	$0	0.0	$1,120	$0	$3,391	45.4
0%	$0	0.0	$1,120	$0	$3,391	45.4
0%	$0	0.0	$681	$0	$2,030	27.6
5%	$1,050	26.6	$1,777	$0	$5,098	72.0
0%	$0	0.0	$2,434	$0	$7,000	98.7
0%	$0	0.0	$1,120	$0	$3,391	45.4
0%	$0	0.0	$2,434	$0	$7,000	98.7
	$2,100	53.3	$5,257	$0	$14,400	213.1
0%	$0	0.0	$730	$0	$2,005	29.6
10%	$2,100	53.3	$3,797	$0	$10,390	153.9
0%	$0	0.0	$730	$0	$2,005	29.6
	$6,300	159.8	$12,267	$15,000	$48,418	497.3
0%	$0	0.0	$2,300	$2,813	$9,287	93.2
20%	$4,200	106.6	$4,490	$5,491	$17,433	182.0
10%	$2,100	53.3	$3,614	$4,420	$14,308	146.5
0%	$0	0.0	$1,862	$2,277	$7,390	75.5
	$4,200	106.6	$19,276	$0	$52,704	781.4
5%	$1,050	26.6	$2,935	$0	$7,995	119.0
5%	$1,050	26.6	$4,250	$0	$11,604	172.3
0%	$0	0.0	$3,592	$0	$9,897	145.6
5%	$1,050	26.6	$4,250	$0	$11,604	172.3
5%	$1,050	26.6	$4,250	$0	$11,604	172.3
	$4,200	106.6	$28,038	$0	$76,765	1136.6
0%	$0	0.0	$2,190	$0	$6,015	88.8
5%	$1,050	26.6	$4,162	$0	$11,332	168.7
0%	$0	0.0	$3,505	$0	$9,625	142.1
5%	$1,050	26.6	$2,848	$0	$7,723	115.4
5%	$1,050	26.6	$4,600	$0	$12,693	186.5
0%	$0	0.0	$2,190	$0	$6,015	88.8
5%	$1,050	26.6	$4,162	$0	$11,332	168.7
0%	$0	0.0	$2,190	$0	$6,015	88.8
0%	$0	0.0	$2,190	$0	$6,015	88.8
	$2,100	53.3	$10,514	$0	$28,679	426.2
5%	$1,050	26.6	$4,162	$0	$11,332	168.7
5%	$1,050	26.6	$2,848	$0	$7,723	115.4
0%	$0	0.0	$0	$0	$0	0.0
0%	$0	0.0	$0	$0	$0	0.0
0%	$0	0.0	$3,505	$0	$9,625	142.1
0%	$0	0.0	$0	$0	$0	0.0

Percent by Sub-step		Percent by Major Step	
A1	0.02603726	A	0.17814728
A2	0.03568341	B	0.05355996
A3	0.01261326	C	0.1800839
A4	0.01261326	D	0.19602427
A5	0.00754959	E	0.28551762
A6	0.01896273	F	0.10666697
A7	0.02603726		
A8	0.01261326		
A9	0.02603726		
B1	0.00745778		
B2	0.0386444		
B3	0.00745778		
C1	0.0345417		
C2	0.0648385		
C3	0.05321819		
C4	0.02748552		
D1	0.02973555		
D2	0.04315955		
D3	0.03681007		
D4	0.04315955		
D5	0.04315955		
E1	0.02237334		
E2	0.04214682		
E3	0.03579734		
E4	0.02872281		
E5	0.04721048		
E6	0.02237334		
E7	0.04214682		
E8	0.02237334		
E9	0.02237334		
F1	0.04214682		
F4	0.02872281		
F5	0		
F6	0		
F7	0.03579734		
F8	0		

Organization: **AFFTC, Edwards AFB, CA**

1. Number of personnel performing ORTA Duties in your organization (including self):
Full Time: **0**
Part Time: **1**

2. Number of CRDAs existing during any part of FY97:
Closed during FY97: **2**
Open for all of FY97: **10**
Created in FY97: **8**

3. Organizational expenses occurred in FY97 by ORTA personnel:

	Costs	Cost Driver
Travel:	**$5,000**	ALL
General office supplie	**$30**	ALL
Computer Equipment:	**$0**	
Marketing:	**$4,700**	STEP C
Training:	**$2,500**	ALL
Contract Services:	**$0**	
Other (Please Specify	**$0**	

Personnel

Grade	Cost	% ORTA	Cost	Hrs Avail	Hrs ORTA
1) GS-13	76498	85	65023.3	1776	1509.6

Organizational Costs

Type	Cost	Driver	
Travel	5000	All	5000
General	30	All	30
Marketing	4700	Step C	4700
Training	2500	All	2500
		Total	77253.3
	COST/CRDA		3862.665

	Person #1 % of time per activit	Labor $s per activit	Labor Hrs per activit	Organizational Costs Cost Driver All	Organizational Costs Cost Driver Step C	TOTAL COSTS	TOTAL HOURS
Major Step A: Strategy.		$22,758	528.36	$2,636	$0	$25,394	528.36
A1: Establish Transfer Thrusts	0%	$0	0	$0	$0	$0	0
A2: Coordinate with the Players	5%	$3,251	75.48	$377	$0	$3,628	75.48
A3: Resource Requirements into Budget	5%	$3,251	75.48	$377	$0	$3,628	75.48
A4: Submit Technology Transfer Plans	0%	$0	0	$0	$0	$0	0
A5: Receive Funding Authority	5%	$3,251	75.48	$377	$0	$3,628	75.48
A6: Implement Strategy Plan	15%	$9,753	226.44	$1,130	$0	$10,883	226.44
A7: Monitor Transfer Initiatives	0%	$0	0	$0	$0	$0	0
A8: Assess Use of Technology	5%	$3,251	75.48	$377	$0	$3,628	75.48
A9: Assess Return on Investment	0%	$0	0	$0	$0	$0	0
Major Step B: Identify Technology.		$3,251	75.48	$377	$0	$3,628	75.48
B1: Query Database	0%	$0	0	$0	$0	$0	0
B2: Evaluate Technology Assets	5%	$3,251	75.48	$377	$0	$3,628	75.48
B3: Maintain Information Base	0%	$0	0	$0	$0	$0	0

Major Step C: Marketing.		$3,251	75.48	$377	$4,700	$8,328	75.48
C1: Develop Marketing Strategy	0%	$0	0	$0	$0	$0	0
C2: Implement Strategy	0%	$0	0	$0	$0	$0	0
C3: Promote Technology Assets	5%	$3,251	75.48	$377	$4,700	$8,328	75.48
C4: Create technology Demand	0%	$0	0	$0	$0	$0	0
Major Step D: Identify Transfer Vehicle.		$6,502	150.96	$753	$0	$7,255	150.96
D1: Review Vehicle Selection	0%	$0	0	$0	$0	$0	0
D2: Confirm with Transfer Partner	0%	$0	0	$0	$0	$0	0
D3: Establish Transfer Framework	0%	$0	0	$0	$0	$0	0
D4: Coordinate with Internal Partner	10%	$6,502	150.96	$753	$0	$7,255	150.96
D5: Reaffirm Appropriate Vehicle	0%	$0	0	$0	$0	$0	0
Major Step E: Perform Transfer.		$26,009	603.84	$3,012	$0	$29,021	603.84
E1: Define Desired Results	0%	$0	0	$0	$0	$0	0
E2: Coordinate w/Appropriate Players	30%	$19,507	452.88	$2,259	$0	$21,766	452.88
E3: Negotiate Terms of Vehicle	5%	$3,251	75.48	$377	$0	$3,628	75.48
E4: Review for Legal Sufficiency	5%	$3,251	75.48	$377	$0	$3,628	75.48
E5: Authorize the Transfer	0%	$0	0	$0	$0	$0	0
E6: Transfer the Technology	0%	$0	0	$0	$0	$0	0
E7: Monitor Technical and Admin Aspects	0%	$0	0	$0	$0	$0	0
E8: Collect Transfer Revenues	0%	$0	0	$0	$0	$0	0
E9: Close Out the Transfer	0%	$0	0	$0	$0	$0	0
Major Step F: Post-Transfer Administration.		$3,251	75.48	$377	$0	$3,628	75.48
F1: Track Process Implement	0%	$0	0	$0	$0	$0	0
F4: Transfer Activity Evaluation	0%	$0	0	$0	$0	$0	0
F5: Transfer Revenue Allocation	0%	$0	0	$0	$0	$0	0
F6: Award and Recognize Individuals	0%	$0	0	$0	$0	$0	0
F7: Public Relations	5%	$3,251	75.48	$377	$0	$3,628	75.48
F8: Prepare Performance Reports	0%	$0	0	$0	$0	$0	0

Percent by Sub-step		Percent by Major Step	
A1	0	A	0.328706
A2	0.046958	B	0.046958
A3	0.046958	C	0.107797
A4	0	D	0.093916
A5	0.046958	E	0.375664
A6	0.140874	F	0.046958
A7	0		
A8	0.046958		
A9	0		
B1	0		
B2	0.046958		
B3	0		
C1	0		
C2	0		
C3	0.107797		
C4	0		
D1	0		
D2	0		
D3	0		
D4	0.093916		
D5	0		
E1	0		
E2	0.281748		
E3	0.046958		
E4	0.046958		
E5	0		
E6	0		
E7	0		
E8	0		
E9	0		
F1	0		
F4	0		
F5	0		
F6	0		
F7	0.046958		
F8	0		

Organization **Rome Laboratory, Rome, NY**

1. Number of personnel performing ORTA Duties in your organization (including self):

Full Time: **1**

Part Time: **7**

2. Number of CRDAs existing during any part of FY97:

Closed during FY97:	**12**
Open for all of FY97:	**33**
Created in FY97:	**11**

3. Organizational expenses occurred in FY97 by ORTA personnel:

	Costs	Cost Driver
Travel:	**$30,000**	ALL
General office supplies:	**$3,000**	ALL
Computer Equipment:	**$7,000**	ALL
Marketing:	**$73,000**	STEP C
Training:	**$4,000**	ALL
Contract Services:	**$10,000**	ALL

Personnel Grade	Cost	% ORTA	Cost	Hrs Avail	Hrs ORTA
1) GS-14	92334	100	92334	1776	1776
2) GS-13	76498	50	38249	1776	888
3) GS-13	76498	50	38249	1776	888
4) GS-13	76498	50	38249	1776	888
5) GS-13	76498	50	38249	1776	888
6) GS-13	76498	50	38249	1776	888
7) GS-13	76498	50	38249	1776	888
8) GS-13	76498	50	38249	1776	888
		TOTAL	360077		7992
		TOTAL COSTS	487077		
		COST/CRDA	8697.80357		

	Person #1			Person #2			Person #3		
	% of time per activity	Labor $s per activity	Labor Hrs per activity	% of time per activity	Labor $s per activity	Labor Hrs per activity	% of time per activity	Labor $s per activity	Labor Hrs per activity
Major Step A: Strategy.		$13,850	266.4		$0	0.0		$3,825	88.8
A1: Establish Transfer Thrusts	1%	$923	17.8	0%	$0	0.0	1%	$255	5.9
A2: Coordinate with the Players	1%	$923	17.8	0%	$0	0.0	1%	$255	5.9
A3: Resource Requirements into Budget	2%	$1,847	35.5	0%	$0	0.0	1%	$510	11.8
A4: Submit Technology Transfer Plans	4%	$3,693	71.0	0%	$0	0.0	3%	$1,020	23.7
A5: Receive Funding Authority	1%	$923	17.8	0%	$0	0.0	1%	$255	5.9
A6: Implement Strategy Plan	2%	$1,847	35.5	0%	$0	0.0	1%	$510	11.8
A7: Monitor Transfer Initiatives	2%	$1,847	35.5	0%	$0	0.0	1%	$510	11.8
A8: Assess Use of Technology	1%	$923	17.8	0%	$0	0.0	1%	$255	5.9
A9: Assess Return on Investment	1%	$923	17.8	0%	$0	0.0	1%	$255	5.9
Major Step B: Identify Technology.		$4,617	88.8		$0	0.0		$1,275	29.6
B1: Query Database	1%	$923	17.8	0%	$0	0.0	1%	$255	5.9
B2: Evaluate Technology Assets	1%	$923	17.8	0%	$0	0.0	1%	$255	5.9
B3: Maintain Information Base	3%	$2,770	53.3	0%	$0	0.0	2%	$765	17.8

Major Step C: Marketing.		$18,467	355.2		$0	0.0		$5,100	118.4
C1: Develop Marketing Strategy	3%	$2,770	53.3	0%	$0	0.0	2%	$765	17.8
C2: Implement Strategy	10%	$9,233	177.6	0%	$0	0.0	7%	$2,550	59.2
C3: Promote Technology Assets	3%	$2,770	53.3	0%	$0	0.0	2%	$765	17.8
C4: Create technology Demand	4%	$3,693	71.0	0%	$0	0.0	3%	$1,020	23.7
Major Step D: Identify Transfer Vehicle.		$13,850	266.4		$0	0.0		$3,825	88.8
D1: Review Vehicle Selection	1%	$923	17.8	0%	$0	0.0	1%	$255	5.9
D2: Confirm with Transfer Partner	3%	$2,770	53.3	0%	$0	0.0	2%	$765	17.8
D3: Establish Transfer Framework	7%	$6,463	124.3	0%	$0	0.0	5%	$1,785	41.4
D4: Coordinate with Internal Partner	3%	$2,770	53.3	0%	$0	0.0	2%	$765	17.8
D5: Reaffirm Appropriate Vehicle	1%	$923	17.8	0%	$0	0.0	1%	$255	5.9
Major Step E: Perform Transfer.		$32,317	621.6		$26,774	621.6		$17,850	414.4
E1: Define Desired Results	2%	$1,847	35.5	5%	$1,912	44.4	3%	$1,147	26.6
E2: Coordinate w/Appropriate Players	5%	$4,617	88.8	25%	$9,562	222.0	12%	$4,462	103.6
E3: Negotiate Terms of Vehicle	15%	$13,850	266.4	5%	$1,912	44.4	12%	$4,462	103.6
E4: Review for Legal Sufficiency	2%	$1,847	35.5	5%	$1,912	44.4	3%	$1,147	26.6
E5: Authorize the Transfer	3%	$2,770	53.3	5%	$1,912	44.4	4%	$1,402	32.6
E6: Transfer the Technology	2%	$1,847	35.5	10%	$3,825	88.8	5%	$1,785	41.4
E7: Monitor Technical and Admin Aspects	2%	$1,847	35.5	10%	$3,825	88.8	5%	$1,785	41.4
E8: Collect Transfer Revenues	2%	$1,847	35.5	0%	$0	0.0	1%	$510	11.8
E9: Close Out the Transfer	2%	$1,847	35.5	5%	$1,912	44.4	3%	$1,147	26.6
Major Step F: Post-Transfer Administration.		$9,233	177.6		$11,475	266.4		$6,375	148.0
F1: Track Process Implement	2%	$1,847	35.5	10%	$3,825	88.8	5%	$1,785	41.4
F4: Transfer Activity Evaluation	1%	$923	17.8	5%	$1,912	44.4	2%	$892	20.7
F5: Transfer Revenue Allocation	2%	$1,847	35.5	0%	$0	0.0	1%	$510	11.8
F6: Award and Recognize Individuals	2%	$1,847	35.5	0%	$0	0.0	1%	$510	11.8
F7: Public Relations	1%	$923	17.8	10%	$3,825	88.8	4%	$1,530	35.5
F8: Prepare Performance Reports	2%	$1,847	35.5	5%	$1,912	44.4	3%	$1,147	26.6

Organizational Costs Type	Cost	Driver
Travel:	30000	ALL
General office supplies:	3000	ALL
Computer Equipment:	7000	ALL
Marketing:	73000	STEP C
Training:	4000	ALL
Contract Services:	10000	ALL
TOTAL	127000	

Person #4 % of time per activity	Labor $s per activity	Labor Hrs per activity	Person #5 % of time per activity	Labor $s per activity	Labor Hrs per activity	Person #6 % of time per activity	Labor $s per activity	Labor Hrs per activity	Person #7 % of time per activity	Labor $s per activity	Labor Hrs per activity	Person #8 % of time per activity	Labor $s per activity	Labor Hrs per activity	Organizational Costs Cost Driver ALL	Organizational Costs Cost Driver Step C	TOTAL COSTS	TOTAL HOURS
	$3,825	88.8		$3,825	88.8		$3,825	88.8		$3,825	88.8		$3,825	88.8	$5,400	$0	$42,200	799.2
1%	$255	5.9	1%	$255	5.9	1%	$255	5.9	1%	$255	5.9	1%	$255	5.9	$360	$0	$2,813	53.3
1%	$255	5.9	1%	$255	5.9	1%	$255	5.9	1%	$255	5.9	1%	$255	5.9	$360	$0	$2,813	53.3
1%	$510	11.8	1%	$510	11.8	1%	$510	11.8	1%	$510	11.8	1%	$510	11.8	$720	$0	$5,627	106.6
3%	$1,020	23.7	3%	$1,020	23.7	3%	$1,020	23.7	3%	$1,020	23.7	3%	$1,020	23.7	$1,440	$0	$11,253	213.1
1%	$255	5.9	1%	$255	5.9	1%	$255	5.9	1%	$255	5.9	1%	$255	5.9	$360	$0	$2,813	53.3
1%	$510	11.8	1%	$510	11.8	1%	$510	11.8	1%	$510	11.8	1%	$510	11.8	$720	$0	$5,627	106.6
1%	$510	11.8	1%	$510	11.8	1%	$510	11.8	1%	$510	11.8	1%	$510	11.8	$720	$0	$5,627	106.6
1%	$255	5.9	1%	$255	5.9	1%	$255	5.9	1%	$255	5.9	1%	$255	5.9	$360	$0	$2,813	53.3
1%	$255	5.9	1%	$255	5.9	1%	$255	5.9	1%	$255	5.9	1%	$255	5.9	$360	$0	$2,813	53.3
	$1,275	29.6		$1,275	29.6		$1,275	29.6		$1,275	29.6		$1,275	29.6	$1,800	$0	$14,067	266.4
1%	$255	5.9	1%	$255	5.9	1%	$255	5.9	1%	$255	5.9	1%	$255	5.9	$360	$0	$2,813	53.3
1%	$255	5.9	1%	$255	5.9	1%	$255	5.9	1%	$255	5.9	1%	$255	5.9	$360	$0	$2,813	53.3
2%	$765	17.8	2%	$765	17.8	2%	$765	17.8	2%	$765	17.8	2%	$765	17.8	$1,080	$0	$8,440	159.8

	$5,100	118.4		$5,100	118.4		$5,100	118.4		$5,100	118.4		$5,100	118.4	$7,200	$73,000
2%	$765	17.8	2%	$765	17.8	2%	$765	17.8	2%	$765	17.8	2%	$765	17.8	$1,080	$10,950
7%	$2,550	59.2	7%	$2,550	59.2	7%	$2,550	59.2	7%	$2,550	59.2	7%	$2,550	59.2	$3,600	$36,500
2%	$765	17.8	2%	$765	17.8	2%	$765	17.8	2%	$765	17.8	2%	$765	17.8	$1,080	$10,950
3%	$1,020	23.7	3%	$1,020	23.7	3%	$1,020	23.7	3%	$1,020	23.7	3%	$1,020	23.7	$1,440	$14,600
	$3,825	88.8		$3,825	88.8		$3,825	88.8		$3,825	88.8		$3,825	88.8	$5,400	$0
1%	$255	5.9	1%	$255	5.9	1%	$255	5.9	1%	$255	5.9	1%	$255	5.9	$360	$0
2%	$765	17.8	2%	$765	17.8	2%	$765	17.8	2%	$765	17.8	2%	$765	17.8	$1,080	$0
5%	$1,785	41.4	5%	$1,785	41.4	5%	$1,785	41.4	5%	$1,785	41.4	5%	$1,785	41.4	$2,520	$0
2%	$765	17.8	2%	$765	17.8	2%	$765	17.8	2%	$765	17.8	2%	$765	17.8	$1,080	$0
1%	$255	5.9	1%	$255	5.9	1%	$255	5.9	1%	$255	5.9	1%	$255	5.9	$360	$0
	$17,850	414.4		$17,850	414.4		$17,850	414.4		$17,850	414.4		$17,850	414.4	$25,200	$0
3%	$1,147	26.6	3%	$1,147	26.6	3%	$1,147	26.6	3%	$1,147	26.6	3%	$1,147	26.6	$1,620	$0
12%	$4,462	103.6	12%	$4,462	103.6	12%	$4,462	103.6	12%	$4,462	103.6	12%	$4,462	103.6	$6,300	$0
12%	$4,462	103.6	12%	$4,462	103.6	12%	$4,462	103.6	12%	$4,462	103.6	12%	$4,462	103.6	$6,300	$0
3%	$1,147	26.6	3%	$1,147	26.6	3%	$1,147	26.6	3%	$1,147	26.6	3%	$1,147	26.6	$1,620	$0
4%	$1,402	32.6	4%	$1,402	32.6	4%	$1,402	32.6	4%	$1,402	32.6	4%	$1,402	32.6	$1,980	$0
5%	$1,785	41.4	5%	$1,785	41.4	5%	$1,785	41.4	5%	$1,785	41.4	5%	$1,785	41.4	$2,520	$0
5%	$1,785	41.4	5%	$1,785	41.4	5%	$1,785	41.4	5%	$1,785	41.4	5%	$1,785	41.4	$2,520	$0
1%	$510	11.8	1%	$510	11.8	1%	$510	11.8	1%	$510	11.8	1%	$510	11.8	$720	$0
3%	$1,147	26.6	3%	$1,147	26.6	3%	$1,147	26.6	3%	$1,147	26.6	3%	$1,147	26.6	$1,620	$0
	$6,375	148.0		$6,375	148.0		$6,375	148.0		$6,375	148.0		$6,375	148.0	$9,000	$0
5%	$1,785	41.4	5%	$1,785	41.4	5%	$1,785	41.4	5%	$1,785	41.4	5%	$1,785	41.4	$2,520	$0
2%	$892	20.7	2%	$892	20.7	2%	$892	20.7	2%	$892	20.7	2%	$892	20.7	$1,260	$0
1%	$510	11.8	1%	$510	11.8	1%	$510	11.8	1%	$510	11.8	1%	$510	11.8	$720	$0
1%	$510	11.8	1%	$510	11.8	1%	$510	11.8	1%	$510	11.8	1%	$510	11.8	$720	$0
4%	$1,530	35.5	4%	$1,530	35.5	4%	$1,530	35.5	4%	$1,530	35.5	4%	$1,530	35.5	$2,160	$0
3%	$1,147	26.6	3%	$1,147	26.6	3%	$1,147	26.6	3%	$1,147	26.6	3%	$1,147	26.6	$1,620	$0

Percent by Sub-step		Percent by Major Step	
A1	0.00577588	A	0.08663825
A2	0.00577588	B	0.02887942
A3	0.01155177	C	0.2653913
A4	0.02310353	D	0.08663825
A5	0.00577588	E	0.39293253
A6	0.01155177	F	0.13952024
A7	0.01155177		
A8	0.00577588		
A9	0.00577588		
B1	0.00577588		
B2	0.00577588		
B3	0.01732765		
C1	0.0398087		
C2	0.13269565		
C3	0.0398087		
C4	0.05307826		
D1	0.00577588		
D2	0.01732765		
D3	0.04043118		
D4	0.01732765		
D5	0.00577588		
E1	0.02517867		
E2	0.09701392		
E3	0.10026515		
E4	0.02517867		
E5	0.03095455		
E6	0.03880557		
E7	0.03880557		
E8	0.01155177		
E9	0.02517867		
F1	0.03880557		
F4	0.01940278		
F5	0.01155177		
F6	0.01155177		
F7	0.03302969		
F8	0.02517867		

Organization **WR-ALC, Warner-Robins AFB, GA**

1. Number of personnel performing ORTA Duties in your organization (including self):

Full Time: **0**
Part Time: **2**

2. Number of CRDAs existing during any part of FY97:

Closed during FY97: **1**
Open for all of FY97: **9**
Created in FY97: **3**

3. Organizational expenses occurred in FY97 by ORTA personnel:

	Costs	Cost Driver
Travel:	**$4,000**	ALL
General office supplies:	**$200**	ALL
Computer Equipment:	**$0**	ALL
Marketing:	**$0**	STEP C
Training:	**$0**	ALL
Contract Services:	**$500**	ALL
Other	**$0**	ALL

Personnel Grade	Cost	% ORTA	Cost	Hrs Avail	Hrs ORTA
1) GS-13	76498	25	19124.5	1776	444
2) Capt	74424	50	37212	1776	888
		TOTAL	56336.5		1332
		TOTAL COSTS	61036.5		
		COST/CRDA	4695.11538		

	Person #1 % of time per activity	Labor $s per activity	Labor Hrs per activity	Person #2 % of time per activity	Labor $s per activity	Labor Hrs per activity	Organizational Costs Cost Driver ALL	Organizational Costs Cost Driver Step C	TOTAL COSTS	TOTAL HOURS
Major Step A: Strategy.		$2,869	66.6		$5,582	133.2	$705	$0	$9,155	199.8
A1: Establish Transfer Thrusts	0%	$0	0.0	1%	$372	8.9	$31	$0	$403	8.9
A2: Coordinate with the Players	0%	$0	0.0	1%	$372	8.9	$31	$0	$403	8.9
A3: Resource Requirements into Budget	0%	$0	0.0	1%	$372	8.9	$31	$0	$403	8.9
A4: Submit Technology Transfer Plans	0%	$0	0.0	1%	$372	8.9	$31	$0	$403	8.9
A5: Receive Funding Authority	0%	$0	0.0	1%	$372	8.9	$31	$0	$403	8.9
A6: Implement Strategy Plan	0%	$0	0.0	1%	$372	8.9	$31	$0	$403	8.9
A7: Monitor Transfer Initiatives	15%	$2,869	66.6	1%	$372	8.9	$266	$0	$3,507	75.5
A8: Assess Use of Technology	0%	$0	0.0	7%	$2,605	62.2	$219	$0	$2,824	62.2
A9: Assess Return on Investment	0%	$0	0.0	1%	$372	8.9	$31	$0	$403	8.9
Major Step B: Identify Technology.		$956	22.2		$9,303	222.0	$862	$0	$11,121	244.2
B1: Query Database	0%	$0	0.0	2%	$744	17.8	$63	$0	$807	17.8
B2: Evaluate Technology Assets	0%	$0	0.0	20%	$7,442	177.6	$627	$0	$8,069	177.6
B3: Maintain Information Base	5%	$956	22.2	3%	$1,116	26.6	$172	$0	$2,245	48.8

Major Step C: Marketing.		$3,825	88.8		$5,210	124.3	$752	$0	$9,787	213.1
C1: Develop Marketing Strategy	0%	$0	0.0	1%	$372	8.9	$31	$0	$403	8.9
C2: Implement Strategy	0%	$0	0.0	2%	$744	17.8	$63	$0	$807	17.8
C3: Promote Technology Assets	20%	$3,825	88.8	7%	$2,605	62.2	$533	$0	$6,962	151.0
C4: Create technology Demand	0%	$0	0.0	4%	$1,488	35.5	$125	$0	$1,614	35.5
Major Step D: Identify Transfer Vehicle.		$956	22.2		$2,977	71.0	$329	$0	$4,262	93.2
D1: Review Vehicle Selection	0%	$0	0.0	1%	$372	8.9	$31	$0	$403	8.9
D2: Confirm with Transfer Partner	0%	$0	0.0	1%	$372	8.9	$31	$0	$403	8.9
D3: Establish Transfer Framework	0%	$0	0.0	1%	$372	8.9	$31	$0	$403	8.9
D4: Coordinate with Internal Partner	5%	$956	22.2	4%	$1,488	35.5	$204	$0	$2,648	57.7
D5: Reaffirm Appropriate Vehicle	0%	$0	0.0	1%	$372	8.9	$31	$0	$403	8.9
Major Step E: Perform Transfer.		$9,371	217.6		$11,164	266.4	$1,708	$0	$22,242	484.0
E1: Define Desired Results	0%	$0	0.0	4%	$1,488	35.5	$125	$0	$1,614	35.5
E2: Coordinate w/Appropriate Players	20%	$3,825	88.8	3%	$1,116	26.6	$407	$0	$5,349	115.4
E3: Negotiate Terms of Vehicle	10%	$1,912	44.4	2%	$744	17.8	$219	$0	$2,876	62.2
E4: Review for Legal Sufficiency	0%	$0	0.0	1%	$372	8.9	$31	$0	$403	8.9
E5: Authorize the Transfer	0%	$0	0.0	1%	$372	8.9	$31	$0	$403	8.9
E6: Transfer the Technology	7%	$1,339	31.1	14%	$5,210	124.3	$548	$0	$7,097	155.4
E7: Monitor Technical and Admin Aspects	10%	$1,912	44.4	2%	$744	17.8	$219	$0	$2,876	62.2
E8: Collect Transfer Revenues	2%	$382	8.9	1%	$372	8.9	$63	$0	$817	17.8
E9: Close Out the Transfer	0%	$0	0.0	2%	$744	17.8	$63	$0	$807	17.8
Major Step F: Post-Transfer Administration.		$1,147	26.6		$2,977	71.0	$345	$0	$4,469	97.7
F1: Track Process Implement	0%	$0	0.0	1%	$372	8.9	$31	$0	$403	8.9
F4: Transfer Activity Evaluation	0%	$0	0.0	1%	$372	8.9	$31	$0	$403	8.9
F5: Transfer Revenue Allocation	4%	$765	17.8	1%	$372	8.9	$94	$0	$1,231	26.6
F6: Award and Recognize Individuals	0%	$0	0.0	1%	$372	8.9	$31	$0	$403	8.9
F7: Public Relations	2%	$382	8.9	2%	$744	17.8	$94	$0	$1,221	26.6
F8: Prepare Performance Reports	0%	$0	0.0	2%	$744	17.8	$63	$0	$807	17.8

Percent by Sub-step		Percent by Major Step	
A1	0.00661003	A	0.15
A2	0.00661003	B	0.18220068
A3	0.00661003	C	0.1603398
A4	0.00661003	D	0.0698301
A5	0.00661003	E	0.36440936
A6	0.00661003	F	0.07322007
A7	0.05745953		
A8	0.04627024		
A9	0.00661003		
B1	0.01322007		
B2	0.13220068		
B3	0.03677993		
C1	0.00661003		
C2	0.01322007		
C3	0.11406956		
C4	0.02644014		
D1	0.00661003		
D2	0.00661003		
D3	0.00661003		
D4	0.04338997		
D5	0.00661003		
E1	0.02644014		
E2	0.08762942		
E3	0.04711973		
E4	0.00661003		
E5	0.00661003		
E6	0.11627024		
E7	0.04711973		
E8	0.01338997		
E9	0.01322007		
F1	0.00661003		
F4	0.00661003		
F5	0.0201699		
F6	0.00661003		
F7	0.02		
F8	0.01322007		

Organization: **OC-ALC/TIE, Tinker AFB, OK**

1. Number of personnel performing ORTA Duties in your organization (including self):
Full Time: **1**
Part Time: **0**

2. Number of CRDAs existing during any part of FY97:
Closed during FY97: **1**
Open for all of FY97: **2**
Created in FY97: **0**

3. Organizational expenses occurred in FY97 by ORTA personnel:

	Costs	Cost Driver
Travel:	**$4,350**	ALL
General office supplie	**$200**	ALL
Computer Equipment:	**$500**	ALL
Marketing:	**$0**	
Training:	**$0**	
Contract Services:	**$0**	
Other (Please Specify	**$0**	

Personnel

Grade	Cost	% ORTA	Cost	Hrs Avail	Hrs ORTA
1) GS-12	64217	100	64217	1776	1776

Organizational Costs

Type	Cost	Driver	Total
Travel	4350	All	4350
General	200	All	200
Computer	500	All	500
		Total	69267
		COST/CRDA	23089

	Person #1 % of time per activit	Labor $s per activit	Labor Hrs per activit	Organizational Costs	TOTAL COSTS	TOTAL HOURS
Major Step A: Strategy.		$14,770	408.48	$1,162	$15,931	408.48
A1: Establish Transfer Thrusts	1%	$642	17.76	$51	$693	17.76
A2: Coordinate with the Players	10%	$6,422	177.6	$505	$6,927	177.6
A3: Resource Requirements into Budget	0%	$0	0	$0	$0	0
A4: Submit Technology Transfer Plans	3%	$1,927	53.28	$152	$2,078	53.28
A5: Receive Funding Authority	0%	$0	0	$0	$0	0
A6: Implement Strategy Plan	2%	$1,284	35.52	$101	$1,385	35.52
A7: Monitor Transfer Initiatives	5%	$3,211	88.8	$253	$3,463	88.8
A8: Assess Use of Technology	1%	$642	17.76	$51	$693	17.76
A9: Assess Return on Investment	1%	$642	17.76	$51	$693	17.76
Major Step B: Identify Technology.		$5,780	159.84	$455	$6,234	159.84
B1: Query Database	2%	$1,284	35.52	$101	$1,385	35.52
B2: Evaluate Technology Assets	5%	$3,211	88.8	$253	$3,463	88.8
B3: Maintain Information Base	2%	$1,284	35.52	$101	$1,385	35.52

Major Step C: Marketing.		$5,780	159.84	$455	$6,234	159.84
C1: Develop Marketing Strategy	2%	$1,284	35.52	$101	$1,385	35.52
C2: Implement Strategy	2%	$1,284	35.52	$101	$1,385	35.52
C3: Promote Technology Assets	5%	$3,211	88.8	$253	$3,463	88.8
C4: Create technology Demand	0%	$0	0	$0	$0	0
Major Step D: Identify Transfer Vehicle.		$12,201	337.44	$960	$13,161	337.44
D1: Review Vehicle Selection	3%	$1,927	53.28	$152	$2,078	53.28
D2: Confirm with Transfer Partner	5%	$3,211	88.8	$253	$3,463	88.8
D3: Establish Transfer Framework	3%	$1,927	53.28	$152	$2,078	53.28
D4: Coordinate with Internal Partner	5%	$3,211	88.8	$253	$3,463	88.8
D5: Reaffirm Appropriate Vehicle	3%	$1,927	53.28	$152	$2,078	53.28
Major Step E: Perform Transfer.		$17,339	426.24	$1,364	$18,702	426.24
E1: Define Desired Results	3%	$1,927	53.28	$152	$2,078	53.28
E2: Coordinate w/Appropriate Players	10%	$6,422	177.6	$505	$6,927	177.6
E3: Negotiate Terms of Vehicle	5%	$3,211	88.8	$253	$3,463	88.8
E4: Review for Legal Sufficiency	0%	$0	0	$0	$0	0
E5: Authorize the Transfer	2%	$1,284	35.52	$101	$1,385	35.52
E6: Transfer the Technology	3%	$1,927	53.28	$152	$2,078	53.28
E7: Monitor Technical and Admin Aspects	2%	$1,284	35.52	$101	$1,385	35.52
E8: Collect Transfer Revenues	1%	$642	17.76	$51	$693	17.76
E9: Close Out the Transfer	1%	$642	17.76	$51	$693	17.76
Major Step F: Post-Transfer Administration.		$8,348	230.88	$657	$9,005	230.88
F1: Track Process Implement	2%	$1,284	35.52	$101	$1,385	35.52
F4: Transfer Activity Evaluation	2%	$1,284	35.52	$101	$1,385	35.52
F5: Transfer Revenue Allocation	0%	$0	0	$0	$0	0
F6: Award and Recognize Individuals	2%	$1,284	35.52	$101	$1,385	35.52
F7: Public Relations	5%	$3,211	88.8	$253	$3,463	88.8
F8: Prepare Performance Reports	2%	$1,284	35.52	$101	$1,385	35.52

Percent by Sub-step		Percent by Major Step	
A1	0.01	A	0.23
A2	0.1	B	0.09
A3	0	C	0.09
A4	0.03	D	0.19
A5	0	E	0.27
A6	0.02	F	0.13
A7	0.05		
A8	0.01		
A9	0.01		
B1	0.02		
B2	0.05		
B3	0.02		
C1	0.02		
C2	0.02		
C3	0.05		
C4	0		
D1	0.03		
D2	0.05		
D3	0.03		
D4	0.05		
D5	0.03		
E1	0.03		
E2	0.1		
E3	0.05		
E4	0		
E5	0.02		
E6	0.03		
E7	0.02		
E8	0.01		
E9	0.01		
F1	0.02		
F4	0.02		
F5	0		
F6	0.02		
F7	0.05		
F8	0.02		

Organization **Wright Laboratories, Wright-Patterson AFB, OH**

1. Number of personnel performing ORTA Duties in your organization (including self):

Full Time: **6**

Part Time: **3**

2. Number of CRDAs existing during any part of FY97:

Closed during FY97: **3**

Open for all of FY97: **67**

Created in FY97: **12**

3. Organizational expenses occurred in FY97 by ORTA personnel:

	Costs	Cost Driver
Travel:	**$20,000**	ALL
General office supplies:	**$600**	ALL
Computer Equipment:	**$1,500**	ALL
Marketing:	**$25,000**	STEP C
Training:	**$3,400**	ALL
Contract Services:	**$300,000**	ALL
Other	**$0**	ALL

		Personnel Grade	Cost	% ORTA	Cost	Hrs Avail	Hrs ORTA
		1) GS-13	76498	100	76498	1776	1776
	MLL	2) Contractor	70000	50	35000	1776	888
	MN	3) GS-13	76498	80	61198.4	1776	1420.8
	MN	4) Contractor	50120	80	40096	1776	1420.8
		5) GS-13	76498	100	76498	1776	1776
		6) GS-14	92334	100	92334	1776	1776
		7) GS-12&14	156551	100	156551	3552	3552
		8) Lt Col	107901	100	107901	1776	1776
				TOTAL	646076.4		14385.6

TOTAL COSTS	1010076.4
COST/CRDA	12318.0049

	Person #1 % of time per activity	Person #1 Labor $s per activity	Person #1 Labor Hrs per activity	Person #2 % of time per activity	Person #2 Labor $s per activity	Person #2 Labor Hrs per activity	Person #3 % of time per activity	Person #3 Labor $s per activity	Person #3 Labor Hrs per activity
Major Step A: Strategy.		$0	0.0		$3,500	88.8		$18,360	426.2
A1: Establish Transfer Thrusts	0%	$0	0.0	0%	$0	0.0	7%	$4,284	99.5
A2: Coordinate with the Players	0%	$0	0.0	2%	$700	17.8	4%	$2,448	56.8
A3: Resource Requirements into Budget	0%	$0	0.0	0%	$0	0.0	2%	$1,224	28.4
A4: Submit Technology Transfer Plans	0%	$0	0.0	0%	$0	0.0	2%	$1,224	28.4
A5: Receive Funding Authority	0%	$0	0.0	0%	$0	0.0	2%	$1,224	28.4
A6: Implement Strategy Plan	0%	$0	0.0	0%	$0	0.0	3%	$1,836	42.6
A7: Monitor Transfer Initiatives	0%	$0	0.0	2%	$700	17.8	4%	$2,448	56.8
A8: Assess Use of Technology	0%	$0	0.0	4%	$1,400	35.5	4%	$2,448	56.8
A9: Assess Return on Investment	0%	$0	0.0	2%	$700	17.8	2%	$1,224	28.4
Major Step B: Identify Technology.		$0	0.0		$5,250	133.2		$6,120	142.1
B1: Query Database	0%	$0	0.0	0%	$0	0.0	1%	$612	14.2
B2: Evaluate Technology Assets	0%	$0	0.0	8%	$2,800	71.0	8%	$4,896	113.7
B3: Maintain Information Base	0%	$0	0.0	7%	$2,450	62.2	1%	$612	14.2

Major Step C: Marketing.		$0	0.0		$5,250	133.2		$12,240	284.2
C1: Develop Marketing Strategy	0%	$0	0.0	3%	$1,050	26.6	4%	$2,448	56.8
C2: Implement Strategy	0%	$0	0.0	4%	$1,400	35.5	6%	$3,672	85.2
C3: Promote Technology Assets	0%	$0	0.0	8%	$2,800	71.0	8%	$4,896	113.7
C4: Create technology Demand	0%	$0	0.0	0%	$0	0.0	2%	$1,224	28.4
Major Step D: Identify Transfer Vehicle.		$0	0.0		$8,750	222.0		$3,060	71.0
D1: Review Vehicle Selection	0%	$0	0.0	5%	$1,750	44.4	1%	$612	14.2
D2: Confirm with Transfer Partner	0%	$0	0.0	5%	$1,750	44.4	1%	$612	14.2
D3: Establish Transfer Framework	0%	$0	0.0	5%	$1,750	44.4	1%	$612	14.2
D4: Coordinate with Internal Partner	0%	$0	0.0	5%	$1,750	44.4	1%	$612	14.2
D5: Reaffirm Appropriate Vehicle	0%	$0	0.0	5%	$1,750	44.4	1%	$612	14.2
Major Step E: Perform Transfer.		$61,198	1420.8		$8,750	222.0		$18,360	426.2
E1: Define Desired Results	0%	$0	0.0	0%	$0	0.0	8%	$4,896	113.7
E2: Coordinate w/Appropriate Players	0%	$0	0.0	15%	$5,250	133.2	1%	$612	14.2
E3: Negotiate Terms of Vehicle	0%	$0	0.0	8%	$2,800	71.0	8%	$4,896	113.7
E4: Review for Legal Sufficiency	0%	$0	0.0	0%	$0	0.0	1%	$612	14.2
E5: Authorize the Transfer	75%	$57,374	1332.0	0%	$0	0.0	1%	$612	14.2
E6: Transfer the Technology	0%	$0	0.0	0%	$0	0.0	8%	$4,896	113.7
E7: Monitor Technical and Admin Aspects	0%	$0	0.0	2%	$700	17.8	1%	$612	14.2
E8: Collect Transfer Revenues	0%	$0	0.0	0%	$0	0.0	1%	$612	14.2
E9: Close Out the Transfer	5%	$3,825	88.8	0%	$0	0.0	1%	$612	14.2
Major Step F: Post-Transfer Administration.		$15,300	355.2		$3,500	88.8		$3,060	71.0
F1: Track Process Implement	0%	$0	0.0	3%	$1,050	26.6	0%	$0	0.0
F4: Transfer Activity Evaluation	20%	$15,300	355.2	0%	$0	0.0	1%	$612	14.2
F5: Transfer Revenue Allocation	0%	$0	0.0	0%	$0	0.0	2%	$1,224	28.4
F6: Award and Recognize Individuals	0%	$0	0.0	2%	$700	17.8	1%	$612	14.2
F7: Public Relations	0%	$0	0.0	5%	$1,750	44.4	1%	$612	14.2
F8: Prepare Performance Reports	0%	$0	0.0	0%	$0	0.0	0%	$0	0.0
		$76,498	$1,776		$35,000	$888		$61,198	$1,421

Organizational Costs

Type	Cost	Driver
Travel:	20000	ALL
General office supplies:	600	ALL
Computer Equipment:	15000	ALL
Marketing:	25000	STEP C
Training:	3400	ALL
Contract Services:	300000	ALL
Other	0	ALL
TOTAL	364000	

Person #4			Person #5			Person #6			Person #7			Person #8						
% of time per activity	Labor $s per activity	Labor Hrs per activity	% of time per activity	Labor $s per activity	Labor Hrs per activity	% of time per activity	Labor $s per activity	Labor Hrs per activity	% of time per activity	Labor $s per activity	Labor Hrs per activity	% of time per activity	Labor $s per activity	Labor Hrs per activity	Organizational Costs Cost Driver ALL	Organizational Costs Cost Driver Step C	TOTAL COSTS	TOTAL HOURS
	$4,010	142.1		$0	0.0		$36,934	710.4		$23,636	536.3		$16,291	268.1	$51,182	$0	$153,912	2171.9
0%	$0	0.0	0%	$0	0.0	5%	$4,617	88.8	2%	$3,254	73.8	2%	$2,243	36.9	$7,046	$0	$21,443	299.0
5%	$2,005	71.0	0%	$0	0.0	15%	$13,850	266.4	5%	$7,122	161.6	5%	$4,908	80.8	$15,421	$0	$46,454	654.4
0%	$0	0.0	0%	$0	0.0	1%	$923	17.8	1%	$798	18.1	1%	$550	9.1	$1,728	$0	$5,224	73.3
0%	$0	0.0	0%	$0	0.0	2%	$1,847	35.5	1%	$1,105	25.1	1%	$762	12.5	$2,393	$0	$7,330	101.5
0%	$0	0.0	0%	$0	0.0	0%	$0	0.0	0%	$491	11.1	0%	$339	5.6	$1,064	$0	$3,117	45.1
0%	$0	0.0	0%	$0	0.0	4%	$3,693	71.0	1%	$1,965	44.6	1%	$1,354	22.3	$4,254	$0	$13,102	180.5
0%	$0	0.0	0%	$0	0.0	11%	$10,157	195.4	3%	$4,666	105.9	3%	$3,216	52.9	$10,104	$0	$31,290	428.7
5%	$2,005	71.0	0%	$0	0.0	2%	$1,847	35.5	2%	$3,438	78.0	2%	$2,370	39.0	$7,445	$0	$20,952	315.9
0%	$0	0.0	0%	$0	0.0	0%	$0	0.0	1%	$798	18.1	1%	$550	9.1	$1,728	$0	$5,000	73.3
	$12,029	426.2		$3,825	88.8		$0	0.0		$13,660	309.9		$9,415	155.0	$29,579	$0	$79,878	1255.2
10%	$4,010	142.1	0%	$0	0.0	0%	$0	0.0	2%	$2,701	61.3	2%	$1,862	30.6	$5,849	$0	$15,034	248.2
5%	$2,005	71.0	0%	$0	0.0	0%	$0	0.0	3%	$4,420	100.3	3%	$3,047	50.1	$9,572	$0	$26,739	406.2
15%	$6,014	213.1	5%	$3,825	88.8	0%	$0	0.0	4%	$6,538	148.3	4%	$4,506	74.2	$14,158	$0	$38,104	600.8

	$12,029	426.2		$30,599	710.4		$12,927	248.6		$31,157	706.9		$21,474	353.5	$67,468	$25,000	$218,143	2863.0
10%	$4,010	142.1	5%	$3,825	88.8	2%	$1,847	35.5	4%	$6,047	137.2	4%	$4,168	68.6	$13,095	$4,852	$41,341	555.7
15%	$6,014	213.1	20%	$15,300	355.2	2%	$1,847	35.5	8%	$12,524	284.2	8%	$8,632	142.1	$27,120	$10,049	$86,558	1150.8
5%	$2,005	71.0	15%	$11,475	266.4	10%	$9,233	177.6	8%	$12,094	274.4	8%	$8,336	137.2	$26,189	$9,704	$86,733	1111.4
0%	$0	0.0	0%	$0	0.0	0%	$0	0.0	0%	$491	11.1	0%	$339	5.6	$1,064	$394	$3,511	45.1
	$2,005	71.0		$19,125	444.0		$1,847	35.5		$14,581	330.8		$10,050	165.4	$31,574	$0	$90,990	1339.8
1%	$401	14.2	5%	$3,825	88.8	0%	$0	0.0	2%	$2,793	63.4	2%	$1,925	31.7	$6,049	$0	$17,355	256.7
1%	$401	14.2	0%	$0	0.0	0%	$0	0.0	1%	$1,259	28.6	1%	$867	14.3	$2,725	$0	$7,614	115.6
1%	$401	14.2	0%	$0	0.0	0%	$0	0.0	1%	$1,259	28.6	1%	$867	14.3	$2,725	$0	$7,614	115.6
1%	$401	14.2	20%	$15,300	355.2	2%	$1,847	35.5	5%	$8,012	181.8	5%	$5,522	90.9	$17,349	$0	$50,792	736.2
1%	$401	14.2	0%	$0	0.0	0%	$0	0.0	1%	$1,259	28.6	1%	$867	14.3	$2,725	$0	$7,614	115.6
	$2,005	71.0		$22,949	532.8		$6,463	124.3		$48,347	1096.9		$33,322	548.5	$104,691	$0	$306,086	4442.6
0%	$0	0.0	0%	$0	0.0	3%	$2,770	53.3	2%	$2,885	65.5	2%	$1,989	32.7	$6,248	$0	$18,788	265.1
2%	$802	28.4	10%	$7,650	177.6	3%	$2,770	53.3	4%	$7,029	159.5	4%	$4,845	79.7	$15,222	$0	$44,180	645.9
0%	$0	0.0	0%	$0	0.0	0%	$0	0.0	2%	$3,192	72.4	2%	$2,200	36.2	$6,913	$0	$20,002	293.4
0%	$0	0.0	0%	$0	0.0	0%	$0	0.0	0%	$246	5.6	0%	$169	2.8	$532	$0	$1,559	22.6
0%	$0	0.0	0%	$0	0.0	0%	$0	0.0	15%	$23,268	527.9	15%	$16,037	264.0	$50,385	$0	$147,675	2138.1
0%	$0	0.0	15%	$11,475	266.4	0%	$0	0.0	4%	$6,569	149.0	4%	$4,528	74.5	$14,225	$0	$41,692	603.6
2%	$802	28.4	5%	$3,825	88.8	1%	$923	17.8	2%	$2,885	65.5	2%	$1,989	32.7	$6,248	$0	$17,985	265.1
0%	$0	0.0	0%	$0	0.0	0%	$0	0.0	0%	$246	5.6	0%	$169	2.8	$532	$0	$1,559	22.6
1%	$401	14.2	0%	$0	0.0	0%	$0	0.0	1%	$2,026	46.0	1%	$1,396	23.0	$4,387	$0	$12,647	186.2
	$8,019	284.2		$0	0.0		$7,387	142.1		$16,269	369.1		$11,213	184.6	$35,229	$0	$99,977	1495.0
5%	$2,005	71.0	0%	$0	0.0	0%	$0	0.0	1%	$1,688	38.3	1%	$1,164	19.2	$3,656	$0	$9,563	155.1
0%	$0	0.0	0%	$0	0.0	3%	$2,770	53.3	5%	$7,306	165.8	5%	$5,035	82.9	$15,820	$0	$46,843	671.3
0%	$0	0.0	0%	$0	0.0	0%	$0	0.0	0%	$491	11.1	0%	$339	5.6	$1,064	$0	$3,117	45.1
3%	$1,203	42.6	0%	$0	0.0	2%	$1,847	35.5	1%	$1,903	43.2	1%	$1,312	21.6	$4,121	$0	$11,698	174.9
12%	$4,812	170.5	0%	$0	0.0	3%	$2,770	53.3	3%	$4,881	110.7	3%	$3,364	55.4	$10,569	$0	$28,757	448.5
0%	$0	0.0	0%	$0	0.0	0%	$0	0.0	0%	$0	0.0	0%	$0	0.0	$0	$0	$0	0.0
	$40,096	$1,421		$76,498	Other	29%	$26,777	515.0	6%	$8,902	202.0	6%	$6,136	101.0	$19,276	$0	$61,091	818.0
							$92,334	$1,776									$1,010,076	14,385.6

Percent by Sub-step		Percent by Major Step	
A1	0.02122901	A	0.15237673
A2	0.04599057	B	0.07908083
A3	0.00517162	C	0.21596705
A4	0.00725718	D	0.09008206
A5	0.00308605	E	0.3030322
A6	0.01297134	F	0.09897976
A7	0.03097777	OTHER	0.06048136
A8	0.02074268		
A9	0.00495051		1
B1	0.01488411		
B2	0.02647257		
B3	0.03772416		
C1	0.04092873		
C2	0.08569451		
C3	0.08586759		
C4	0.00347621		
D1	0.01718219		
D2	0.00753827		
D3	0.00753827		
D4	0.05028507		
D5	0.00753827		
E1	0.01860091		
E2	0.04373917		
E3	0.01980203		
E4	0.00154303		
E5	0.14620183		
E6	0.04127598		
E7	0.01780518		
E8	0.00154303		
E9	0.01252106		
F1	0.00946722		
F4	0.0463754		
F5	0.00308605		
F6	0.01158093		
F7	0.02847015		
F8	0		

STEP	COSTS	HRS	COSTS %	HRS %			
	1169376	15385.38					
A1	127749.7	1614.221	0.027922	0.026371			
A2	192890.1	2622.31	0.042159	0.04284	A	0.255585	0.251347
A3	65971.15	877.965	0.014419	0.014343	B	0.066648	0.071861
A4	76994.56	1097.092	0.016828	0.017923	C	0.212948	0.164932
A5	35840.61	494.558	0.007834	0.008079	D	0.11577	0.12087
A6	155745	2050.752	0.03404	0.033503	E	0.227346	0.255439
A7	173958.5	2307.854	0.038021	0.037703	F	0.10835	0.122186
A8	181221	2363.746	0.039609	0.038616	OTHER	0.013352	0.013364
A9	159005.7	1956.885	0.034753	0.031969			
	304936.5	4398.734				1	1
B1	49718.89	757.3421	0.010867	0.012373			
B2	175363.9	2393.822	0.038328	0.039107			
B3	79853.69	1247.57	0.017453	0.020381			
	974301.5	10095.78					
C1	193870.4	1989.799	0.042373	0.032507			
C2	292879.6	3055.608	0.064013	0.049919			
C3	327119.8	3544.478	0.071497	0.057905			
C4	160431.7	1505.891	0.035065	0.024601			
	529682.1	7398.659					
D1	126447.8	1634.86	0.027637	0.026708			
D2	83454.31	1209.665	0.01824	0.019762			
D3	135285.6	1836.593	0.029569	0.030004			
D4	159778.3	2310.628	0.034922	0.037748			
D5	24716.02	406.9129	0.005402	0.006648			
	1040173	15635.85					
E1	136562.4	1826.25	0.029848	0.029835			
E2	190359.5	3185.622	0.041606	0.052043			
E3	140188.4	2233.633	0.03064	0.03649			
E4	74289.6	1048.206	0.016237	0.017124			
E5	225135.7	3233.887	0.049207	0.052831			
E6	100038.5	1565.335	0.021865	0.025573			
E7	102207.4	1508.346	0.022339	0.024642			
E8	14913.49	256.9976	0.00326	0.004199			
E9	56478.35	837.9586	0.012344	0.01369			
	495733.8	7479.206					
F1	114147.1	1611.459	0.024949	0.026326			
F4	138367.3	1887.888	0.030242	0.030842			
F5	10177.85	181.8833	0.002225	0.002971			
F6	43977.23	627.7638	0.009612	0.010256			
F7	125894.6	2291.092	0.027516	0.037429			
F8	63169.64	879.12	0.013807	0.014362			
Other	61090.8	818.0047	0.013352	0.013364			
	4575294	61211.62	1	1.000986			

STEP	COSTS	HRS	COSTS %	HRS %			
	1069984	13556.1					
A1	119653.1	1488.915	0.029337	0.028323			
A2	172338.3	2217.284	0.042255	0.042178	A	0.262343	0.25787
A3	58548.79	748.2184	0.014355	0.014233	B	0.065841	0.070161
A4	70106.87	971.7854	0.017189	0.018486	C	0.220793	0.173718
A5	29779.68	382.5713	0.007301	0.007277	D	0.110548	0.114338
A6	137974.8	1707.885	0.033829	0.032488	E	0.216469	0.243631
A7	159987.6	2044.907	0.039226	0.038899	F	0.109027	0.124722
A8	170685.3	2162.959	0.041849	0.041145	OTHER	0.014978	0.01556
A9	150909.1	1831.578	0.037	0.034841			
	268538.6	3688.334				1	
B1	45521.52	674.4621	0.011161	0.01283			
B2	148798.8	1880.262	0.036483	0.035767			
B3	74218.31	1133.61	0.018197	0.021564			
	900520.3	9132.296					
C1	182794.6	1852.159	0.044818	0.035233			
C2	273254.6	2820.288	0.066998	0.053649			
C3	293043	3064.958	0.071849	0.058303			
C4	151428	1394.891	0.037128	0.026534			
	450879.1	6010.715					
D1	115565.5	1446.604	0.028335	0.027518			
D2	67577.48	932.6089	0.016569	0.01774			
D3	122704.2	1625.249	0.030085	0.030916			
D4	134604.3	1837.324	0.033003	0.03495			
D5	10427.52	168.9289	0.002557	0.003213			
	882886.7	12807.57					
E1	126449.2	1641.546	0.031003	0.031226			
E2	142956.5	2235.462	0.035051	0.042524			
E3	116536.9	1794.073	0.028573	0.034128			
E4	61520.99	830.6456	0.015084	0.015801			
E5	210450.7	2999.455	0.051599	0.057057			
E6	84442.42	1260.751	0.020704	0.023983			
E7	84584.35	1206.426	0.020739	0.022949			
E8	7185.175	129.1256	0.001762	0.002456			
E9	48760.4	710.0866	0.011955	0.013508			
	444675.5	6556.574					
F1	100011.6	1380.579	0.024521	0.026262			
F4	127841	1710.288	0.031345	0.032534			
F5	8743.751	151.6913	0.002144	0.002886			
F6	41173.46	565.6038	0.010095	0.010759			
F7	106943.3	1940.332	0.026221	0.03691			
F8	59962.41	808.08	0.014702	0.015372			
Other	61090.8	818.0047	0.014978	0.01556			
TOTAL	4078574	52569.6	1				

STEP	COSTS	HRS	COSTS %	HRS %			
	26101.87	626.04					
A1	1096.123	26.64	0.007278	0.007829			
A2	7330.153	186.48	0.048672	0.054802	A	0.173316	0.183977
A3	403.4533	8.88	0.002679	0.00261	B	0.121976	0.123956
A4	3496.443	79.92	0.023216	0.023486	C	0.113116	0.114823
A5	403.4533	8.88	0.002679	0.00261	D	0.125123	0.133873
A6	1788.793	44.4	0.011878	0.013048	E	0.341959	0.319676
A7	6970.478	164.28	0.046284	0.048278	F	0.124511	0.123695
A8	3516.843	79.92	0.023352	0.023486			
A9	1096.123	26.64	0.007278	0.007829			
	18369.9	421.8					
B1	2192.247	53.28	0.014556	0.015658			
B2	12547.4	284.16	0.083314	0.083507			
B3	3630.258	84.36	0.024105	0.024791			
	17035.59	390.72					
C1	1788.793	44.4	0.011878	0.013048			
C2	2192.247	53.28	0.014556	0.015658			
C3	11440.74	257.52	0.075966	0.075678			
C4	1613.813	35.52	0.010716	0.010438			
	18843.89	455.544					
D1	2887.455	69.264	0.019173	0.020355			
D2	4272.795	104.784	0.028371	0.030793			
D3	2684.459	65.712	0.017825	0.019311			
D4	6314.718	150.072	0.04193	0.044102			
D5	2684.459	65.712	0.017825	0.019311			
	51500.15	1087.8					
E1	4097.815	95.904	0.027209	0.028184			
E2	14305.25	328.56	0.094986	0.096555			
E3	10399.29	222	0.069051	0.06524			
E4	1418.433	26.64	0.009418	0.007829			
E5	1991.789	47.952	0.013225	0.014092			
E6	9580.73	215.784	0.063616	0.063413			
E7	6291.323	133.2	0.041774	0.039144			
E8	1712.943	39.072	0.011374	0.011482			
E9	1702.573	39.072	0.011305	0.011482			
	18751.7	420.912					
F1	2803.773	62.16	0.018617	0.018267			
F4	2803.773	62.16	0.018617	0.018267			
F5	1434.096	30.192	0.009522	0.008873			
F6	2803.773	62.16	0.018617	0.018267			
F7	5699.06	133.2	0.037842	0.039144			
F8	3207.227	71.04	0.021296	0.020877			
TOTAL	150603.1	3402.816					

STEP	COSTS	HRS	COSTS %	HRS %			
	73290.97	1203.24					
A1	7000.471	98.66667	0.020226	0.018832			
A2	13221.63	218.5467	0.0382	0.041714	A	0.211752	0.229661
A3	7018.911	120.8667	0.020279	0.02307	B	0.052086	0.055085
A4	3391.246	45.38667	0.009798	0.008663	C	0.163949	0.109322
A5	5657.475	103.1067	0.016346	0.01968	D	0.173234	0.177966
A6	15981.38	298.4667	0.046173	0.056968	E	0.305638	0.332203
A7	7000.471	98.66667	0.020226	0.018832	F	0.09334	0.095763
A8	7018.911	120.8667	0.020279	0.02307			
A9	7000.471	98.66667	0.020226	0.018832			
	18027.99	288.6					
B1	2005.125	29.6	0.005793	0.00565			
B2	14017.74	229.4	0.0405	0.043785			
B3	2005.125	29.6	0.005793	0.00565			
	56745.67	572.76					
C1	9287.005	93.24	0.026832	0.017797			
C2	17432.71	182.04	0.050367	0.034746			
C3	22636.1	222	0.0654	0.042373			
C4	7389.855	75.48	0.021351	0.014407			
	59959.12	932.4					
D1	7994.806	118.992	0.023099	0.022712			
D2	11604.03	172.272	0.033526	0.032881			
D3	9896.889	145.632	0.028594	0.027797			
D4	18859.36	323.232	0.054488	0.061695			
D5	11604.03	172.272	0.033526	0.032881			
	105786.6	1740.48					
E1	6015.376	88.8	0.01738	0.016949			
E2	33097.73	621.6	0.095626	0.118644			
E3	13252.27	217.56	0.038288	0.041525			
E4	11350.18	190.92	0.032793	0.036441			
E5	12693.18	186.48	0.036673	0.035593			
E6	6015.376	88.8	0.01738	0.016949			
E7	11331.74	168.72	0.03274	0.032203			
E8	6015.376	88.8	0.01738	0.016949			
E9	6015.376	88.8	0.01738	0.016949			
	32306.53	501.72					
F1	11331.74	168.72	0.03274	0.032203			
F4	7722.519	115.44	0.022312	0.022034			
F5	0	0	0	0			
F6	0	0	0	0			
F7	13252.27	217.56	0.038288	0.041525			
F8	0	0	0	0			
TOTAL	346116.9	5239.2					

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Vita

Captain Thomas S. Van Egeren [redacted] enlisted in the Air Force on 4 February 1983, and attained the enlisted rank of Technical Sergeant. He was accepted in the Airmen's Education and Commissioning Program in August 1990. He completed his Bachelor's of Science in Mechanical Engineering at the University of Oklahoma, Norman, OK. Upon completing Officer Training School on 26 May 1993 at Lackland AFB, TX, Captain Van Egeren was assigned to the 545th Test Group at Hill AFB, UT, as a Flight Test Engineer.

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13. ABSTRACT (*Maximum 200 Words*)

An ever shrinking Research and Development (R&D) budget, coupled with a widespread perception that the nation is not realizing an adequate return from its substantial investment in the federal laboratory system, has paved the way for an increase in the transfer of technology from the federal laboratories to the private sector. The objective of this research is to determine the indirect cost of performing technology transfer by identifying the resources consumed by several key Office of Research and Technology Applications (ORTA) organizations and the activities performed within these organizations.

It was hypothesized that the ORTA organizations, which are considered indirect labor by most costing methods, would expend considerable portions of their resources on activities identified as not being performed by direct labor. This hypothesis was proven true, as all but two of the identified steps consumed a significant portion of the ORTA resources. It was also hypothesized that comparisons could be made among the various ORTAs to determine a "step-wise" level of resources expended based on the amount of technology being transferred. This hypothesis was proven false, however, as there was too much variance in resources consumed to technology transfer activity level among the ORTAs researched.

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