9-1996

Identifying Cost Patterns of Managing Technology Transfer Actions

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IDENTIFYING COST PATTERNS OF MANAGING TECHNOLOGY TRANSFER ACTIONS

THESIS

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Presented to the Faculty of the School of

Logistics and Acquisition Management of the

Air Force Institute of Technology

Air University

Air Education and Training Command

In Partial Fulfillment of the

Requirements for the Degree of

Master of Science in Systems Management

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September 1996

Acknowledgments

I would like to thank my advisor, Maj Richard M. Franza, for his direction, insight, and persistence, but most of all his patience. Additionally, I thank Dr. David S. Christensen for his valuable technical advice, assistance, as well as his continued efforts to ensure my focus was correct. Without these gentlemen, this effort would not have been accomplished.

I thank my family. Thank you Susan for "standing in the gap" for me while I was away those many evenings, weekends and even nights. Knowing that you were pouring out your love and care on our children allowed me to focus and complete this short-term distraction. Thank you Aubrey and Bryce for your love and understanding when Daddy had to be away or couldn't play with you, and also your excitement when I returned.

Most of all, I thank the God of all creation for seeing me through these difficult days and nights. Without His grace and kindness I could not have made it through.

James C. Boyd III

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Abstract

Significant national resources are dedicated to research and development (R&D) at government laboratories. In an era of increasing deficits and resulting budget reductions, transfer of technology from these laboratories to the private sector is important in order to improve the return on this R&D investment, as well as to improve the US industrial technological base, thus enhancing our nation's economic security. However, no accurate measures to evaluate the efficiency of the technology transfer (TT) process exist. Likewise, accurate cost information, affording insight into the cost patterns and allowing more effective resource management, does not exist. This research draws on the principles of activity-based costing in order to develop a collection instrument, quantify the direct cost-over-time, and identify the cost patterns of eight TT projects managed at Wright Laboratory, all employing the cooperative research and development agreement vehicle.

Results reveal 80 percent of a technology transfer's total resources were dedicated to the performance of the transfer activity. Additionally, human resources accounted for 80 percent of the total. Expenditures were linear and fairly consistent over the project's life, which begins nearly six months prior to signature and ends more than five months after expiration.

IDENTIFYING COST PATTERNS OF MANAGING TECHNOLOGY TRANSFER ACTIONS

I. Introduction

Overview

A large amount of resources are currently being spent on research and development (R&D) in United States federal laboratories. Presently there are over 700 federal laboratories and R&D centers that, according to the National Science Foundation, spent approximately $70 billion for research & development in 1994 (Shahidi and Xue, 1994:151). Carr reports the annual federal R&D budget for 1991 was slightly larger at $71 billion, of which the federal laboratories, employing over 100,000 scientists and engineers, spent over $25 billion (Carr, 1992:8). The emphasis of the research performed at these laboratories is directed towards programs such as space and energy as well as the nation's defense. These technologies, including both advanced products and processes, are presently effectively utilized within the federal government for their intended purposes in support of national security and well being.

However, the potential of these advancements in both similar yet unrelated applications within the federal government, as well as in related areas in the private sector, known as *spin-offs*, has not been fully realized. To optimize the return on tax dollars spent on R&D, these technologies need also to be effectively utilized in peripheral areas in both the government and the private sector. This need for proliferation of these technologies necessitates their transfer to other agencies, both government and private. This would enable the nation to reap indirect benefits through: (1) spin-offs resulting in an improved US industrial technological base and subsequent enhancement to the nation's economic security; as well as (2) spin-backs enabling the government to reap

tertiary returns through improved national security. Spin-back, as is shown in Figure 1-1 (Technology Transfer Terminology) is a phenomenon in which a federally-owned

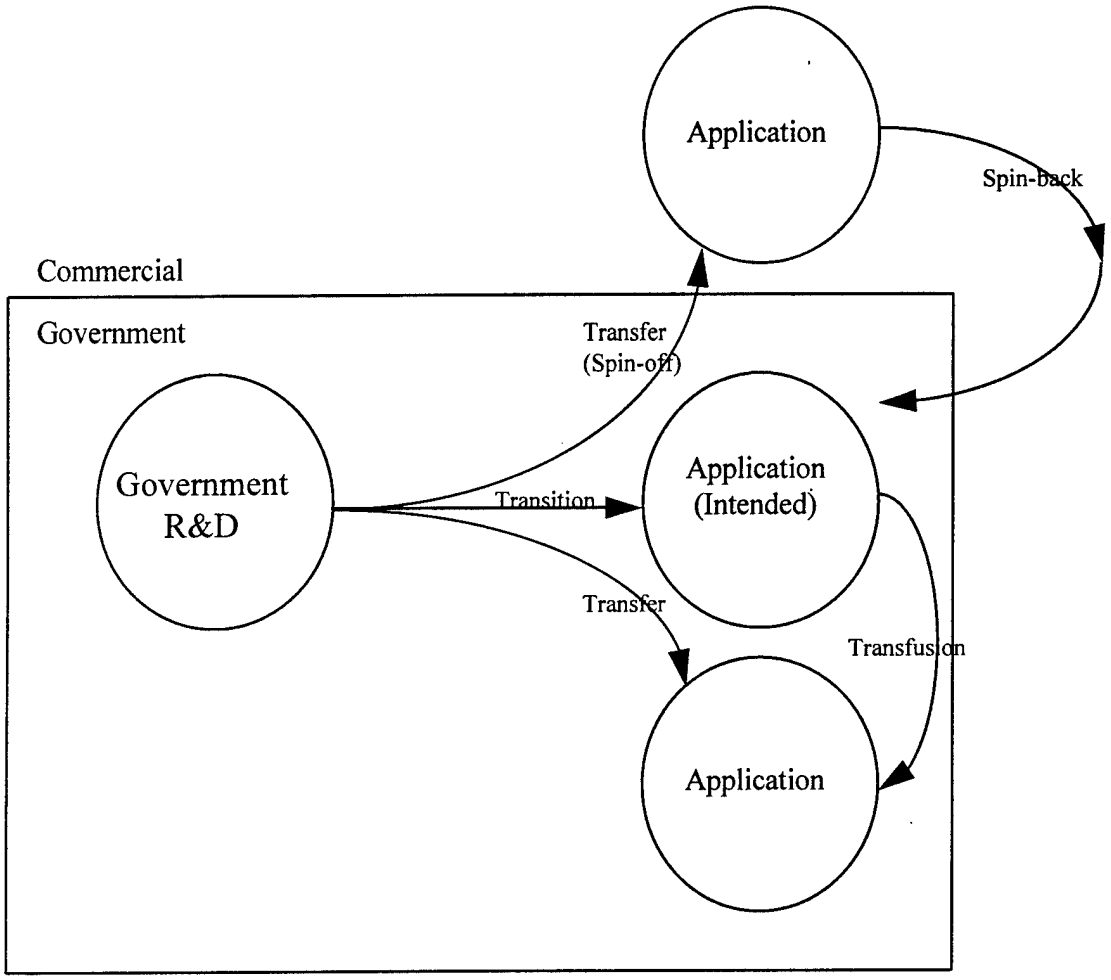


Figure 1-1. Technology Transfer Terminology

technology is transferred to a commercial entity which in turn is utilized by that commercial entity in a manner that benefits the federal government. "These enhancements not only serve the commercial sector, but they spin-back to the government in the way of cheaper, higher performing systems and components" (West and Mitchell, 1994:119). The transfer of technologies, developed by federally-funded

laboratories to other uses within the government or to the commercial or private sector, is important in order to maximize the return for each tax dollar spent.

Despite being conceived of as early as the 1950s, technology transfer (TT) has only recently been emphasized. To date, there has been much research conducted addressing the transfer of federally developed technologies. Areas of research range from the identification of the processes and methods used to most efficiently perform the transfer to the effectiveness and benefits of these efforts. However, there has been very little, if any, research directed at quantifying the costs of performing the technology transfer process. While the total spent by the federal government on R&D is known, an accurate identification of the portion of this total that is consumed by technology transfer activities is not; thus the crux of this research effort. An example of one such method, that may be well suited for capturing and quantifying the cost of performing the transfer of technology, is activity-based costing.

Activity-based costing (ABC) is a concept that has its roots in attempting to better allocate the costs associated with the production of a product. ABC is unique in that it does not utilize the traditional costing methods that allocate non-direct costs by some physical aspect of the product such as size, number of parts, or production volume. The ABC concept more accurately allocates costs by quantifying the resources actually consumed and then tracing these to the activities in the production of a product or performance of a service. Activity-based costing principles have been used in many associated areas, especially process improvement, as it is an effective method to better identify the true cost of a process by aggregating its activities and the resources they consume. This research effort will endeavor to utilize the concepts and principles of activity-based costing while laying the foundation for the identification of the costs of performing the technology transfer process.

Identification of cost is important because only by accurately knowing these costs can the government's limited funding be put to its best use as well as be accurately forecasted and programmed.

Before delving too deeply, the definition of a few terms important to any discussion of technology transfer are presented in order to ensure an understanding of the terminology. The first term for the foundation is technology itself.

Definitions

When discussing technology transfer, what exactly is it that is being transferred? According to Air Force Material Command (AFMC) and in the context of this research, the Technology Transfer Handbook defines a technology as, "The branch of knowledge that deals with industrial arts, applied science, engineering, etc.; a technological process, invention, method, or the like; the application of knowledge for practical ends" (AFMC, 1995:O-5). Additionally, technologies may include products, processes, people, as well as their unique facilities (AFMC, 1995:D-4). Understanding *what* it is that is being transferred, the question now is what is meant by transfer; where is it now, how will it be transferred, and to where is it going to be transferred?

"When stripped of the ever increasing jargon of the technology transferrists, technology transfer is simply putting something which is known into use or a new use or application" (Creighton and others, 1985:65). While truly basic and *cutting to the chase*, it does not fully define some important aspects of technology transfer. More formally, it is defined as "a subset of innovation dealing with the movement of technology, both with and without adaptation, from the source to the user" (Dawson, 1986:21). This definition is important as it addresses the frequently overlooked issue of the adaptation of the technology during the transfer. Adaptation, which is most often the case, occurs as the new product or process is integrated into its new environment. However, for the purposes

of this study it is insufficient since it only generically identifies both the originator and receiver of the technology as the source or the user respectively.

The Federal Laboratory Consortium (FLC) more specifically identifies federal research and development (R&D) facilities as the source. The FLC defines federal technology transfer as, "the process by which existing knowledge, facilities or capabilities developed under federal R&D are utilized to further public or private domestic needs" (Federal Laboratory Consortium, 1990). A federal laboratory is, "a facility or group of facilities owned, leased, or otherwise used by a federal agency, a substantial purpose of which is to perform research, development, or engineering by employees of the Federal Government" (AFMC, 1995:O-2). While this improves upon identifying the originator or source, it still leaves some ambiguity with respect to the receiver of the technology. According to AFMC, as defined in their Technology Transfer handbook, TT is defined as:

> A process by which facilities, equipment, or other resources relating to scientific or technological developments of a federal laboratory are provided or disclosed by any means to another industrial organization, including a corporation, partnership, limited partnership, or industrial development organization; public or private foundation; nonprofit organization, including a university, or other person to enhance or promote technological or industrial innovation for a commercial or public purpose. (AFMC, 1995:O-5)

This definition quite specifically identifies both the source and receiver of the technology. Additionally, it states that even the use of resources possessed by a federal laboratory to enhance innovation is considered a transfer of technology. Resources in this context are any elements used as input in the performance of the TT process. For the purposes of this effort, the term resources will be more limited and only include both the funding, or money, and the personnel, or human resources, utilized in TT process.

As an aid in understanding more exactly what technology transfer is, it is useful to also understand what it is not. TT is distinct from two very similar terms; technology transition, and technology transfusion, both are shown in Figure 1-1 presented earlier.

Technology Transition is the movement of a technology from R&D in a laboratory directly to its first-time application (AFMC, 1995:O-5). For example, the F-16 was developed using a prototype fly-off program between the General Dynamics YF-16 and the Northrop YF-17. In an effort to satisfy a NATO requirement, the US Air Force formulated a concept known as the *Air Combat Fighter* which could utilize one of the fly-off designs while incorporating additional air-to-ground capability. The Government accelerated the schedule of the Light Weight Fighter program requiring the contractors to take state-of-the-art technology that was to be tested in their prototypes and make it in their missionized version--taking technology straight from the laboratory and into the field and *tweaking* it to make it meet the mission (Aronstein, 1995:55-56).

Technology Transfusion is the movement of a technology from one existing operational system into another existing operational system. The wing-tip lens covering for the C-141 was made of glass and had a propensity for breaking. In order to correct this deficiency that was costing significant funds, Zytell 330, an extremely durable plastic that could be injection molded into any shape and tinted most colors was used. Zytell already existed and was already commercially available (Guilfoos, 1989:2).

With the basic terminology of technology transfer complete, it is time to turn attention to ABC--activity-based costing.

The theory of activity-based costing was developed by the Texas-based Consortium for Advanced Manufacturing-International (CAM-I) in an effort to determine a method to allocate the overhead costs to the products when there is no direct labor required; e.g., in the *lights-out* factories of the future where machines will do all the work and no direct labor will be performed by humans (Miller, 1996:10). One of the main

conclusions of CAM-I's efforts was that products do not consume cost directly, but rather money is spent on activities, which are in turn consumed in the manufacture of a product or performance of a service (or process) (Miller, 1996:11). This new costing methodology was first published in the *Harvard Business Review* in early 1988. Coined *activity-based costing*, it is:

> 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. (Miller, 1996:12)

According to Miller, the focus of ABC is on accurate information about the true cost of products, processes, activities, and projects. Putting activity-based costing information to work, *activity-based management* (ABM) makes this cost and operating information useful by providing value analysis and performance measures to initiate, drive, or support improvement efforts and ultimately to improve decision making (Miller, 1996:1). ABM, making use of ABC, aids organizations in making better decisions, setting priorities, allocating resources, and monitoring actions (Miller, 1996:15).

Since its *founders* were all in the manufacturing specialty, ABC was originally viewed as applicable only to manufacturing organizations (Miller, 1996:12). However, since activities are universal to all organizations, its principles are useful to service companies, schools, governments and not-for-profit organizations as well (Miller, 1996:12). Activities are fundamental and basic to any organization's success as they are a common denominator and must be managed and improved in order to remain competitive (Miller, 1996:13). In the case of many federal laboratories, an accurate identification of both the costs and benefits of performing TT may be crucial to their survival.

Why all this discussion of technology transfer? Why does it seem that it is one of today's hottest *buzz words* in government R&D circles? With the foundation firmly

established, attention can now be directed toward understanding why TT is an important topic of research.

Importance of Technology Transfer

A large amount of money is being directed to both R&D as well as issues surrounding the transfer of technology from the federal government to the commercial sector. This infers that, for all this money being expended, there are significant benefits to be gained and valuable returns anticipated. The primarily benefits of technology transfer, as discussed earlier, are spin-offs and spin-backs. These phenomena improve the nation's industrial base through the merger of the two former industrial bases, military and commercial, increasing its competitiveness in the global marketplace and resulting in enhanced economic, as well as national, security.

Despite the vast resources expended by the federal government, a significant increase in global competition over the past twenty years has resulted in a relative decline in the United State's industrial prowess. More importantly, this competition has, in a number of areas, taken the lead in technologies viewed as potentially critical to the security of our nation and its defense. Together, these developments have lead many to press for government action to reverse this trend.

However, with the fall of the Berlin Wall and subsequent collapse of the former Soviet Union (USSR), the US defense budget has been dramatically reduced. Additionally, due to the seemingly out-of-control national deficit, federal R&D is increasingly viewed as discretionary, resulting in R&D budgets becoming less secure and smaller. Together, these developments have impacted major industrial powers in this country. Their work, previously focused on providing the defense infrastructure and basic scientific knowledge, has either been canceled or has *dried up*, and both Congress and the American people turn their focus toward more *pressing* domestic issues.

One possible remedy to these problems has been a more efficient utilization of funding spent on federal research and development by transferring what has been described by one laboratory official as the "treasure of intellectual wealth" possessed by these laboratories to the commercial sector (Scott: 1993:64). This would ultimately benefit the nation twofold by simultaneously addressing both the commercial and military threats. First, this would improve the country's technological and industrial base as the technologies developed in the nation's laboratories are put to use by private companies through spin-offs. In addition to improving the private sector's position, it would also indirectly benefit the DoD through *spin-back.* All together, it can be seen that efforts invested in the transfer of technology have the potential to produce significant benefits, thus ultimately resulting in a reduction in the burden on our economy. Secretary of Defense Perry summed up the importance of TT, as quoted in AFMC's Technology Transfer Handbook, when he stated that:

> Domestic Technology Transfer and Dual Use Technology Development (DTT/DUTD) are integral elements of the Department's pursuit of its national security mission. They must have a priority in all Department of Defense (DoD) acquisition programs and must be recognized as key activities of the DoD laboratories. (AFMC, 1995:vii)

Recent budgetary limitations have heightened the urgency to reap the benefits of TT, resulting in increased visibility and an enhanced understanding of the benefits themselves. This is evidenced by the new emphasis and activity in technology transfer in recent years. Research using many techniques has been conducted in order to identify and improve the methods for effecting a TT as well as to quantify the results, both success and failures, in order to determine measures of effectiveness. While technology transfer may now be one of the fastest growing areas in the Air Force and the Department of Defense (DOD) today, this has not always been the case. A history of technology transfer and a summary of important legislation is included in Appendix A.

Identification of Cost

Corresponding to this increased emphasis and activity on TT, the resources expended in the performance of technology transfer activities have also grown. However, the increasing US budget deficit and resulting decrease in federal and DoD funding levels have resulted in two conflicting pressures on the funding set aside for TT. The first is a call to increase funding in order to increase the *bang for the buck* through better utilization of the resources invested in R&D. The second is pressure to reduce funding set aside for TT. While potential benefits may be recognized, if concrete results are not evident in today's fiscal environment, even funds for TT are in jeopardy. Interestingly, Carr reports that a, "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 technology transfer" (Carr, 1992:8).

Despite passage of the previously discussed legislation and the resources invested, formalization and definition of TT and its processes have only recently begun to *gel*, with less than full agreement on these results. Additionally, despite the wide variety of technology transfer models and methods that have been developed, few address measurements of effectiveness and are neither well defined nor universally accepted (Spann *et al.*, 1995:20). Furthermore, with respect to the measures of effectiveness or performance measures that have been developed, the focus has been on the successes or failures alone, while few, if any, address the aspect of quantifying the cost of performing these activities. Therefore, a great deal of uncertainty still exists not only with respect to the processes and performance measures used to affect and quantify these transfers, but especially with respect to methods of identifying the costs.

These uncertainties result in a number of challenges for federally-funded laboratories and organizations charged with managing technology transfers, especially when attempting to plan and execute them efficiently and effectively. One example, and

of particular interest for this research, is the lack of information on the requirements for resource planning, especially manpower.

It is generally understood that the cost of manpower expended to conduct a transfer is the *lion's share* of these resources and the process' total cost overall. Major General Paul, Air Force Material Command's Deputy Chief of Staff for Science and Technology (AFMC/ST) and command focal point for technology transfer, at Wright-Patterson AFB, as well as others, have often alluded to the fact that technology transfer is a *person-to-person* activity or a *high body-contact sport* (Carr, 1992:9) In other words, TT requires a large amount of personal interaction between government and industry personnel, likened to the lubricant that allows the TT *engine* to run (Carr, 1992:10). This, combined with the uncertainties discussed previously, highlights the importance of developing tools that aid managers in forecasting these resources accurately. Additionally, in order to be useful, these tools must be able to reliably and accurately quantify and predict not just the quantity of these resources, but also, with respect to the personnel resources, the type and timing of resources that will be needed. In other words, when attempting to program manpower requirements for a TT project, it is not just a question of how many man-hours the government must spend in order to conduct a successful transfer. It is also important to be able to plan for and program the required grade (i.e., Captain, Major, GS-13, etc.), required type (i.e., engineer, manager, etc.), and when this manpower is needed (e.g., 3rd quarter of 1997). This time-phased information of manpower required will yield a *cost pattern* of the life cycle cost of the TT process. Identification of this cost pattern as an aid in managing the transfer of technology is the ultimate objective of this research effort.

The principles of activity-based costing will be used in order to capture and characterize the cost of performing the activities that comprise the TT process.

Activity-Based Costing

As discussed previously, activity-based costing is a concept that has its roots in attempting to better allocate the costs associated with the production of a product. ABC is unique in that it does not utilize the traditional costing methods that allocate non-direct costs by some physical aspect of the product such as size, number of parts, or production volume. One particular trait of the ABC concept is that it more accurately allocates costs by quantifying the resources actually consumed while accomplishing the *activities* of production. "Costs are traced from activities to products based on the product's demand for these activities during the production process." (Cooper, 1988:45) While ABC is most often associated with the production of a product, activity-based costing principles have also been used previously in other areas.

Similar to technology transfer, activity-based costing is a recent phenomenon that has experienced large growth in the past ten years. While the basic principles of ABC have remained unchanged (the measurement and tracking of the costs of performing activities allowing improvements in cost management), ABC has been tailored in order to improve its usability in associated areas by combining these key principles with other concepts.

For example, it has been proposed that ABC methodologies be modified to identify not only the typical cost drivers, but also both the capital costs and capital drivers used to manage scarce critical capital resources (Hubbell, 1996:18). "The result will be an improved cost management system that helps managers focus on all the necessary elements of creating shareholder value, including the management of both costs and capital" (Hubbell, 1996:20).

Another example is the marriage of ABC with the management philosophy of the theory of constraints and its throughput accounting. "Some of the methodologies of activity-based costing and throughput accounting, e.g., activity mapping, are

complementary and can be used effectively as integrated elements of an advanced cost management system" (Salafatinos, 1995:58).

Finally, Lawson states that while many have suggested that ABC be used as a tool to support such techniques as total quality management, benchmarking, and continuous quality improvement, ABC is inherently unsuitable for these purposes for a number of reasons (Lawson, 1994:33). However, he then proposes a new information system methodology called process-based costing which incorporates the essential elements of ABC, overcomes its shortcomings (Lawson, 1994:33).

Similarly, this research will draw from these principles of ABC in order to develop a tool to accurately identify the costs of performing the activities of the technology transfer process. Once established, a number of technology transfer projects will be analyzed to determine how much time is required, by whom (type and level), and how that time is expended over the life of a project. Using the information from multiple projects, the ultimate goal of this project is to identify and postulate a *typical* cost-over-time curve for performing a transfer of technology project. Due to the exploratory nature of this effort as well as constraints of time, this research will concentrate its focus on TT projects at the Wright Laboratory, Wright-Patterson AFB, Dayton OH. Wright Laboratory is a premier federal laboratory that maintains world class research and development facilities in materials, avionics, propulsion, flight dynamics, and crew systems.

Research Objectives

The objective of this research is to provide insight into the *cost of doing business* in the Air Force's management of technology transfer actions. While much has been done regarding an assessment of the results of efforts to transfer technologies and the benefits, to date, little has been done to identify and quantify the cost of performing these

efforts. A cost benefit analysis cannot be performed if the cost to perform the service is not known.

The research objectives are to:

1. Effectively employ the concepts of activity-based costing in the development of an instrument for capturing the resources expended performing the *typical* technology transfer process at Wright-Patterson AFB's Wright Laboratories.
2. Establish the foundation for the development of a tool that may ultimately be used to project the time-phased resource requirements curve for performing a technology transfer project.
3. Provide a foundation for further research into the identification of the significant resources required to perform a transfer of technology project.

Tentative Hypothesis

The principles of ABC can be used to determine the cost of performing a transfer of technology project. Additionally, a relationship does exist between projects of similar characteristics allowing for the identification of a typical cost-over-time curve to aid in managing technology transfer actions.

Thesis Overview

Chapter Two will focus on a more in-depth discussion of what research has been performed in technology transfer in order to highlight the fact that research in identifying the cost of performing the TT process is seriously lacking. Additionally, while ABC has been used in many similar areas, it has not used in the identification of the cost to perform TT, although it is well suited for this purpose. Chapter Three will provide details regarding the methodology used for this research, and Chapter Four presents a detailed analysis of the collected data as well as guidance for its interpretation. Chapter Five concludes this effort providing a review of the results as well as a discussion of their implications, and finally recommendations and conclusions.

II. Literature Review

Introduction

A great deal of funding is being spent on federal research and development. In an era with increasing federal deficits and continuing reductions in the R&D budget, technology transfer (TT) becomes more important in order to boost the efficiency of each dollar spent by our federal laboratories; i.e., each dollar must be spent wisely. As a result, at each step of the lengthy federal budgeting cycle, each request for funding is being scrutinized with increased intensity as decision makers decide how the most benefit can be achieved with their constrained resources dollar-for-dollar. At the same time, Carr reports that there is a growing perception that our nation is not getting an adequate return on its federally-funded R&D budget (Carr, 1992:8). Together, these facts demand that accurate measures of effectiveness for the technology transfer process be utilized in order to assess the true value of the program. However, methods to accurately evaluate the effectiveness and efficiency of technology transfer efforts do not presently exist.

This chapter provides a review of the literature addressing past research of the measurements of technology transfer effectiveness showing that although plentiful, the research regarding the identification of the cost to conduct technology transfer is lacking. Next, a review of activity-based costing literature is presented showing that ABC and its principles have been effectively integrated with other concepts such as the theory of constraints, yielding improvements and enhanced usability. In conclusion, results of the literature search will be summarized as a stepping stone to the analysis of Wright Laboratory's TT process using principles of ABC. However, to begin, a review of the basic technology transfer process is provided as a foundation for this effort.

The Technology Transfer Process

The technology transfer (TT) process is extremely complex and has many unknowns remaining. A survey of 172 technology transfer cases within the Department of Energy (DOE) revealed that no two technology transfer strategies were identical (Deonigi *et al.*, 1990:328). Spann *et al.* add that research also has not reached consensus on the fundamental theories of the TT process, including how to define, track, or measure the success of TTs (Spann *et al.*, 1993, 63). This diversity is primarily a result of two factors. First, technology transfer, despite tracing its origins back to the 1950s has only in the past 10 years been implemented as the *desire* for the transfer of technology has evolved into a *need* for reasons previously discussed. Secondly, each TT effort is driven by a relationship between at least two organizations. These relationships are similar to relationships between individuals in that each is unique to suit the characteristics of the individuals. While this leads to great inconsistency in the establishment and discharge of government transfer policies, the basic steps in the process are generally recognized.

Since the focus here is on Wright Laboratories (WL), which are managed by the Air Force Material Command (AFMC), the steps presented in the AFMC Technology Transfer Handbook, are the basis used in this research. AFMC's Transfer Master Process (TMP), describes the *what* of technology transfer, but intentionally not the *how*; encouraging each organizational focal point to develop a detailed site-specific process that best suits their needs. The top-level TMP provides the basic steps or

framework for its development. and include the following:

1. Develop the organization's technology transfer strategy
2. Identify technologies
3. Market these technologies
4. Identify the transfer vehicle
5. Perform the transfer
6. Perform the post-transfer administration or *close-out.*

(AFMC, 1995:D-2)

These steps refer to the entire process. Not all participants in the TT effort will perform every step, nor will each step necessarily be performed sequentially.

In developing AFMC's technology investment strategy, the command's focal point performs the first step, integrating its laboratories' technology strategies (or annual business plans) and administrative requirements into a single command strategy. Once complete, technologies are identified as available for transfer, assessed regarding potential transferability, prioritized, and then added and stored in a database. This database is used in the third step, Marketing, in hopes of identifying matches between potential recipients and these technologies. When found, the Vehicle Identification step determines the best method of transfer. These *vehicles* range from Cooperative Research and Development Agreements (CRDAs) to licensing and should be chosen to best suit the needs of both participants. With the method established, participants proceed with the *meat* of a transfer: the actual exchange of the technology. Upon completion, Close-out is performed to do just that; complete the administrative aspects which include, among other things, advertising the transfer's success and rewarding its participants.

Technology Transfer Related Research

Despite the deceptive simplicity of the TT process just described, much research has been, and continues to be, conducted in order to understand its complexities. This research centers on three areas: basic understanding, process improvement, and finally, process evaluation or measurement.

Basic Understanding. The objective of research into the basics is an establishment of the foundation in the technology transfer field answering the investigative questions of what, who, and how. In an effort to uncover differences in TT rates between federal laboratories and universities, Carr expertly lays the foundation answering many *whats* in a comprehensive review of the basics (Carr, 1992). Beginning with the *phenomenon* of TT itself, he continues by proceeding through the process; describing the source (federal labs), the types or methods used, and the recipients of the transfer. Carr then summarizes the impetus for transfer, the major methods employed, and the models used to classify these efforts. He also identifies limitations to TT due to federal laboratories' culture and structure and concludes with a review of the four models postulated for measurement of TT: the out-the-door model, the market-impact model, the political model, and the opportunity-cost model (Bozeman, 1991:141). Carr states:

> Opportunity-cost models examine technology-transfer-program expenditures and ask what else could have been done with the same funds. Evaluations based on this model might ask whether a program is more valuable than other activities that could have been undertaken. The opportunity-cost evaluation may be most useful in comparing competing technology transfer programs within an institution rather than as a measure of absolute success. (Carr, 1992:20)

This model is an impetus for this effort. This research will allow the Air Force to better understand its TT expenditures.

Dawson, in an exploratory study of TT concepts, provides definitions of terminology and identifies several factors noted as either promoting or hindering the TT process. These factors can be grouped by participant; either pertaining to management's involvement, or the source-user [recipient] relationship. An investigation into the roles and relationships of the participants, with emphasis on the Defense Department, as well as the federal infrastructure follows. He then reviews the TT models that have been

developed, noting that a complete working model of the process does not appear to be available (Dawson, 1986).

Shahidi and Xue identify one of the many *whos* that participate in the process, the Federally Funded Research and Development Centers (FFRDCs). They describe the historical development of FFRDCs as well as the statutory and regulatory definition of this source of federal technology. Finally, the resources FFRDCs utilize are identified, along with their contributions and future research directions relating to technology transfer (Shahidi and Xue, 1994). While addressing the funding resources expended by these participants, FFRDCs account for just one small aspect of the overall TT process.

Going beyond just identifying who, Taylor evaluates both the roles and effectiveness of three categories of *middle men* or *transfer agents* including *third parties*, *outside agents*, and *technology brokers* (Taylor, 1996). Carr recognizes these intermediary organizations as a way to improve TT rates as they operate more like businesses and can be useful in bridging the gap between corporate and federal lab cultures (Carr, 1992:22). Specifically examining Wright Laboratory's Wright Technical Network, Taylor identifies what these agents do well as well as what they do not do well (Taylor, 1996). Closely related to this, Salvador's work centers on an investigation of four intermediaries in southwest Ohio's Miami Valley. These intermediaries were established in an effort to help promote economic growth and development by facilitating TT in specific market areas to recipients in order to reap maximum benefits from the Miami Valley's vast technological resources (Salvador, 1995). Again, only one portion of the overall TT process is addressed and additionally not from the aspect of cost.

Turning toward the basics of *how*, Widman addresses factors, such as agreement type, product orientation, prior business experience, and firm size, that affect the commercialization of technologies (Widman, 1995). These evaluations were made through comparisons of results of completed CRDAs and Small Business Innovation

Research (SBIR) agreements, but do not account for the resources expended. He found that results differed significantly between the two mechanisms, technology was more easily transferred to smaller firms, and more mature technologies were more successfully transferred (Widman, 1995). While transfer is most commonly associated with CRDAs and SBIRs, numerous other methods alluded to earlier include inventions, patents, and licensing agreements (AFMC, 1995:H-1). These mechanisms can range in formality from a formal CRDA to the very informal interchange or consultation among scientific and technical peers. Selection of the method is the most important determinant of the TT rate which is one measure of an effort's success (Carr, 1992:21), and depends on a number of factors that are the subject of research addressing the improvement of the technology transfer process.

Process Improvement. In today's environment of emphasizing quality, process improvement is a key area of focus. This is true in technology transfer as well for reasons previously discussed. This is evident from the volume of studies that address improving on the methods used to perform TT. Olsen, in response to the Federal Technology Transfer Act of 1986, qualitatively examined, in general, both the opportunities and barriers to commercial application of federally developed technology to the private sector as perceived by federal laboratory personnel (Olsen, 1987). More narrow in scope, but also evaluating personal perception, Rose, through an in-depth analysis of existing research combined with surveys of personnel involved, analyzed nineteen Air Force TT efforts, recommending techniques that can be used to improve the TT process. Finally, and even more focused, Leuthold, through an in-depth case study, investigated the factors affecting TT from Wright Laboratory (WL) to the private sector in order to determine potential facilitators and barriers. He identified lack of guidance, timeliness and distribution of technology documentation, and WL-private sector awareness as areas needing improvement (Leuthold, 1988). These qualitative case studies allow the sharing

of unique procedures, both successful and unsuccessful, and can give others new insights into problems and challenges they are facing (Riddlebaugh, 1994:212).

Improvement here is viewed from the aspect of throughput, such as an increase in the number of CRDAs or new products, but does not address reductions in the cost of performing the TT function. Also, in order to evaluate whether a process has indeed improved, measurements of the process must be taken in order to make comparisons either over time or between more than one methods. Finally, while qualitative research is useful for investigating concepts and relationships, it is less so for identifying the expenditures of resources and as a basis for programming and planning these resources.

Process Measurement. A great deal of research has been done in order to quantify the benefits of TT projects, i.e., their effectiveness, albeit little from a financial perspective (Braun, 1996). Bozeman, drawing from his national survey of over 300 government laboratories concluded that measuring TT effectiveness is a *tricky* business with the most fundamental problem being little agreement on a concept of technology transfer effectiveness itself (Bozeman, 1991:141).

While Bozeman's research, as well as others, in an attempt to evaluate TT's success, has identified many measures of technology transfer effectiveness or *metrics*, none are well defined nor universally accepted (Spann *et al.*, 1995:20). The diverse number of individuals, roles, organizations and goals, methods, and environments that exist in TT produces correspondingly diverse perspectives and thus numerous performance measures (Spann *et al.*, 1995:19). However, these numerous effectiveness measures can be divided into four model types: the *out-the-door* model, the *market-impact* model, the *political* model and the *opportunity-cost* model (Bozeman, 1991:141).

The out-the-door model, while it is easiest to measure, is limited in that it only addresses that the transfer of information occurred and not its resultant impact.

Recognizing there is little benefit from transferring technology that proves commercially and instrumentally barren, the market-impact model assess the effectiveness according to the commercial success of the transferred technology or information. The political model recognizes that TT is in part a political game where the *pay-offs* are indirect. Finally, the opportunity-cost model assesses transfer activities in terms of the tradeoffs federal laboratories must make in the use of its funds, human resources, and time, in other words, its cost (Bozeman, 1991:141-142). While all four types of models view these measures from the source's (or sponsor's) perspective, of interest in this research, only the *opportunity-cost* model addresses the costs associated with the performance of TT. However, Bozeman does not proceed further with a discussion of the opportunity-cost model and narrows his focus on the three *major* approaches to measuring TT; number of licenses, out-the-door, and market-impact (Bozeman, 1991:141-142).

Spann, Adams and Souder, in field study conducted to identify reasons for the historically low rate of federal technology transfers, suggest one possible reason for the low rate being the inability to reach consensus on how to define, track, or measure transfer progress and success (Spann *et al.*, 1993:63). Twenty three performance measures were identified in the study and are presented in Table 2-1.

Note that three of the input measures (transfer expenditures, transfer budgets, and time spent), and one long-term outcome (return on investment), deal with the resources required. However, while again recognizing that the costs associated with performing the TT are elements of performance measures, they also provide no discussion of these elements. Additionally, the measures identified as most often used by the developer were the number of new commercial sales and the number of technical briefs/papers published (Spann *et al.*, 1993:69). The developer here, defined as the organization that either develops or applies the technology, is most closely aligned with, but is not specifically, a federal laboratory.

Table 2-1. Performance Measures of Technology Transfer

Input Measures
Transfer expenditures
Transfer budgets
Time spent
Requests for help
Number of site visits
Intermediate Outcome
Technical briefs/papers published
Technical briefs/papers requested
Technical presentations
Technical problems solved
Licenses granted
Success stories published
Long-Term Outcome
Return on Investment
Cost savings
Productivity gains
Royalties
Competitive advantage gains
Market share gains
New commercial sales
Number of new products
New commercial customers
User satisfaction
New businesses started
Jobs created

(Spann *et al.*, 1993:70)

Two curious outcomes of this study are that none of participants in the TT process is much concerned with measuring transfer progress or outcomes, and that developers, who had the most transfer experience, reported the lowest use of measures (Spann *et al.*, 1993:73). Although not specified as such, these are definite explanations for the low transfer rates reported.

Continuing their efforts of defining and describing the measures used in the transfer of government-funded technologies to the private sector, Spann *et al.* tie together Bozeman's models and Carr's market pull versus technology push strategies into an

initial framework to aid in understanding these many metrics (Table 2-2). Spann emphasizes that one important area of concern within the government is the measurement of the economic costs associated with trade-offs made by federal laboratories in the use of funds, human resources, and time (Spann *et al.*, 1995:20). Again, however, the effectiveness measures addressing the resources expended during the TT process are just listed and not developed.

Table 2-2. Technology Transfer Metrics

Temporal Dispersion	Short Term	Long Term
Transfer Strategy	Technology Push	Technology Pull
Transfer Models	Political Model Out-the-Door Model Opportunity Cost Model	Market Impact Model Economic Impact Model
Measures	Licenses Granted (S) Requests for help (S) Site Visits (S) Tech Briefs/Papers - Requested - Published Technical Presentations (D) Time Spent Transfer Budgets Transfer Expenditures	Competitive Advantage Gains Cost Savings Jobs Created (S) Market Share Gains New Business Started New Commercial Customers New Commercial Sales New Products Productivity Gains Royalties (S) Return on Investment Success Stories Technical Problems Solved User Satisfaction

(Spann *et al.*, 1995:21)

A pioneer in the area, Jung tackles the problems of the evaluation of the benefits that may result from technology transfer. His unique method of calculating the benefit of a TT is important as it includes the costs of producing and communicating (transferring) the relevant knowledge as well as the costs of information lost in the communication. However, he then states that the costs of producing the necessary knowledge and communication can be made without difficulty and turns his focus toward evaluating the

level of utilization of the information by the receiver (Jung, 1980:43 & 46). This is primarily because he feels the most difficult part of determining the benefit is an assessment of the utilization level. The costs are simplified to include production, communication, and marketing and are assumed to be recorded and known.

Beginning with the review of the basics, through the process itself, and finally addressing its measurement, information regarding the cost to conduct a technology transfer, either the actual amount, method to use to find it, or its general trends, is absent. This is a recurring theme throughout the review of previously accomplished research literature regarding the quantification of resources expended, and thus the cost, of the TT process.

Technology transfer is a very complex process with many unknowns, especially with respect to the identification of cost. Cost information is needed to improve the management of the TT process by allowing better decisions through use of tools or techniques such as cost-benefit analyses, for the better allocation of limited resources, as well as better, more accurate forecasting, budgeting, and planning. As mentioned, one method proposed to quantify the resources expended, i.e., the cost of performing TT, may be to employ the principles of activity-based costing. This information can be used by decision makers in managing TT efforts to plan and program these resources more accurately, now being done based only on subjective measures.

Activity-Based Costing

In order to determine the cost of manufacturing a product or performing a service, the cost of all the resources required in its creation must be known. These resources obviously include the labor and materials that are used directly, but additionally include resources that do not go directly to the creation of the product or service. These resources, usually labeled as *overhead*, include things such as management, the facilities,

insurance, etc. Traditional methods usually allocate these costs based on factors that yield inaccurate results. According to Brimson:

> A common mistake is to aggregate costs into overhead and allocate these costs without tracing them to specific products and customers. Conventional costing ignores important differences between products and services, markets, and customers, which incur different overhead costs. The broader the product line, the more distortions result from conventional costing practices. With distorted costing, some products or customers are overcharged while others are subsidized. Profitable business is lost through overpricing and unprofitable business is won through underpricing. (Brimson, 1991:7)

Presently, the determination of the cost for a technology transfer project is much the same. Resources that are used in performing the activities in the TT process need to be identified and quantified in order to accurately determine its cost. In order ensure a better understanding, it is appropriate to provide some additional definitions of ABC terminology.

ABC Definitions

In order to determine cost using ABC, the process of cost assignment is performed and is illustrated in Figure 2-1.

The overall objective of ABC, as well as this effort, is to account for the resources expended while performing a technology transfer. *Resources* are officially defined as, "an economic element that is applied or used in the performance of activities" (Miller, 50). Brimson identifies them as, "factors of production: labor, technology, travel, supplies, and the like, employed to perform an activity" (Brimson, 1991:51). For the purposes of this effort, resources are those things that are required to perform an activity. Examples are the salaries of all government personnel involved, the materials they use including supplies and equipment, as well as the travel they take. Due to the exploratory nature of this research, other items expected to be either relatively

insignificant, such as utilities, or not applicable, such as rent and insurance, will not be considered. The next step is determining the resource drivers.

Resource drivers are, "a measure of the quantity of resources consumed by an activity" (Miller, 1996:50). Examples, corresponding to the resources identified above, include the percentage of time for each person spent, actual supplies used, equipment usage time, and the actual cost of the travel taken. Resource drivers are needed to trace the resources used to each activity.

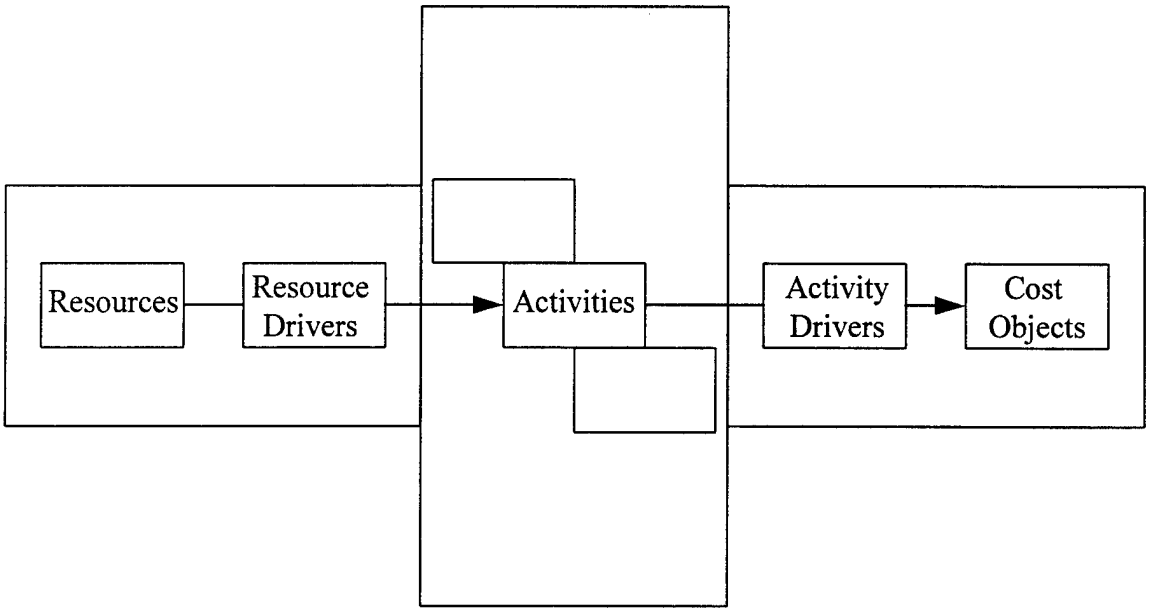


Figure 2-1. Cost Assignment Under ABC. (Miller, 1996:50)

An *activity* is defined as work performed within an organization or the aggregation of tasks; the very core of what an organization does (Miller, 1996:5). Activities, for this effort, are defined as those tasks or steps that the participants of the process perform while conducting a technology transfer. The TT process was studied and then *broken down*, by the AFMC's Technology Transfer Process Action Team (PAT) of the Integrated Weapon System Management Technology Insertion PAT, into six steps and forty sub-steps. These forty sub-steps, as stated previously, are the basis used in this

research and are presented in Appendix B. An example of one activity is "Develop Marketing Strategy," part of TT's *Marketing* process. *Processes* then are series of activities that are linked to perform a specific objective (Miller, 1996:5). As resources are traced to activities using resource drivers, activities are likewise traced to the cost object using activity drivers.

Activity drivers are measures of the frequency and intensity of the demands placed on activities by cost objects (Miller, 1996:53). Activity drivers are used to trace the cost of performing an activity to the objects being produced, either a product or service, and should be representative of the actual usage of that activity. Most simply, it is the number of times each activity is performed during a process. Continuing the previous example, the marketing strategy should normally be developed only once for any one technology project, thus the activity driver would be *1*. However, if conditions or the environment change obsolescing the present strategy, it would obviously need to be revisited and the activity driver increased to *2* in order to accurately account for the total cost of the cost object.

Miller defines *Cost Objects* as, "any customer, product, service, contract, project, or other work for which a separate cost measurement is desired" (Miller, 1996:54). For this effort, the cost object will be a specific TT project.

Finally, a cost driver is any factor that causes a change in the total cost of an activity, in short, *the cause of cost*, with each activity having multiple cost drivers (Miller, 1996:9).

With the basic ABC terminology understood and an overview of the ABC process complete, it is time to return to discussion of the specifics of a technology transfer project at Wright Laboratory.

As discussed, resources used in performing a TT project, depicted in Figure 2-2, can be categorized into two groups; direct and indirect. The actual scientific and

engineering (S&E) personnel assigned to the transfer project account for the bulk of the direct costs. However, rarely is an S&E's time fully dedicated to one project as represented by the arrows pointing off in other directions. Other direct costs could include any equipment, facilities, etc., dedicated to a TT project, but as with the S&Es, is rarely the case. It is expected that the Transfer Focal Point (TFP), a central point of contact for TT issues at the directorate level within WL, also provides direct resources to the project. However, it is anticipated that only some portion of their efforts to be direct with the remainder being provided indirectly via the performance of activities applicable to the multiple projects they oversee. Resource inputs to the project may also include the efforts of others such as consultants, regarding financial or legal issues for example, through any number of means. Finally, the figure also shows that Office of Research & Technology Applications (ORTA) personnel, at the staff level within WL, are also inputs to a project, but are expected to be so only indirectly.

The Stevenson-Wydler Technology Innovation Act of 1980 stipulates that all federal laboratories with more than 200 scientific, engineering, and related technical positions shall provide one or more full-time equivalent positions as staff for its ORTA (AFMC, 1995:C-2). Wright Laboratory, employing more than 2,000 scientists and engineers, presently has five individuals on its ORTA staff. They are responsible for the day-to-day management of Wright Laboratory's technology transfer program. Acting as the *go-between* for the laboratory and industry, the ORTA actively markets the laboratory's technologies and then is the point of contact for all requests from industry. As with the S&Es, the efforts of the ORTA staff are not dedicated to just one TT project thus the other arrows representing the ORTAs many projects and responsibilities.

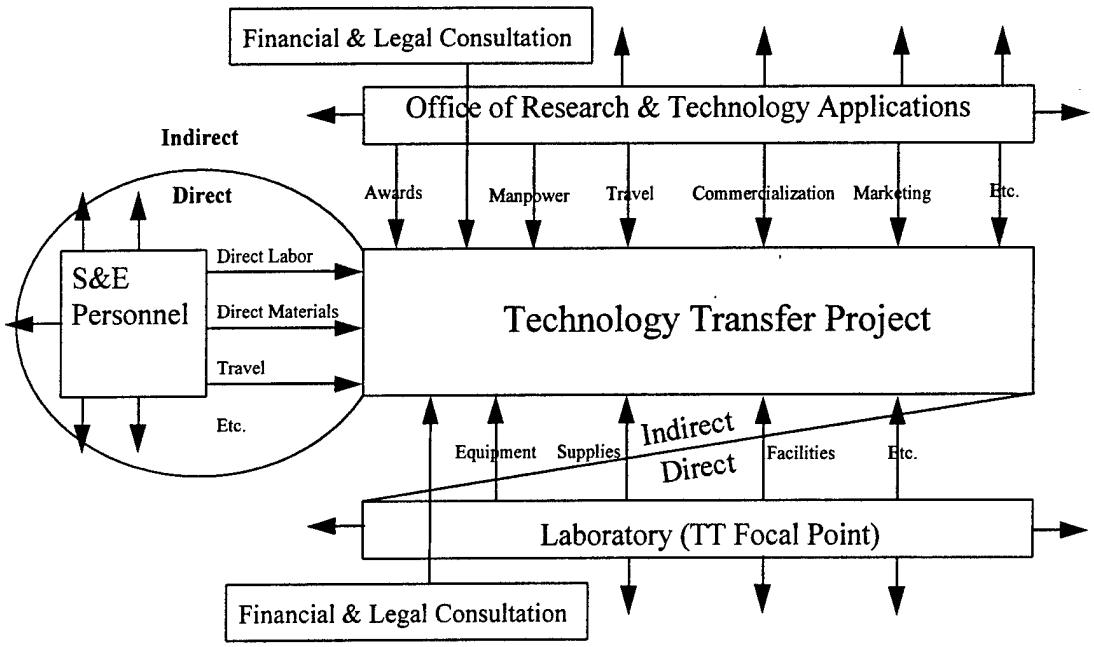


Figure 2-2. Technology Transfer Resources Map

As the technology marketers for Wright Laboratory, the ORTA opens Wright Lab's doors and offers its discovery and development as a rich and powerful resource for American's private sector (Wright Laboratory, undated: 6). As the point of contact for industry, the ORTA staff handles requests for information and assistance that come in from businesses, universities, state and local governments, as well as other military organizations. The inquiries for technological support are initially screened and, if valid, are handed over to the appropriate Wright Lab technology directorate, one of seven, or are directed to other federal labs or organizations that can provide assistance (Salvador, 1995:41-42).

To help the ORTA conduct its technology activities, each of the seven technology directorates has a technology transfer focal point (TFP) whose efforts should also be accounted for when identifying resources used in the process. The focal point helps match a laboratory scientist with the technological know-how to the industrial partner in order to best satisfy their particular need. To encourage technical communication and

information dissemination, the technology transfer focal points meet with the ORTA staff monthly to review technology activities and bring forth issues. Again, as with the others, the laboratory focal point is not dedicated to one project.

Receiving their funding from the laboratory's R&D budget, the cost of performing the functions of the ORTA are absorbed by the individual laboratories and are considered as laboratory overhead as well as overhead to each TT project. While the total dollar amount allocated to the ORTA is known (and legislated in many cases), it is not known how its costs should be traced to the individual TT projects. Additionally, with respect to the TT project, the focal points' efforts are categorized as overhead. As with variances in products that result in distortions in the allocations of overhead costs when using traditional costing systems, there are wide variances in TT projects that may also result in similar cost distortions if a traditional costing system is used.

As stated, ABC's emphasis is to more appropriately allocate these overhead costs to the products based on actual consumption of these overhead resources since the direct labor and direct materials are usually easily identified and assigned or traced. However, as just mentioned with respect to TT, it is not only the overhead that requires attention (ORTA and Laboratory), but also the direct materials and direct labor which both are presently unknown. However, more and more, federal agencies are being forced into operating like a conventional business to remain not only competitive, but also viable. While not to say that all federal agencies are not competitive, because many are, it is to say that their traditional methods of operation do not necessarily lend themselves to the intense scrutiny that is becoming more common place because the detailed information is unavailable.

In order to obtain this information, organizations often implement an ABC system. There are many different ways presently in use in which to implement an ABC system. Choosing which method is a matter of personal preference and a matter of

adapting the general model to a specific situation (Miller, 1996:38). One method of implementation is provided by Miller in his Four-Step Building Block Model, shown in Figure 4, which can be applied to any size organization. The model includes Planning, Activity Analysis, Activity/Product Costing, and Document Results as its primary step with Data Gathering and Analysis ongoing and integral to each step.

The first step, Planning, entails the development of a, "detailed project plan complete with time line and assigned responsibilities, defining the resources required, and selecting the specific people to do the work" (Miller, 1996:39). The main purpose of planning is to ensure the effort is thought through thoroughly. The results can be used to help win support for the effort and dispel any fears by advertising the exact purpose and goals of the effort. Once people understand, authorization for use of the resources identified including personnel is more easily achieved.

Four-Step ABM Implementation Model			
Data Gathering and Analysis			
Planning	**Activity Analysis**	**Activity/Product Costing**	**Document Results**
Purpose	Specific activities and business processes	Select or develop software	Prepare report
Objectives	Outputs and output measures	Specify resource drivers	Make recommendations
Scope	Value-added analysis	Specify activity drivers	Assign action
Time	Identify cost drivers	Trace costs	Refine data
Resources	Activity performance	Develop costing model	Identify next steps
Expectations			Track improvement results
Team development			

Figure 2-3. Four-Step ABM Implementation Model. (Miller, 1996:39)

The heart of the implementation, Activity Analysis begins with the identification of the specific activities and processes to be analyzed and results in the identification of the; cost drivers; the outputs and output measures; classification from a value-added

perspective; and performance measures for each of the activities (Miller, 1996:40). Performing this second step prepares the implementation point of contact or team for actually calculating the cost of each activity by defining all pertinent aspects of each. It is broken down into eight sub-steps:

1. Define business processes and specific key and significant activities.
2. Define activity outputs and measures.
3. Identify the customer or user of the activity outputs.
4. Perform value-added analysis.
5. Identify cost drivers.
6. Determine activity performance measures and goals.
7. Define other activity attributes.
8. Gather activity data required for activity/product costing.

(Miller, 1996:69-70)

Miller states that, other than the first sub-step (defining the activities to be analyzed), the others can be completed in any order. For example, an organization may wish to specify activities (sub-step 1) and then skip to gathering preliminary data on resource drivers (sub-step 8), such as how people spend their time, in order to make a preliminary estimate of the activity's cost (Miller, 1996:70). This may allow the implementation plan to be fine-tuned by concentrating more emphasis or analysis on items commanding more of the organization's resources and less on the more insignificant. Once understood, actual product or service costing can begin.

Activity/Product Costing includes documenting the cost tracing methodology and base assumptions and then developing a software system to export, import, and accept data necessary to calculate the cost of the activities as well as product or service costs (Miller, 1996:39). Basically, this involves taking the information from the activity analysis step and proceeding through the ABC methodology previously discussed (Figure 2-2) for each activity as well as each process and cost object resulting in the determination of their cost.

The final step, Document Results, involves documenting the work that has been completed, including results, recommendations, and conclusions; "to be successful, action must be taken on the knowledge gained" (Miller, 1996:40).

Finally, Data Gathering and Analysis is done from beginning to end in the Four-Step Implementation Plan and is an integral part of each step discussed (Miller, 1996:40).

There are five basic information outputs for the ABM system. These include:

1) The cost of activities and business processes
2) The cost of non-value-added activities
3) Activity-based performance measures
4) Accurate product/service cost (cost objects)
5) Cost drivers

(Miller, 1995:5)

The first is the most basic of these outputs. When considering the cost of implementing an actual ABM system, if only the cost of activities and processes were achieved, the project would be classified a failure. These costs are used in determining the others which are what make implementation valuable. During activity analysis, judgment of value of each activity is determined and by aggregating the costs of those labeled as adding no value, an efficiency of the organization can be determined. This is but one of many performance measures that can be used as a gauge to monitor an organization's progress. Accurate product or service costs are critical in today's highly competitive global marketplace and identification of the cost drivers enable an organization to affect the costs of their products or services. Therefore, judging from these outputs, an effectively implemented ABM system utilizing the principles of ABC can prove to be quite valuable to the survival of the organization.

As discussed in Chapter I, since activities are the very basics of anything done in an organization, its principles and benefits can potentially reap rewards for almost every

organization. This combined with its relative youth, hint of vast potential just waiting to be tapped. Additionally, these principles are not limited to being used in isolation. In other words, the principles of ABC have proved beneficial when integrated with other theories, principles, and practices.

Similar Uses of ABC/ABM

An example is the marriage of ABC with the management philosophy of the theory of constraints (TOC). The core idea of TOC is that every system has at least one constraint; the theory's goal being the identification of these constraints or bottlenecks and a minimization of their impacts on the flow through the system. A subset of TOC is throughput accounting (TA) which focuses on the dynamics of the flow of production through a factory in an effort to balance this flow by minimizing resource constraints (Salafatinos, 1995:58). As previously discussed, ABC can, through activity analysis, provide insight into the relationships between the resources in an organization. "Some of the methodologies of activity-based costing and throughput accounting, e.g., activity mapping, are complementary and can be used effectively as integrated elements of an advanced cost management system" (Salafatinos, 1995:58). As ABM puts the principles of ABC into action, this new concept uses ABC's principles linking both production and non-production activities allowing increased throughput by focusing on the coordination of activities rather than the physical resources. TOC allows managers to identify bottlenecks and, by minimizing them, reduce work-in-process, thus inventory, and finally costs. ABC is the tool that provides the information to identify these bottlenecks.

Greenwood and Reeve propose using the principles of ABC in an approach called *process cost management* (PCM) in order to determine the cost of processes for the purposes of benchmarking, activity cost analysis, or product costing. While ABC leads to more accurate product costs and a much better understanding of the relationships between activity drivers and resource levels, there is no tool available for linking changes

in products or processes to potential changes in resource levels (Greenwood and Reeve, 1994:4). "Put simply, the ability to reverse the flow of information, which usually flows from resource to product, back from products to resources is only now receiving attention" (Greenwood and Reeve, 1994:4). They predict that PCM can help companies improve their competitiveness by providing a method for evaluating the impact of product and process cost drivers on resource spending through identification of the spending impact of various *what-if* scenarios.

Finally, Lawson states that while many have suggested that ABC be used as a tool to support such techniques as total quality management, benchmarking, and continuous quality improvement, ABC is inherently unsuitable for these purposes due primarily to its failure to identify activities with respect to their processes and their interrelationships, a process-oriented view (Lawson, 1994:34). He proposes a new information system methodology called process-based costing which incorporates the essential elements of ABC, yet overcomes its shortcomings.

> Process-based costing does not make ABC obsolete. Rather, process-based costing modifies it and provides an overall framework within which ABC fits. By incorporating ABC concepts along with consideration of quality, costs, and time and by introducing a focus that is both process and customer oriented, process-based costing provides information vital to organizations in today's competitive business environment. (Lawson, 1994:43)

ABC is traditionally used to improve a company's ability to more accurately determine the cost to produce a product or service. Whereas with the conventional accounting systems some costs were inaccurately allocated to products or services yielding a distortion, with ABC, the costs are allocated to activities. A product's or service's cost is then determined based on its consumption of those activities. This effort is exploratory with the goal of improving the laboratory's ability to accurately assess the cost of performing the process of transferring a technology. By breaking down this into

its component activities and then identifying the resources required to perform these activities, each TT project can be costed by aggregating these activities. Knowing the time-phased relationship of the TT project's activities, cost patterns over time can be identified. Through further analysis of this information, it is anticipated that additional trends will be identified including the activities that wield a significant cost as well as relationships between the cost to perform a TT and the project's:

1) type (process, hardware, use of facilities).
2) method (CRDA, SBIR, other).
3) complexity.
4) size.

In technology transfer, the focus of past research has not been balanced between the two categories of benefits received and the costs to execute; benefits have been most often the emphasis. However, benefits are only half of the picture.

As noted earlier, a great deal of federal funding is spent on research and development each year. More specifically, in order to gauge the total spent on TT, Bozeman surveyed 187 national laboratories. He reports that each laboratory averaged about $191,000 annually on TT activities or about 6.28 percent of their R&D budgets (Bozeman, 1991:145). That equates to over $35.7 million on TT alone out of a total budget for these 187 labs of over $568.7 million. This, however, is the most detailed cost information presently available regarding the cost of performing TT. Additionally, as previously discussed and shown in Figure 2-2, there are many other costs that go into the process. This void is the focus of this research.

Summary

In review, technology transfer is a complex process that, despite its identification as early as the 1950s, has many unknowns. While much research has been conducted probably least known is information regarding the cost of performing an actual TT project.

Accurate cost information is important for a number of reasons including more credible justification of requests for resources, evaluation of process improvements as well as alternative uses of limited resources, and finally, for the planning and programming of future resources (forecasting). For these reasons, it is important to be able to reliably and accurately quantify and predict the quantity as well as the timing of resources that will be needed.

The principles of activity-based costing have been effectively implemented in organizations and most importantly integrated with other principles. ABC's focus on activities uniquely qualify it for application to an analysis of and integration with the TT process in an effort to identify the cost as well as trends or patterns of performing the TT process at Wright Laboratory.

Again, being exploratory, the goal of this effort was not to identify a formula that can be applied to a TT project to accurately estimate its cost with a high degree of confidence. Therefore, the total cost of performing the transfer process that resulted are *ball park* figures and are not accurate to the dollar. This effort was intended to provide a foundation for future efforts focusing on topics such as process improvement and efficiency, as well as budgeting and forecasting thus enhancing the federal laboratory's viability while wringing the most value out of every tax dollar spent.

Chapter I provided the background and an overview, and Chapter II detailed the *why* for this research effort. Chapter III will now provide details regarding *how* this research obtained the information used in its analysis.

III. Methodology

Introduction

This chapter discusses the methodology used to conduct this research. First, the overall research design selected will be presented followed by a discussion of why this approach is the most appropriate. Next, the data collection plan will be presented and then concluded with a detailed look at the process utilized in the development of the data collection instrument.

Research Design

As stated in Chapter I, and in light of the deficiencies in the literature identified in Chapter II, the primary objective of this research is to establish the foundation for the development of a tool that may ultimately be used to project the *costs-over-time* of performing a technology transfer project. In support of this, a secondary objective is the development of a data collection instrument that may be initially utilized to identify the cost of performing the TT process activities at Wright Laboratories. In short, how are resources currently being expended during a transfer project's life cycle?

To begin, there are five strategies that may be employed when conducting research. These strategies are:

1) Experiment
2) Survey
3) Archival
4) History
5) Case Study

When choosing the method to use from among these, Robert K. Yin states that selection of the best strategy is dependent upon three conditions consisting of:

> 1) the type of research question posed;
> 2) the extent of control an investigator has over actual behavioral events; and
> 3) the degree of focus on contemporary as opposed to historical events.
>
> (Yin, 1989:16)

Addressing the first condition, he points out that *how* and *why* questions are more explanatory and are more appropriately addressed using experiments, histories, and case studies since, "such questions deal with operational links needing to be traced over time rather than mere frequencies or incidence" (Yin, 1989:18). Since this effort asks *how*, the choice of strategy is correspondingly narrowed to three.

Proceeding to the second condition, and being reminded that the researcher has no control over the actual behavioral events, Yin again narrows the field leaving just two, histories and case studies. This is because in order to assess the effect on the dependent variable in an experiment, the investigator must be able to manipulate at least one independent variable while attempting to hold all other aspects constant.

Concluding with the final condition, Yin explains that the, "distinctive contribution of the historical method is in dealing with the 'dead' past--that is, when no relevant persons are alive to report, even retrospectively, what occurred" (Yin, 1989:19). Considering this effort is focused on the *contemporary* and not *dead* past, only the case method remains.

Additional considerations regarding the classification of research design utilized in research may be helpful. According to C. William Emory and Donald R. Cooper,

selection of a research design is a complex concept and requires the effort to be viewed from at least eight different perspectives:

1) the degree to which the research problem has been crystallized (exploratory versus formal);
2) the method of data collection (observational versus interrogative);
3) the power of the researcher to affect the variables under study (experimental versus ex post facto);
4) the purpose of the study (descriptive versus causal);
5) the time dimension cross-sectional versus longitudinal);
6) the topical scope--breadth and depth--of the study (case versus statistical);
7) the research environment (field versus laboratory); and
8) the subjects' perceptions of the research (deviations from their everyday routines).

(Emory and Cooper, 1991:139)

Beginning with the first perspective, Emory and Cooper state that exploration is appropriate when; (1) the researcher lacks a clear idea of the problems that will be met in the course of the study, (2) the area of investigation is so new or vague that the researcher needs to perform an exploration just to learn something about the problems; and (3) unsure of the practicality of the study proposed (Emory & Cooper: 1991:144). Considering this research area's infancy, both the quantification of the cost of performing TT and the utilization of ABC to this end, this effort is viewed to be exploratory. Also, the final research objective is to establish a foundation for further research into these areas.

Next, not merely observing how the resources are expended but through interviews of government personnel directly involved with a TT project, this effort is therefore interrogative.

As previously discussed, since there will be no control over the variables in the sense of being able to manipulate them, an ex post facto design is most appropriate. Also, since the objectives are to discover how the resources are expended, how much, and

when, the study will be descriptive as opposed to causal which is concerned with answering the question of *why* (Emory and Cooper, 1991:141).

Cross-sectional studies are carried out once and are a *snapshot* of one point in time while others are repeated over an extended period of time in order to track changes that occur through time (Emory and Cooper, 1991:141). As such, the interviews of laboratory personnel are intended to develop a picture of the spending patterns throughout the TT project's life cycle.

The next classification is somewhat interesting in light of the previous discussion, with respect to Yin, resulting in the selection of the case method. Emory and Cooper state that a case study places more emphasis on a, "full contextual analysis of a limited number of events or conditions and their interrelations," while statistical studies are designed for breadth to capture adequately the characteristics of a population by making inferences from a sample of items (Emory and Cooper, 1991:142). The proposed method for this research has aspects of both. However, considering the objectives to be exploratory, this research will lean more toward a full analysis on a somewhat limited sample with the goal of establishing the foundation more firmly.

Elementary, yet requiring statement, since this research will take place under actual environmental conditions, it is classified as a field study.

Finally, the last perspective will require some attention, since the subjects in the study will be aware that the research is being conducted. The design, conduct, as well as analysis of the results will have to address the fact that subjects can influence the results of the research.

In summary, this research effort will be an exploratory case study using ex post facto interviews of personnel in the field in an effort to describe the relationship of resource expenditure over time following completion of the project. This will be the foundation for future efforts and ultimately a tool for the programming of resources

required to complete a TT project. As such, and having already completed the first step of exploratory research, the literature search, a survey of the experience of experts in the field as well as historical information is the next step.

Methodology

This effort, in general, was conducted as though it were a pilot implementation of an ABM system in a small organization. As a guide for this *implementation*, the researcher followed the steps developed by Miller in his Four-Step ABM Implementation Model, as discussed in general in Chapter II. Regardless of how ABM information is used, the scope of effort, the organization size, or the purpose of implementation, the general steps of implementation are about the same (Miller, 1996:33). However, while all steps were performed, since this effort is not an actual implementation, the steps were tailored focusing on the middle two steps only: Activity Analysis and Activity/Product Costing.

The Planning, as well as Documentation steps, were accomplished merely through the act of preparing for and then reporting the results of this effort. Activity Analysis, combined with the integral step of Data Gathering and Analysis, were the major thrust of this effort. Miller further segments this step into eight sub-steps. Although discussed in Chapter II, they are repeated here for clarity and include the following:

1. Define business processes and specific key and significant activities.
2. Define activity outputs and measures.
3. Identify the customer or user of the activity outputs.
4. Perform value-added analysis.
5. Identify cost drivers.
6. Determine activity performance measures and goals.
7. Define other activity attributes.
8. Gather activity data required for activity/product costing.

(Miller, 1996:69-70)

Also discussed in Chapter II, Miller states that, other than the first step, the others can be completed in any order. The example given to demonstrate this is of an

organization that tailors the process accomplishing only the first and the last in order to make a preliminary estimate of activity cost (Miller, 1996:70). As in Miller's example, this effort will also tailor the eight sub-steps and, considering sub-step one as having been accomplished, focus on sub-step eight. Sub-steps two and three were determined to be unnecessary for capturing only the cost of performing a transfer. Sub-steps four, five, six and seven were considered beyond the scope of this effort since they required judgments of value that can only be made by stakeholders in the organization or process during an actual implementation of an ABM system.

Step one, defining the business processes and specific activities, was previously accomplished by the technology transfer process action team in 1992. The business process in question equates to the transfer itself and the specific activities of the TT process correspond to the series of activities broken down and identified in the Technology Transfer Handbook (TTHB). The six major steps and their forty sub-steps, detailed in the TTHB, were used as the starting point for this effort and are included as Appendix B.

Step eight was accomplished in order to gather the activity data required for calculating the cost of the individual activities as well as the complete transfer process. Using the forty sub-steps as the *jumping-off* point allowed the researcher to avoid one implementation stumbling block, an inappropriate level of activity detail (Miller, 1996:71). If the activities had been specified at too detailed a level, the resulting activity specification would have had an exorbitant number of activities making the system, as well as the data collection interviews, too cumbersome and costly. If not enough detail is included, the resulting information would have been aggregated too broadly and thus not useful (Miller, 1996:71).

With respect to sub-step eight above, the scientific and engineering (S&E) personnel are assigned to a specific project, albeit usually more than one project as well

as other R&D projects simultaneously, and the activities performed by them, having the overall output objective of a successful transfer, were considered as *direct labor.* Because they, nor the equipment used for the specific TT project, are not usually dedicated to one project, quantifying the portions of each actually spent on the project proved to be challenging. Through interviews with S&E personnel assigned to each TT project investigated, as well as the appropriate transfer focal point and office of research and technology applications (ORTA) staff personnel, efforts focus on better identifying the direct labor, direct materials, and overhead resources that are actually utilized for each TT project.

The amount of detail required for ABM reporting depends on both the use and application of the information (more detail and specificity of activities are required for process improvement applications) less for product/service cost applications (Miller, 33). Since the primary objective of this effort is the identification of a *service* cost (the transfer of a technology) less detail and specificity will be required. Additionally, as a warning, Miller states that applications of ABC concepts in practice can be quite complex and therefore it is important to resist the urge for perfection by defining activities and drivers at too detailed a level, especially in the early stages of implementation. "The goal of ABM is to provide relevant information useful for decision making, measuring performance, and effecting improvement" (Miller, 56).

For the investigation of the transfer projects, keeping the above in mind, a series of interview questions were developed to capture the resources required to perform each activity in the process. A unique questionnaire was initially developed for each group of persons interviewed during this research. For each TT project investigated, the first interview was with the S&E. While conducting each interview, in addition to questions of resource expenditure and timing, questions were asked regarding other personnel

involved in the project. If the interviewee was not able to provide detailed information regarding these others inputs, contact was made and subsequent interviews conducted.

Data Collection and Analysis Plan

Raw, uncollected, historical data presently exist for numerous TT projects at Wright Laboratories, Wright-Patterson AFB, OH. The researcher's first challenge, requiring some level of *detective* work, was to evaluate its usefulness and applicability to this effort.

In parallel with this, the six-step technology transfer master process, as defined in AFMC's Technology Transfer Handbook and included as Appendix B, was used to develop a preliminary series of questions. These questions were an aid to both guide as well as standardize the interviews with laboratory personnel. These interviews extracted expert information regarding time personally spent as well as any other *significant* expenditures of resources. Expenditures are considered *significant* if they are more than five percent (5%) of the overall expenditures on the project as a whole.

In order to enhance the probability for success in the conduct of a personal interview, Emory and Cooper list three broad conditions that must be met:

1) availability of the needed information from the respondent;
2) an understanding by the respondent of their role; and
3) adequate motivation by the respondent to cooperate.

(Emory and Cooper, 1991: 321)

They point out that there are a number of ways in which interviewers can influence the results of an interview results as well as the motivation of respondents, including effective screening questions and expert interviewing technique respectively. Following development of the screening questions, a number of core interview questions are developed.

While not specifically using the terminology in the Technology Transfer Handbook; interview questions address each of the activities in the Transfer Master Process (TMP) in an effort to capture both the quantity and *time-phasing* of the use of the resources. These initial questions are first used in a pilot project to examine TT projects of the past. Using the lessons learned from this pilot, formal interview questionnaires were developed and are attached as Appendix C. These instruments were used to collect detailed project information during sixteen interviews on eight separate TT projects.

Emory and Cooper emphasize the importance and value of an experience survey in the conduct of exploratory research. "While published data are a valuable resource, seldom is more than a fraction of the existing knowledge in a field put into writing" (Emory & Cooper: 145). Additionally, while much of the published data quickly becomes dated, expert experience is more fresh and timely.

Two characteristics of an experience survey, important to its effective use, are flexibility and depth. The investigative format of the interview should be flexible enough to allow for the exploration of the various avenues that emerge during the interview (Emory & Cooper: 146). Also, with respect to determining the number of interviews to conduct, Emory and Cooper state the interview process should continue until findings duplicate what is already known (Emory & Cooper: 146).

Research Sample Population

The population for this research included *representative* technology transfer projects completed at Wright Laboratories, Wright-Patterson AFB, OH. In general, participants in the technology transfer process can be grouped into three categories including the source, intermediaries, and receivers. This research will address establishment of the foundation for, and the development of, a cost accounting and resources planning tool for participants identified as a *source*.

Projects studied were selected by the director of the Wright Laboratories ORTA. Due to the exploratory nature of this research, not enough information was known upon initiation to establish definitive criteria to be used for selecting *representative* TT projects. *Representative* projects are desired to avoid the possibility of skewing the findings as a result of including *outliers* or unusual projects in the sample population. Therefore this effort had to rely on the expert judgment of the ORTA director, Mr. Bill Hale, in determining which TT efforts would be *representative* as well as which personnel would be the most appropriate to interview for each TT project selected. However, general criteria considered in his selections of representative projects included the project's overall cost, time-to-complete, and complexity.

Wright Laboratory personnel interviewed for each project investigated can be classified into one of three categories as mentioned previously; S&E, TFP, or ORTA management. The S&E personnel were, in many cases, the project manager of the TT project under investigation. Being the closest to the project, they have the most in-depth insight into the majority of resources expended on the TT project. While the S&E's major responsibilities are confined to three of the six steps in the TMP, the TFP has responsibilities in all six. The TFP is the individual actually assigned to the laboratory that is designated as the central point of contact for that laboratory and the ORTA staff. Responsible for a number of transfer efforts, most of the TFP's time spent was considered as *overhead* to the TT project. However, some was considered as *direct*. Finally, ORTA management personnel were also interviewed to obtain the *big picture* view and to identify any significant expenditures that are *above* or *transparent* to both the S&E and TFP. A graphic representation of this relationship was provided in Figure 2-2 in Chapter II where it was also discussed in some detail. With an understanding of who was included and why, attention now focuses on the instrument used for data collection during these interviews as well as from the Wright Laboratory's historical records.

Research Instrument Development

Development of the data collection instrument used during interviews of WL personnel began with an analysis of the TMP as defined in AFMC's Technology Transfer Handbook and provided in Appendix B. Using the TMP as a base, a questionnaire was developed to quantify the resources used by the TFP while performing each activity. Note that the TMP was developed by the Technology Transfer Process Action Team in 1992, "from the perspective of the individual organization's TFP" (AFMC, 1995:D-1). Next, this questionnaire was tailored for use with the S&E personnel who have fewer responsibilities than do TFPs. Additionally, as discussed in Chapter II, the ORTA staff is a source of overhead to the individual TT project and therefore a questionnaire was developed to capture the use of their resources. However, the pilot effort allowed the questionnaires to be combined into only one which is included as Appendix C.

Questions for each interview were developed to identify the resources utilized specific to each step. Knowing the general order of completion of these steps, as shown in Figure 3-1, Technology Transfer Timeline, as well as the time elapsed from the beginning to the end of the process, provided a *time-line* of when the resources were expended over the life of the transfer.

With the draft interviews developed, and as part of the effort in developing a preliminary collection instrument for the historical data, the researcher first met with the director of Wright Laboratories' ORTA, Mr. Hale. The first objective of this meeting was to obtain help in developing and focusing the initial questions drafted for the personal interviews to ensure no oversights or mistakes existed prior to beginning the lengthy and detailed interview process. The second objective was to assess the availability, extent, and applicability of WL's historical information. Following this meeting, the wisdom gained was used to both refine the interview questions as well as set

up a database to be used as a framework for inclusion of the information gathered during subsequent interviews of WL's personnel and analysis of the historical data.

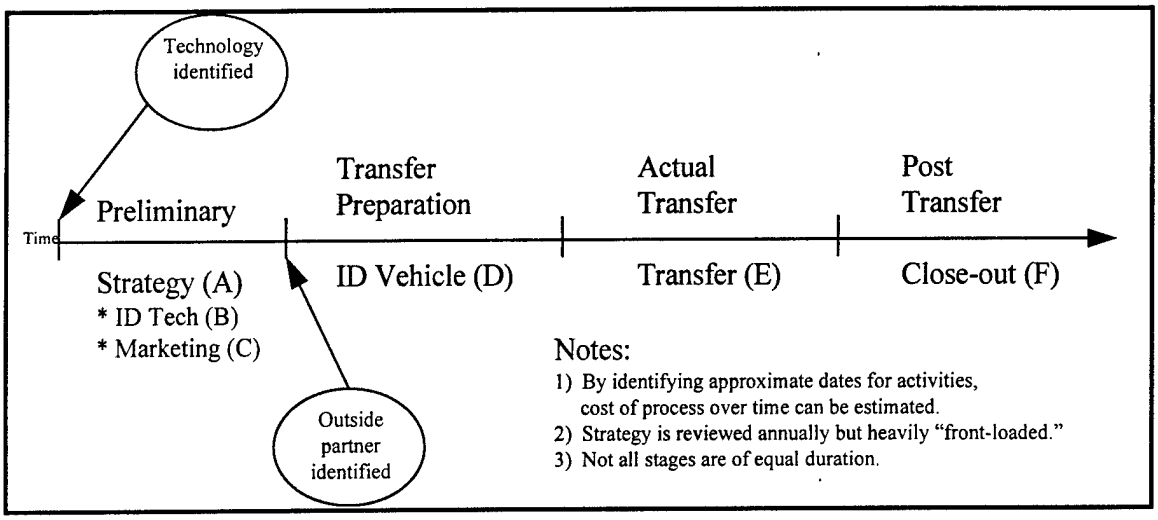


Figure 3-1. Technology Transfer Timeline

Using these refined instruments, due to the many unknowns at the start of the data collection effort, it was decided to conduct a small pilot effort. This preliminary audit consisted of a review of historical records as well as interviews of the three appropriate project personnel on two separate small-scale technology transfer projects, completed in the recent past. An example of one unknown was the question of, with respect to the TMP, whether all forty sub-steps were pertinent or would some of them be found to be unnecessary.

Due to the length of the interviews, required to gather and record the detailed case information, close coordination with Mr. Hale and the interviewees was critical to achieving maximum cooperation. After receiving the assignment of the specific TT projects to be examined from Mr. Hale, the first step was to contact the appropriate personnel and schedule the interviews. Next, and prior to the interviews, a visit was

made to the laboratory in order to collect all historical information as well as to meet the interviewees if possible. In order to aid the interview process, a number of actions were performed including:

1) Each interview was scheduled at the interviewees convenience to the maximum extent possible.
2) Brief personal contact was made between the researcher and the interviewee at least one day prior.
3) At this meeting, the interviewee was provided a copy of the:
    1) Research purpose statement.
    2) Interview expectations and procedures.
    3) Interview questions.
    4) Information regarding the TMP (Appendix B)

These actions were taken to minimize the impact to the interviewee, alleviate interviewee anxiety, reduce the *fear of the unknown* prior to beginning the formal interview process, and finally to allow the interviewee a chance to familiarize themselves with the terminology and structure of the AFMC's formal TMP.

During the actual interview, each question was asked of the interviewee and each response was recorded by the researcher on the *hard copy* of the interview questionnaire. Following each section, as well as upon completion, the interviewee was asked to review the information for accuracy. A photo-copy of the final interview questionnaire was provided to the interviewee as they were instructed to call the researcher if any errors were noted or if any additional pertinent information was recalled. Additionally, with permission of the interviewees, each interview was recorded using a hand-held mini-cassette recorder. These tapes were kept in case details from the interview were required following closure of the meeting. The interviewee was informed that any personal information requested would be used for tracking purposes only and would be deleted upon completion of this effort at which point the tapes of the interviews would

also be erased. These interview procedures were followed for all interviews conducted for this effort.

The information collected during this pilot effort was then analyzed in order to evaluate the suitability of the data collection instruments and guide any revisions necessary to either the instruments, the database structure, or overall data collection approach. Done over a one-week period, the pilot effort showed that, with respect to the quantification of resources, all forty activities were not sources of direct cost to the total cost of performing a transfer. These results allowed the lengthy interview questionnaires to be further refined as well as final modifications to the information database. With this complete, the formal data collection effort commenced.

Formal data collection was conducted using the same procedures as used during the pilot effort; schedule, collect historical information and meet interviewees, conduct interview, record information in the database. As this data were collected, analysis began in an attempt to identify trends and establish the foundation of the identification and development of a *typical* TT time-phased manpower requirements curve useful as a predictive tool for future resource requirements planning on similar TT efforts.

Following each interview, and before the close of the day, all data gathered were analyzed and entered into a database using Microsoft's Excel software program widely available on the commercial market. For each of the project's interviewees, hourly time values and resources identified were aggregated to the various activities (sub-steps) and steps of the TMP. Next, knowing the general sequence of when the activities are performed, and based on information from the interviews, these recorded data were placed along a relative time-line from the beginning of the project to its end. This resulted in a general life-cycle resource requirements curve for each project. Additionally, these resources, using appropriate conversions such as established hourly rates for a given rank or grade (including comparable benefits), were converted into

dollar values allowing for the total project cost as well as the life-cycle cost of the project to be calculated.

Data Analysis and Interpretation

Analysis of the data was performed by examining the data collected through reviews of existing historical records maintained by Wright Laboratories as well as through the expert interviews with their personnel. This data were compared, contrasted, and interpreted yielding the identification of preliminary patterns of resource expenditure while performing technology transfer actions. These results are presented in the following chapter. The results of the personal interviews conducted with individuals working at Wright Laboratories are recorded in Microsoft Excel spreadsheets and are contained in Appendix D.

Summary

This chapter presented the methodology used in the conduct of this research. First, the overall research design selected was presented followed by a discussion of why this approach was the most appropriate, the plan for data collection, and finally concluding with a detailed look at the process utilized in the development of the data collection instrument. Chapter Four presents a detailed analysis of the collected data and is followed by Chapter Five containing the results of this effort.

IV. Analysis and Results

Introduction

The objective of this research is to identify trends with respect to the cost of performing a transfer of technology from Wright Laboratories to the commercial sector. This chapter discusses the data collected during this research as well as provides the analysis of these data. First, a general overview of the data collected is reviewed, along with some important information to aid in its interpretation. Next, a thorough discussion of the results of the pilot project for this effort is presented, thus establishing the foundation for discussion and understanding of the data for the remaining seven projects that follow. Finally, an in-depth analysis is conducted and the results provided.

Historical Data Review

As discussed in Chapter III, the first task is the investigation of historical data (referred to here as the TT database) maintained within Wright Laboratories' technology transfer office (WL/XPT). Maintained in a Microsoft Excel spread sheet, this TT database is used to track the status of all transfers formally initiated by WL. Presently, all TT efforts initiated utilize the Cooperative Research and Development Agreement, or CRDA, as the transfer vehicle. Formal initiation of transfer is recognized when both parties have signed the transfer agreement and this document has been reviewed, approved, and signed by WL's designated *reviewing official*, thus becoming an official CRDA. This occurs on what is referred to as the *signature date*. At signature, in addition to it being added to the TT database, a file is initiated in the ORTA office for the collection of all pertinent information generated throughout the transfer project's life.

A Wright Laboratory CRDA document consists of two basic sections; the *boiler plate* and the *work plan*. The boiler plate section contains the required legal language, and acts as a *skeleton* for the agreement. Items such as definitions of terms and

procedures for changing or terminating the agreement are included. The boiler plate section is tailored to address the unique aspects of each individual agreement; for example, royalty types and amounts. The work plan is the *meat* of the CRDA and contains most of the details. A work plan is a written explanation of what each party expects the other to actually do as part of the effort.

Sample Population. Examination of the TT database revealed 33 potential projects as having been concluded when this research was conducted. These projects comprise the sample population. For each of these 33 projects, information such as the project's identification number, signature and expiration dates, collaborator's name, and a synopsis of the *basics* of the transfer effort were collected from the transfer files. The term *collaborator* is used by Wright Laboratory's TT community to generically identify the CRDA partner in the commercial sector.

Also collected during this review was the transfer project's office of primary responsibility (OPR), its primary point of contact (the S&E), and a phone extension. The S&Es for 32 of the 33 projects were contacted. This task proved quite challenging due to frequent reorganization and restructuring over the past couple of turbulent years in the defense industry.

As discussed in Chapter III, the S&E is key to this research effort, because the S&E is closest to the project and first-hand information is critical to obtaining useful information regarding resource expenditures as well as the time-phasing of these expenditures during the project's life. As a result, three projects were eliminated from this study because, in each case, the S&E had retired and could not be contacted. Three additional projects, lead by WL directorates but located at Eglin AFB, were discarded due to inaccessibility of the S&E for a personal interview. Contact with the S&E for one project was not achieved and another was unavailable for interview and further questioning due to prior commitments, thus leaving 25 potential projects in the sample.

Ten other projects had been terminated prior to their expiration, for a variety of reasons, with no transfer of information occurring, while another was converted into a modification to an existing contract between WL and the collaborator. Two more were extended beyond the original expiration date and had not yet reached completion. Finally, four others were found to be *non-standard* projects where no transfer of technology was intended. Therefore, only 8 projects remained, of the 33 original in the sample population, that were suitable for further, more in-depth examination. A summary of the initial evaluation of these 33 projects is shown in Table 4-1.

Table 4-1. Summary - Sample Population

Qty	Result of Contact with S&E/OPR
3	Primary points of contact retired.
3	WL directorates at Eglin AFB, FL.
1	No contact made.
1	S&E unavailable.
10	Terminated prior to transfer.
1	Converted into contract modification.
2	Expiration extended thus not yet complete.
4	*Non-standard* CRDAs.
8	Available for further examination.
33	Total

The Pilot Project

Of the eight remaining projects, the most recently concluded project, Project 94-241-wl-01, Workstation-Based Simulation Software (WBSS), was chosen to be the pilot project. According to the project's work plan, the intent of this CRDA was to exploit modern workstation technologies to develop the WBSS, a portable engineering environment that allows system and software engineers to utilize workstations, vice mainframes, for system development, evaluation, and integration. The S&E was contacted and an interview was scheduled. As planned, a package of information was provided during a short contact with the S&E one day prior. This package contained, as discussed in Chapter III, procedures for the interview, both Figures 2-2 and 3-1, an

overview of the transfer master process (Appendix B), and the interview questionnaire (Appendix C). This information allowed the S&E to be familiar with the *game plan* for the interview and research objectives, the official transfer process and unique terminology, and the interview questions themselves.

While conducting the interview with the S&E, in addition to questions of resource expenditure and timing, questions were asked regarding other personnel involved in the project. After collecting the data, contact was made with these other personnel. For this specific transfer, the S&E identified three other persons having involvement. The S&E was confident of the involvement for two of three, the support engineer and legal consultant, leaving the third, the S&E's supervisor, to be contacted and scheduled for an interview. The interview with the supervisor, acting as the transfer focal point in this instance, quantified the supervisor's effort, confirmed the S&E's information, and identified no additional personnel involved in the project. Information gathered during these interviews was entered into a Microsoft Excel *workbook* containing three spread sheets.

One result of this pilot effort was the elimination of role-specific questionnaires. Originally, one questionnaire was generated for each of the three roles identified in AFMC's Technology Transfer Handbook: the office of research and technology (ORTA), the transfer focal point (TFP), and the S&E. Although the initial questionnaires for the S&E and TFP were not significantly different. The pilot interviews confirmed both roles perform the same range of activities, but at a different level. Additionally, the interview with the ORTA revealed that the ORTA is purely an indirect resource with respect to an individual project within WL.

Again, as a reminder, the two primary purposes of the questionnaires are to extract information regarding resource expenditure, and as a probe for the identification of additional sources of input resources. Following incorporation of the above as well as

other minor adjustments to the questionnaire, seven additional projects were investigated through twelve additional interviews over a three-week period linking resources expended to the major steps and sub-steps in the transfer master process (TMP). These data were entered into the appropriate spread sheet and then included in the one workbook for each transfer project. Each of these workbooks, as specified in Table 4-2, Project Summary, is included in Appendix D, Interview Data, organized in descending numerical order based on project number.

Interpretation of these spread sheets and workbooks, as well as the figures resulting from them, are key to the analysis and understanding of these data. Therefore, in order to facilitate these, Project 94-241 is used as a model, thus providing a number of examples, while *walking* through each spread sheet and subsequent figures.

Table 4-2. Project Summary

Identification Number	Project Title	Transfer Type
94-241-wl-01	Workstation-Based Simulation Software (WBSS)	Product
94-173-wl-02	Aviation Simulation Software	Product
94-047-wl-01	In-Flight Mission Planner	Product
93-267-wl-02	Ti-Al Process Property	Process
93-250-wl-01	Ti-Al Foil Into Aircraft Parts	Process
93-221-wl-01	Compressor Casing Treatments	Product
93-208-wl-01	GE-90 Blade Testing	Facility
93-207-wl-01	Interface Property Test Stand	Product

Interpreting the Spread Sheets

The first spread sheet in the Project 94-241 workbook, is referred to as *Sheet 1*, and includes the resources expended by the S&E and the Legal Consultant, as well as a summary for the entire project. The second sheet, *Sheet 2*, contains data from the S&E's supervisor acting in the role of the TFP. The last, *Sheet 3*, contains information as a result of the interview with the support engineer (Sheet 3). The person of interest in each of the three spread sheets (S&E, TFP, or Support Engineer) is highlighted in bold print in

order to help distinguish the spread sheets. Each workbook, somewhat *graphically*, shows the expenditure of the resources over the project's life by both month and activity.

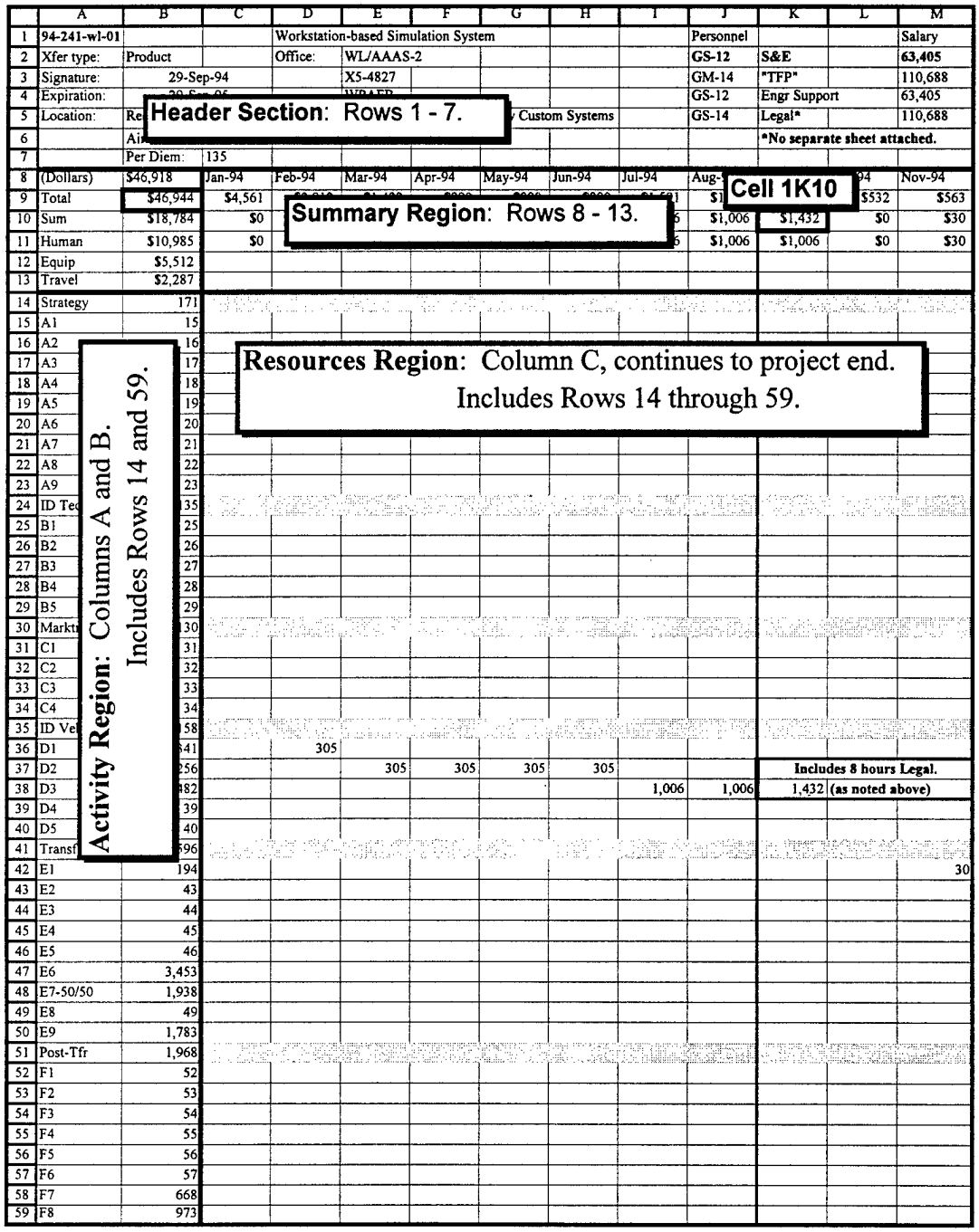
Standard Conventions. To minimize confusion when discussing the contents of the numerous cells on the multiple spread sheets in the eight project workbooks, some general information is needed including standard conventions used when referencing the spread sheets, format of the specific values, source of the values used for salaries, and finally, the layout of the spread sheet itself.

When referencing cells in the spread sheets, a standard convention is followed (SheetColumnRow). For example, referring to Figure 4-1, Spread Sheet Layout, 1K10 is the designation for cell K10 (Column K, Row 10) on Sheet 1. For Project 94-241, cell 1K10 contains the value *$1,432* and represents the dollar value of the man-hours expended by, in this case, both the S&E as well as the Legal Consultant during September 1994 while performing the TMP sub-step, *establish transfer framework* (D3). When specifying entire rows or columns, they are capitalized to help capture attention; e.g., *Row 3* or *Column 7*.

Additionally, since the goal of this effort is to identify the cost trends of TT, all values shown in the project workbooks are in dollars. If knowing the number of hours expended is desired, this can be determined by dividing the dollar value shown by the appropriate hourly rate for the individual in question. However, please note that in order to do this accurately, care must be taken to ensure the cell in question contains only one hourly rate. In other words, ensure the cell is not a summation of efforts by personnel compensated at different rates, as is the case in Cell 1K10 discussed previously.

Salaries. Salaries for all government personnel interviewed are based on the civilian grade or military rank identified during the interview and are based on information corresponding to that level as listed in Air Force Instruction (AFI) 65-503,

dated 2 May 1996. For civilians, composite rates (Table A26-1 as of 1 April 1996) are used as a baseline and correspond to the person's current level since their grade and step may have changed over the life of the TT project. Any inaccuracies introduced as a result



	A	B	C	D	E	F	G	H	I	J	K	L	M
1	94-241-wl-01			Workstation-based Simulation System						Personnel			Salary
2	Xfer type:	Product		Office:	WL/AAAS-2					GS-12	S&E		63,405
3	Signature:	29-Sep-94			X5-4827					GM-14	"TFP"		110,688
4	Expiration:									GS-12	Engr Support		63,405
5	Location:	Re					Custom Systems			GS-14	Legal*		110,688
6		Ai									*No separate sheet attached.		
7		Per Diem:	135										
8	(Dollars)	$46,918	Jan-94	Feb-94	Mar-94	Apr-94	May-94	Jun-94	Jul-94	Aug-		94	Nov-94
9	Total	$46,944	$4,561							$1		$532	$563
10	Sum	$18,784	$0						6	$1,006	$1,432	$0	$30
11	Human	$10,985	$0						6	$1,006	$1,006	$0	$30
12	Equip	$5,512											
13	Travel	$2,287											
14	Strategy	171											
15	A1	15											
16	A2	16											
17	A3	17											
18	A4	18											
19	A5	19											
20	A6	20											
21	A7	21											
22	A8	22											
23	A9	23											
24	ID Tec	135											
25	B1	25											
26	B2	26											
27	B3	27											
28	B4	28											
29	B5	29											
30	Markt	130											
31	C1	31											
32	C2	32											
33	C3	33											
34	C4	34											
35	ID Ve	58											
36	D1	641		305									
37	D2	256			305	305	305	305			Includes 8 hours Legal.		
38	D3	482							1,006	1,006	1,432 (as noted above)		
39	D4	39											
40	D5	40											
41	Transf	696											
42	E1	194											30
43	E2	43											
44	E3	44											
45	E4	45											
46	E5	46											
47	E6	3,453											
48	E7-50/50	1,938											
49	E8	49											
50	E9	1,783											
51	Post-Tfr	1,968											
52	F1	52											
53	F2	53											
54	F3	54											
55	F4	55											
56	F5	56											
57	F6	57											
58	F7	668											
59	F8	973											

Figure 4-1. Spreadsheet Layout

	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA
1	Hourly													
2	30.48													
3	53.22	Cell 105												
4	30.48													
5	53.22	$426	8 hrs: Sep 94, Sub-step D3.											
6														
7														
8	Dec-94	Jan-95	Feb-95	Mar-95	Apr-95	May-95	Jun-95	Jul-95	Aug-95	Sep-95	Oct-95	Nov-95	Dec-95	Jan-96
9	$563	$624	$4,635	$654	$654	$654	$4,635	$654	$654	$654	$654	$654	$654	$6,207
10	$30	$91	$1,855	$122	$122	$122	$1,855	$122	$122	$122	$122	$122	$122	$5,622
11	$30	$91	$1,097	$122	$122	$122	$1,097	$122	$122	$122	$122	$122	$122	$122
12														$5,500
13			$758				$758							
14														
15														
16														
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38														
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40														
41														
42	30	91												
43														
44														
45														
46														
47			549	61	61	61	549	61	61	61	61	61	61	61
48			549	61	61	61	549	61	61	61	61	61	61	61
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Figure 4-1. Spreadsheet Layout (Continued)

of these changes are judged to be negligible; the more critical aspects are deemed to be reasonableness and consistency. These rates, according to AFI 65-503, include basic pay, additional variable payments (overtime, holidays, night differentials and incentive

awards), as well as costs to the government for benefits such as retirement, health, life insurance, and quarters or uniform allowances.

Likewise, the rates for military personnel are based on AFI 65-503 (Table A19-1 as of 22 Mar 96) and include comparable benefits such as retirement pay accrual, basic allowance for quarters and variable housing allowance, as well as miscellaneous (basic allowance for subsistence, separation allowance, social security tax, etc.). Please note that incentive pays, such as for aircrew or hazardous duties, were not included in the military rates so as to enhance consistency with the civilian rates previously discussed and since these are the exception for personnel in this environment.

Salaries for others were determined by asking the person in question during the interview. These others include the technicians, government contractors overseeing operation of one laboratory facility, as well as personnel from Wright Technology Network. These rates also include *overhead* charges such as benefits. The rates for each person are specified in the *header* region on each spread sheet. Each spread sheet in Appendix D can be broken down into four basic areas or regions of information; header, resources, summary, and activity.

Four Spread Sheet Regions. The first region, the *header*, includes the top seven rows (1-7) of each spread sheet as shown in Figure 4-1, Spread Sheet Layout. Each header contains general project information such as the identification number, signature and expiration dates, office of primary responsibility within WL, as well as information on the personnel identified during the interviews as contributing to the project. As previously noted, the primary person of interest for each particular spread sheet in the file is shown in bold. Depicting a portion of Sheet 1 for Project 94-241, the S&E, is primary in Figure 4-1.

If a contributor's effort can be clearly represented on the Sheet 1, an asterisk (*) follows the appropriate contributor's *name* declaring that a separate spread sheet is not

provided. Again using Project 94-241 as an example, no separate spread sheet is provided to show the eight hours expended by the Legal Consultant. The consultant's efforts are shown both in Cell 1K38 and Cell 1O5. In both locations, notes are included to show the consultant spent eight hours (8 X $53.22 = $426) performing the TMP sub-step *establish transfer framework* (D3) in September 1994.

The second region, *resources*, is the largest and shows the resources expended by activity and over time. This region includes all cells in Row 14 and higher, and in Column C and to the right. Signature and expiration *date lines* for each project are shown by a bold, vertical line in this region and correspond to the dates listed in Cell 1B3 and Cell 1B4 respectively. However, note that in two cases, Project 93-207 and Project 94-173, the transfer was completed prior to their expiration dates, thus the expiration *date-line* is not shown. As previously noted, values in this region are dollar representations of the number of hours spent by each participant as multiplied by their corresponding hourly rate.

Above the resources region is the third region entitled *summary*, which includes Rows 8 through 13. Row 8 lists the month and year for which the personnel interviewed identified the expenditure of resources. Skipping Row 9 for now, Row 10 (Sum) is a summary of the resources expended by the participants captured on the sheet for each month during the life of the project as detailed in the three rows below it; Row 11 (Human), Row 12 (Equipment), and Row 13 (Travel). *Human* includes only the human resources expended as shown in the resources region discussed previously. *Equipment* and *Travel* identify resources used in direct support of the CRDA for the purchase of equipment and travel respectively which are shown in the month of purchase. Travel includes round-trip airfare to the location listed in header Cell 1B5, as quoted by the local travel pay section of the military personnel flight at Wright-Patterson AFB, as well as the per diem for the appropriate number of days.

Row 9 (Total) is included only on Sheet 1 for each project workbook. Row 9 is a total of each of the Sum rows for all spread sheets in this file. Cell 1P10 ($1,855) is the total of cells 1P11 ($1,097), 1P12 ($0), 1P13 ($758).

	1P11	$1,097
	1P12	$ 0
+	1P13	$ 758
	1P10	$1,855

This represents the dollar value of resources expended during the month of February 1995 by the S&E while performing both *Transfer* (E6) and *Monitor Tech and Admin Aspects* (E7) activities. Cell 1P9 ($4,635) however, includes not only the sum in Cell 1P10 ($1,855) but also the sums in both Cell 2P9 ($1,290 expended by the *TFP*), and Cell 3P9 ($1,490 expended by the Support Engineer). Cell 1P9 represents the total amount of resources expended for that month by all participants. Note the sums on both Sheet 2 and Sheet 3 include the Human and Travel expenditures of the *TFP* and *Engr Support* respectively, during February 1995 in performance of the corresponding sub-task.

	1P10	$1,855
	2P9	$1,290
+	3P9	$1,490
	1P9	$4,635

The dollar value in Cell 1B9 ($46,687) represents a summation of all the values in Row 9 of Sheet 1 throughout the duration of the project (January 1994 through July 1996), and therefore represents the total cost of all direct resources expended throughout the life of this TT project. Cell 1B9 for all project workbooks is the total direct cost of performing the technology transfer.

The final region, activity (Columns A and B below Row 13), includes a list of the steps and sub-steps in the TMP as well as a total of the resources expended by all contributors highlighted on the sheet. For Project 94-241, Sheet 1's activity totals in

Column B include resources (hours and travel) for both the S&E and Legal Consultant. Only travel that could be specifically associated to each activity is included in these values. For example, Cell 1B58 shows the S&E for Project 94-241 accounted for $914 worth of resources while performing the *prepare performance reports* sub-step (F8) of the *Post-Transfer* major step (F). The total expended by the S&E for the entire *Post-Transfer* major step is $1,968 as shown in Cell 1B51.

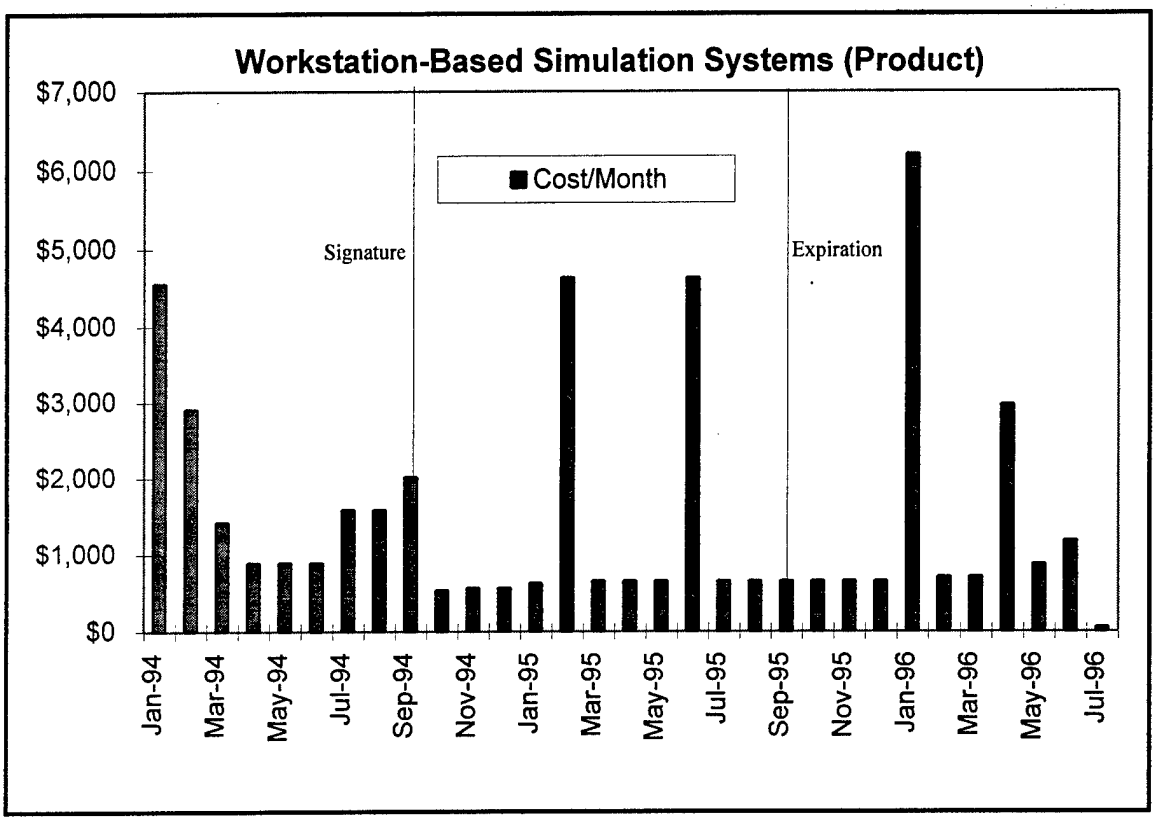

Figure 4-2. Project 94-241 Cost/Month

In an effort to more easily identify trends, the data from each of these eight workbooks are processed and presented in three different ways using the *Chart* function provided by Microsoft Excel. First, the dollar values in Row 9 of Sheet 1 (Total) are charted versus the month of expenditure over the life of the project yielding a cost-over-time (COT) curve. The cost-over-time curve for Project 94-241 is shown as

Figure 4-2, Project 94-241 Cost/Month; COT curves for the remaining seven projects are included as each project is discussed. Next, the cost for each sub-step or activity is plotted for each of the eight transfers; included here for as Figure 4-3, Project 94-241 Sub-Step Cost. Lastly, the percentage spent, with respect to the total project cost, is graphed versus the percentage complete, with respect to the total length of the project, resulting in a plot as shown in Figure 4-4, Project 94-241 Spend Rate.

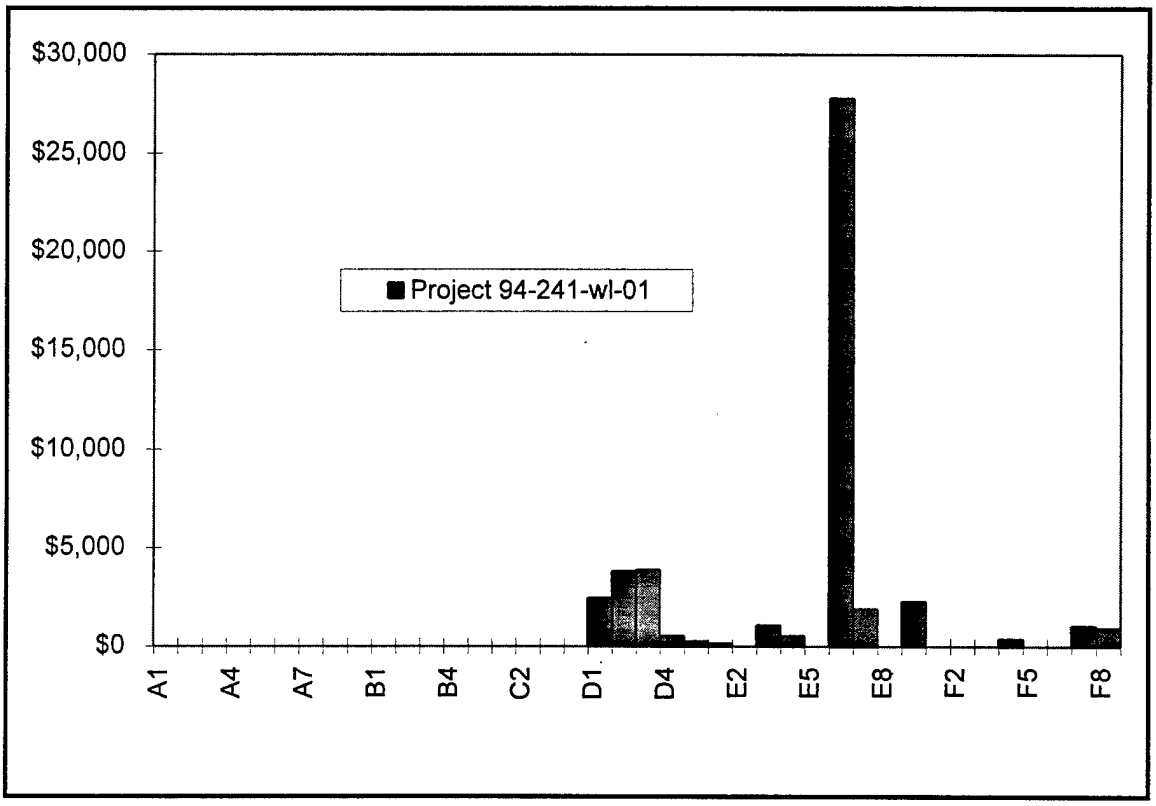

Figure 4-3. Project 94-241 Sub-Step Cost

Having completed a description of the spread sheet layout and the resulting figures, using the pilot effort as an example, information contained in the workbooks, as presented in Appendix D, as well as the figures for the seven remaining projects can be interpreted. Attention will now turn to a case-by-case discussion and analysis of the information gathered during the interviews for each project. The modus operandi, in the

next section is to provide, for the eight projects, general information regarding the basics of the project, interpretation of the three figures provided for each, and finally, a discussion of any peculiarities noted. Since the order of the projects is not important, they are presented in a fashion that flows best based on themes noted for each project.

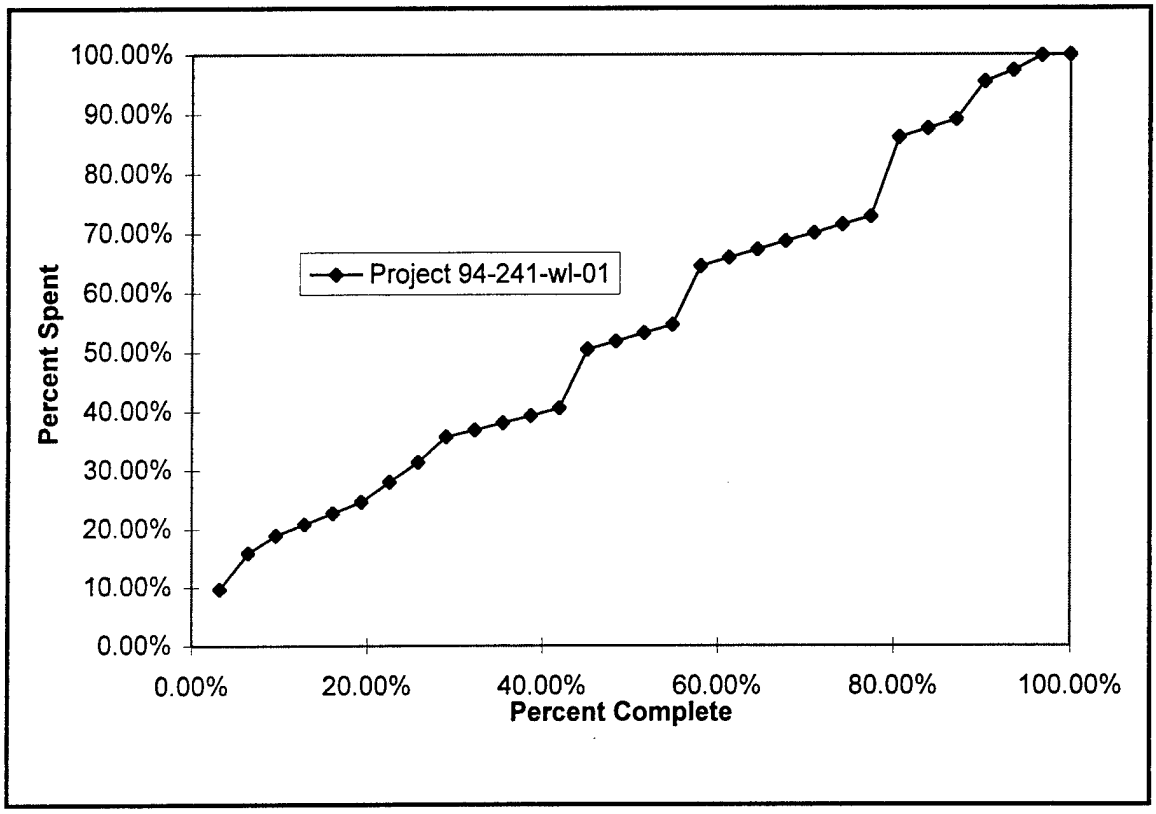

Figure 4-4. Project 94-241 Spend Rate

The Projects

Having only discussed the pilot project in terms of the layout and presentation of the data collected during its study, more in-depth analysis of the eight projects examined will begin with the Workstation-Based Simulation Systems transfer.

Project 94-241-wl-01, Workstation-Based Simulation System. Having previously provided the general information for this project in the pilot project section, discussion

begins with the project workbook in Appendix D which shows the total cost of all direct resources is $46,908. This total includes $5,500 of equipment, $5,929 for travel (including the S&E, TFP, and support engineer), with the remaining $35,479 being attributed to the participants' efforts. This project is unique in that it is the only transfer where the supervisor of the S&E, labeled here as the *TFP*, was directly involved. The S&E's supervisor is labeled as such due to his participation in a role that, at the start of this study, was expected from a TFP. As seen later, this is not the case.

Project 94-241 is categorized as a product-type technology transfer. Each of the eight projects was classified, according to the type of technology transfer it represented, into one of three categories; product, process, or facility. This is indicated for each project in the spread sheet header, Cell 1B2. A product-type transfer has as its ultimate goal, the commercialization of a physical product. The WBSS is the product in this instance. Projects in the second type, process, have the goal of transferring a unique process; a better way of doing something. The last transfer type is labeled as *facility*. While it is similar to a services-type contract, discussed previously in this chapter and noted as grounds for exclusion from this investigation, a facility-type transfer goes beyond just use of the facility to include cooperative research and the transfer and sharing of information between the two parties. Of the eight projects investigated during this effort, five were product-type efforts, two were process, leaving only one in the facility category.

Figure 4-2 shows that the expenditure of direct resources began in January 1994, eight months prior to the signature for this one-year CRDA. Its formal initiation (signature) and end (expiration) are shown in the figure as the thin, vertical lines on the left and right. Resource usage continued for nine months following its formal expiration. The *spikes* in the cost for the months of January 1994, February and June 1995, and April 1996 are a result of travel to the collaborator's facility. The spike in January 1996 is the

purchase of an advanced IBM-clone PC to demonstrate and test the operation new simulation software. The average cost per month is about $1,500.

Figure 4-3 reveals two interesting points. First, no effort was identified during any the interviews for the first three major steps of the TMP; Strategy (activities A1 through A9), ID Tech (B1-B5), and Market (C1-C4). No strategy development, technology assessment, or marketing was necessary for this project since it was initiated by *chance* through personal contacts between the S&E's supervisor (*TFP*) and the collaborator. Secondly, of the other three major steps, a large majority of the resources were consumed by the *Transfer* (E) major step and specifically, activity E6, also called Transfer; about 1.5 times more than all others combined.

Figure 4-4 shows that, despite the spikes evident in Figure 4-2, the rate of expenditure over the *actual life* of transfer appears linear and fairly constant. The actual life is from first to last resource expenditure regardless of the signature and expiration dates.

Project 93-208-wl-01, GE-90 Engine Testing. Project 93-208 is the only facility-use type of CRDA investigated during this effort, consuming $50,332 (Cell 1B9) of direct resources. Described as a "Blade Containment Test Program" in the work plan, the goal was to obtain test data, through use of WL's Propeller Test Facility, to help understand the impact capability of large composite fan blades, and their containment requirements. Used to assist General Electric Aircraft Engines (GEAE) in the

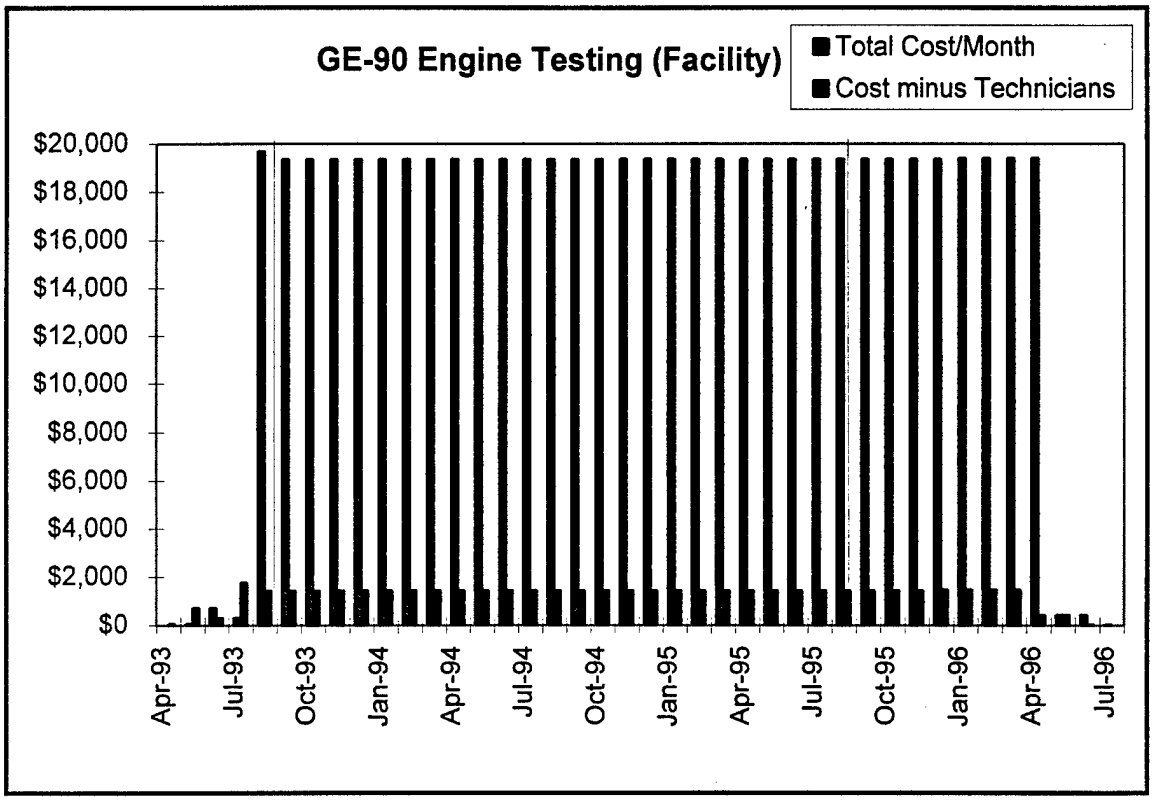

Figure 4-5. Project 93-208 Cost/Month

commercial development of their GE-90 engine, the test data, consisting of strain gauge data, was shared with WL's Aero Propulsion and Power Directorate (APPD) to aid in the development of analytical techniques for composite blades under impact conditions. In return for use of the facility, GEAE reimbursed APPD for the costs of operating the facility during the conduct of the tests in both time and materials. No special equipment or travel was charged to this effort, thus all resources identified are human (hours).

Human resources expended consisted of both WL personnel and their sub-contractor, responsible for operation of the test facility, but primarily the latter which are labeled as *Technicians (Test)* in the spread sheet's header. Technician's efforts were tracked and then charged, but were subsequently reimbursed by GEAE. Therefore,

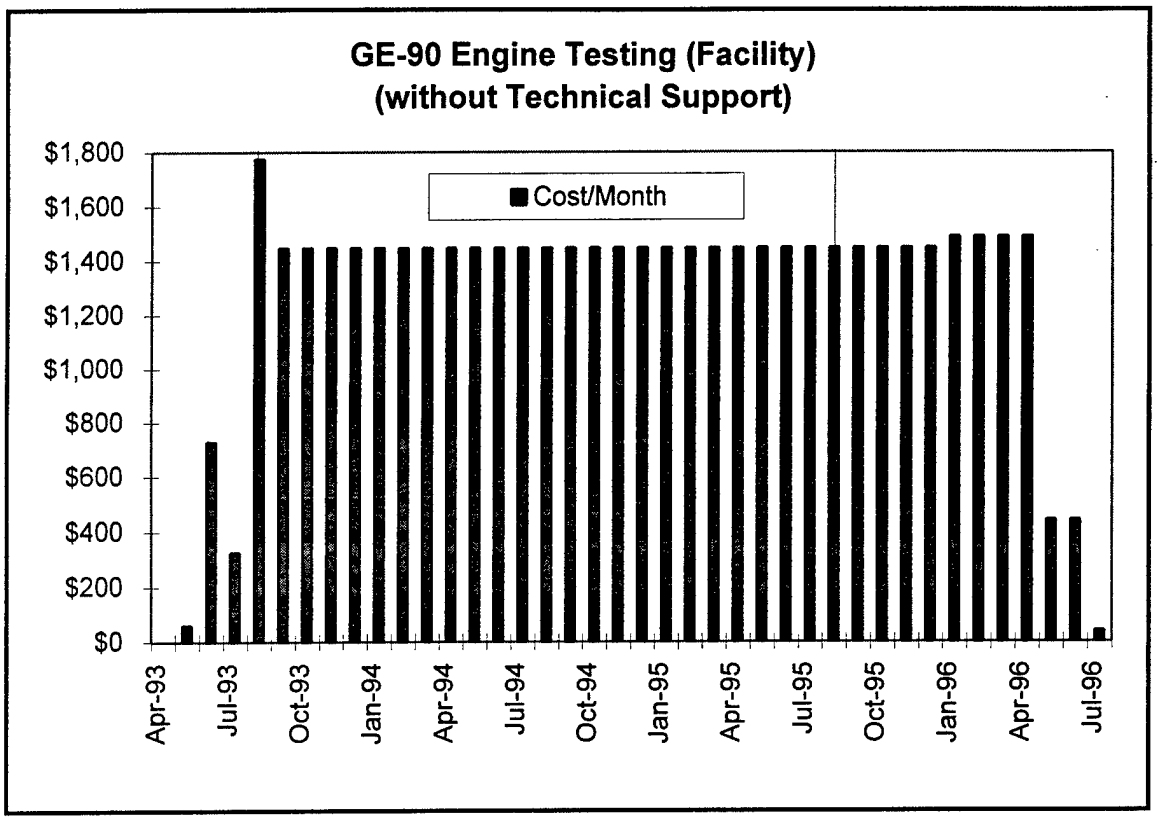

Figure 4-6. Project 93-208 Cost/Month (w/o Support)

although identified in Appendix D as expended in the total cost in Cell 1B10, costs for the test technicians were not an actual cost to WL. These amounts were initially included, however, in order to capture the total resources expended by WL (even if reimbursed) in the performance of the CRDA.

Specifics regarding actual effort by month during the project were unfortunately not retained. However, when questioned, the S&E reported that, over the project's life, technical support costs were fairly consistent. This application of these costs result in a nearly *square* pattern in Figure 4-5, Project 93-208 Cost/Month.

In order to better understand the cost-over-time curve without the possible skewing effects of the disproportionately large technical support expenditures, the effects of removing them from consideration in the transfer's totals were evaluated and a second

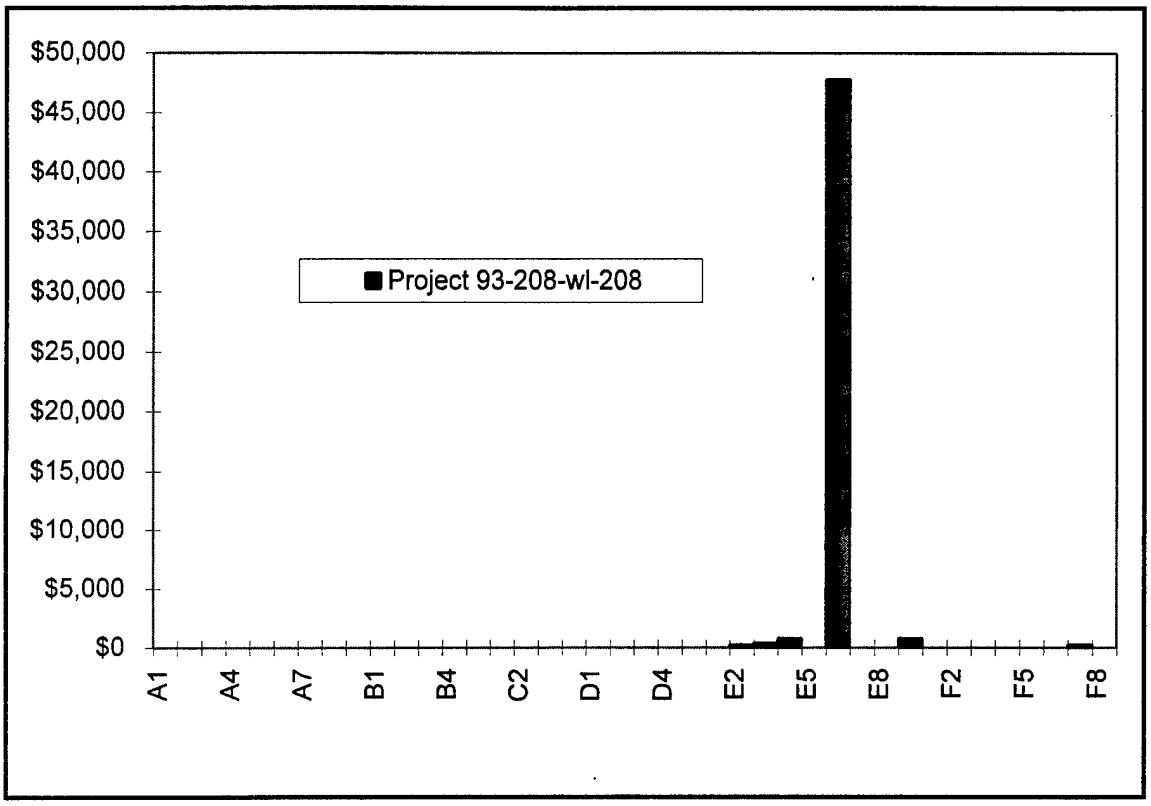

Figure 4-7. Project 93-208 Sub-Step Cost

figure, Figure 4-6, Project 93-208 Cost/Month (w/o Support), is included. However, because the S&E reported his own efforts, expended monitoring the project, as being *consistent over time*, the resulting cost-over-time curve in Figure 4-6 is not significantly different from Figure 4-5. Notwithstanding this, in order to better assess the *true* consumption of resources, the test technician's hours are excluded in any further discussion and analysis of this transfer project. Both figures show that resources were expended both before signature and after expiration. The average cost per month over this transfer's actual life is about $1,290.

As with the previous transfer, Figure 4-7, Project 93-208 Sub-Step Cost, reveals that almost all of the resources were consumed performing the *transfer* (E6) activity; nearly a 10 to 1 ratio. Additionally, no resources were consumed in any of the first three

major steps in the TMP. However, for this transfer, this dearth of resource expenditure extended to also include the *Identify Vehicle* (D) major step.

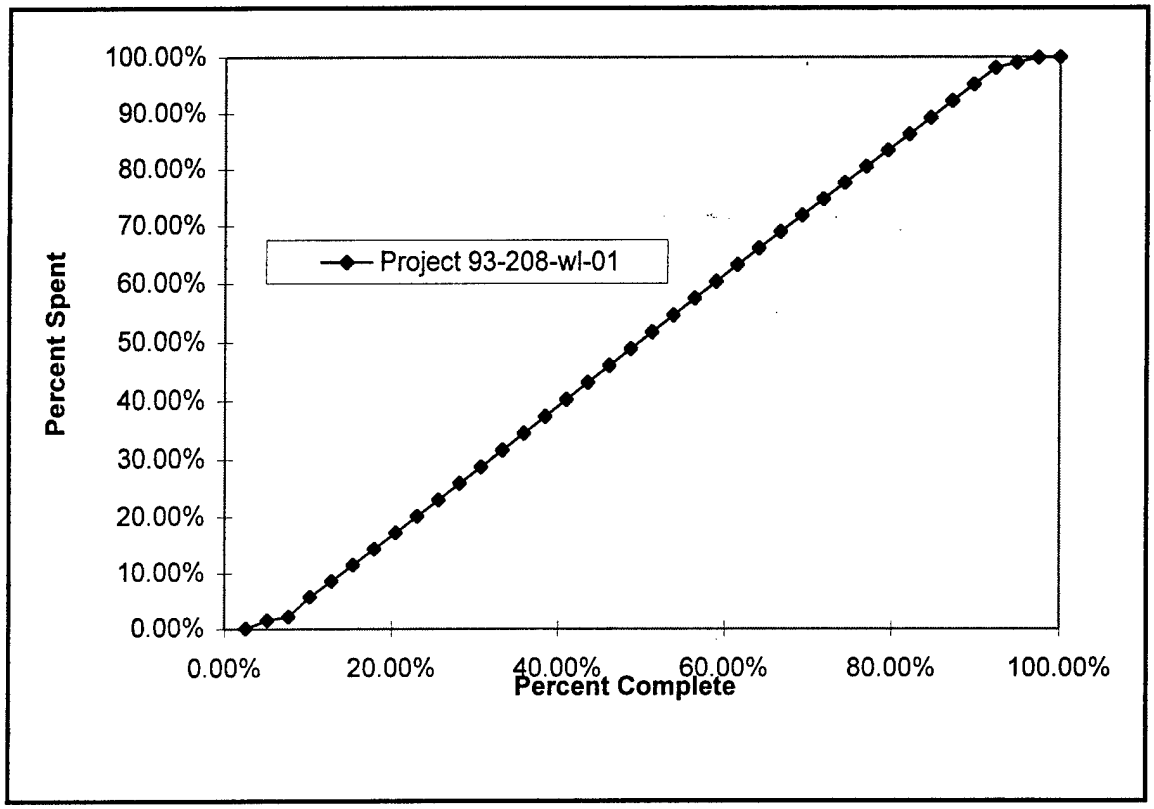

Figure 4-8. Project 93-208 Spend Rate

Another result of the *consistent over time* estimate of resource consumption, even discounting the test technician's efforts, is a linear and very consistent spend rate as depicted in Figure 4-8, Project 93-208 Spend Rate.

Identified as "Legal" in the spread sheets, it was noted during the interview with the TFP, that this project, when compared to others in the same directorate, required above average involvement by the intellectual property office, AFMC/JAZ. Therefore, prior to discussing the next project, some information concerning AFMC's intellectual property office is in order.

Intellectual Property Office (AFMC/JAZ). While the direct effort attributed to each of the individual projects is minimal, because JAZ is involved in every project, it important to understand the activities it performs. These activities include answering questions posed by both parties (WL and partners), actual legal review of draft and final CRDA documents, and finally documentation of their legal *opinion* or a final ruling of the transfer's legality. Note that JAZ does not get involved with either writing the actual CRDA documents or negotiating the final agreement. These are performed by the individual S&Es and collaborators involved in the transfer.

In an interview with the individual specifically involved with the GE-90 Engine Testing CRDA, the lawyer estimated only fifteen hours of his effort total. This included numerous phone calls from the collaborator's lawyers in order to satisfy their concerns regarding some of the language in the CRDA documents. Note that the pay grade of the *working-level* intellectual property lawyer is GS-14, higher than the working level typically involved with the legal reviews of this type. This was attributed to the requirement for both, a higher level of technical expertise, as well as legal training as a patent attorney and in intellectual property law.

Project 93-250-wl-01, Ti-Al Foil into Aircraft Parts. This is one of only two projects identified as a process-type transfer. However, it is important to note that this CRDA was initiated without the goal or intent of actually transferring any specific information or technology. The purpose of this CRDA was to evaluate the feasibility of pack rolling direct cast titanium aluminide (Ti-Al) strip into foil, including the pack design, for commercial use. WL's goal was to investigate the development of techniques for use in preparing foils in general, not specific to any one material. Like the previous transfer, neither equipment nor travel consumed for any resources leaving the human element to account for the total cost of $24,913.

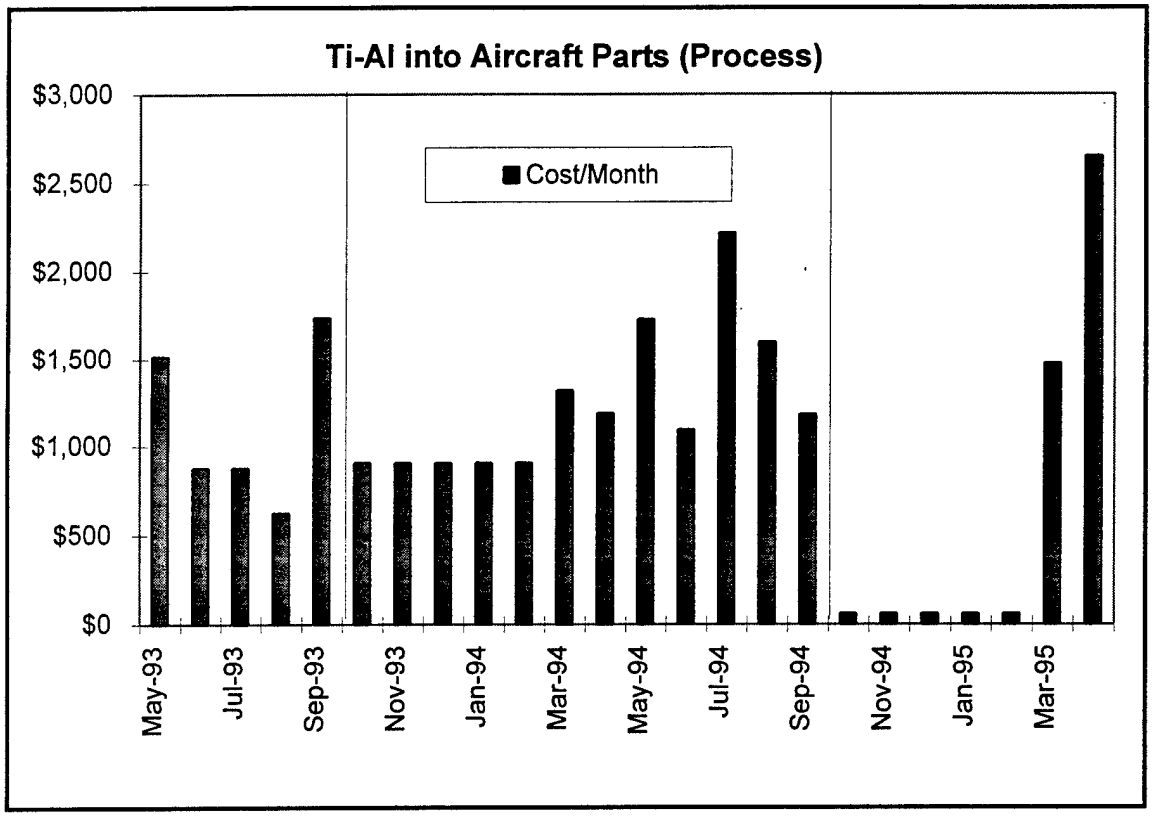

Figure 4-9. Project 93-250 Cost/Month

Similar to the previous project in that a government-owned facility was utilized and operated by contractor personnel (known as a government owned, contractor operated facility or GOCO) via a government contract, it is different since there were no provisions for the government to be reimbursed by the collaborator. Therefore, these resources are truly a cost with respect to the project.

One benefit of the GOCO facility is that, in order to be reimbursed for their efforts, the government contractor must keep very detailed records regarding the number of technician hours, time period, and reason the hours were expended. Thus, the resources identified by the technicians are not estimates but actual values with respect to both quantity and time frame. However, this only accounted for $5,541 (Cell 2B9), about 22 percent of the project's total. Therefore, accounting for the remaining 78 percent depended on estimates of both quantity and period. *Supervision* (Cell 1J5), is the effort

expended by the supervisor of the contractor's technicians in direct support of this CRDA and includes comparable employee benefits.

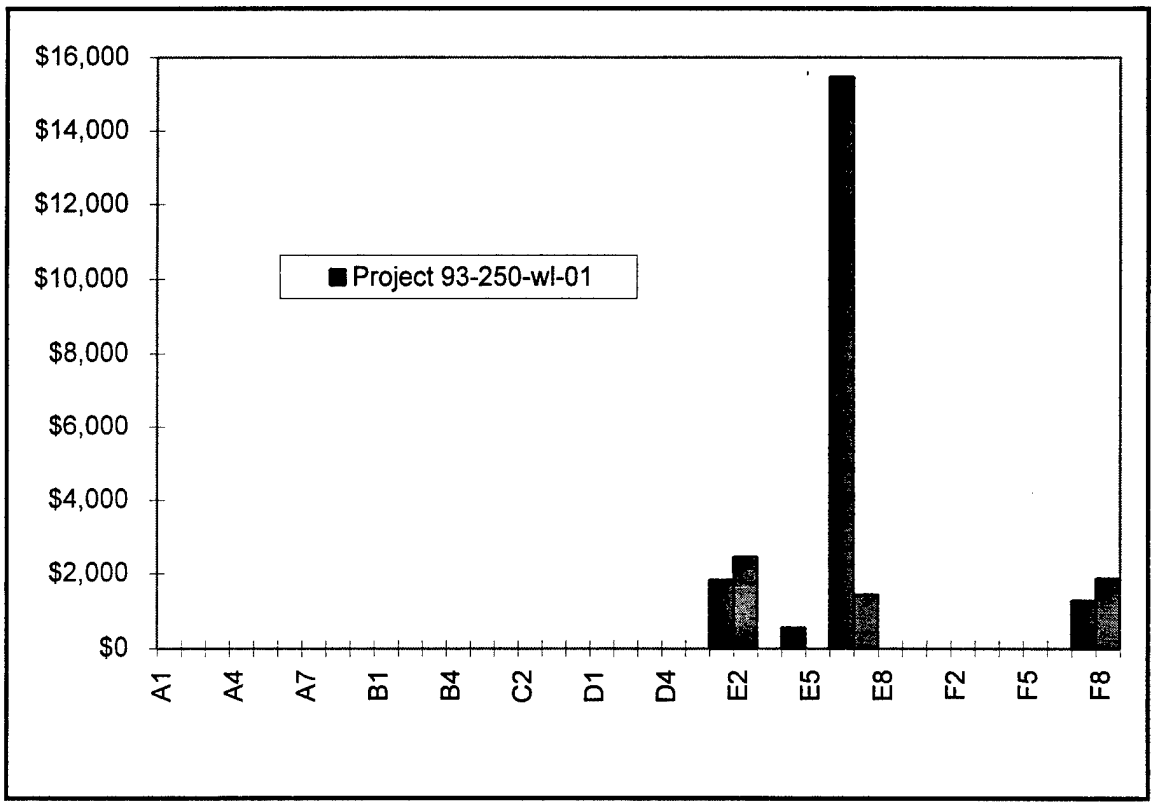

Figure 4-10. Project 93-250 Sub-Step Cost

This transfer continues the three trends already emerging with respect to these eight TTs. First, resources are expended both before signature and after expiration (Figure 4-9, Project 93-250 Cost/Month). Second, the *transfer* sub-step (E6) accounted for the *lion's share* of the project's total expenditures, a 1.6 to 1 ratio (sub-step E6 to all other sub-steps), while major steps *Strategy*, *Identify Tech*, *Marketing*, and *Identify Vehicle* consumed none (Figure 4-10, Project 93-208 Sub-Step Cost). Third, the spend rate appeared to be both linear and fairly consistent (Figure 4-11, Project 93-208 Spend Rate).

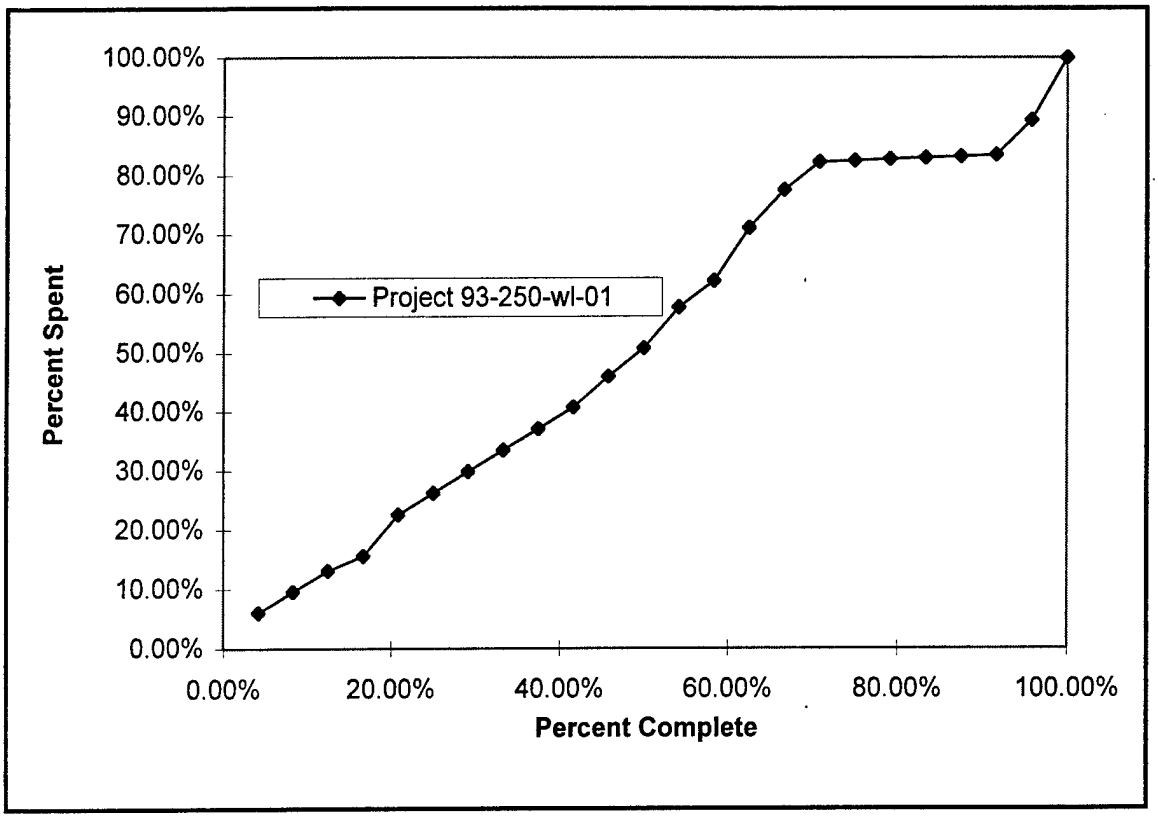

Figure 4-11. Project 93-250 Spend Rate

The interview with the TFP for this directorate within WL estimated minimal direct involvement during the life of this CRDA; less than ten hours. Therefore, these hours are included along with the S&Es on Sheet 1 (Cells 1C43 through 1G43). This time was spent reviewing CRDA documentation and coordinating with the appropriate players, thus attributed to TMP sub-step E2. However, legal was not included in the total project cost since interviews indicated less than one hour of direct time was expended. Conversely, the first of the *WTN-created* CRDAs, a Wright Technical Network consultant was added having accounted for about $7,220 (nearly 30 percent) while performing five different sub-steps. Because of this, discussion here of WTN's role in four of the eight projects studied is appropriate.

Wright Technology Network. Wright Technology Network (WTN) is a non-profit organization chartered, by the state of Ohio, with facilitating TT between Wright

Laboratory and industry in Ohio. While four of the eight projects investigated identified WTN as playing a role in the development of the CRDA, only one of the projects (Project 94-173) could provide the name of the specific WTN individual involved. In order to fully characterize the resources expended, this individual with WTN was contacted and a telephone interview conducted.

Understandably, working many similar efforts, in the facilitation of the development of numerous CRDA agreements, resulted in a *blurring* of details regarding the specifics of projects initiated nearly three years ago. However, WTN was able to provide some details regarding activities that are typically performed while providing their services, as well as an average range of effort.

WTN's role is described as *creating the deal* with the overall goal of protecting the intellectual property of both parties. If the relationship is not formalized, intellectual property such as proprietary information and patents are not protected and become vulnerable to exploitation by other companies.

Creating the deal encompasses overcoming the unfamiliarity of the parties to TT, coordinating the formalization of both the boiler plate and work plan sections of the actual transfer agreement, and also performing *relationship maintenance*. Unfamiliarity is overcome through a process WTN describes as *inculturation*. Inculturation involves the conduct of meetings with each partner and detailing the process of establishing the agreement, defining the purpose for the transfer, as well as conveying the importance of the agreement; providing the urgency to complete the deal. Understandably, more effort is required when either of the parties are unfamiliar with either TT or WTN's role in it. The converse also holds that less effort is required when the parties are familiar with TT and WTN; on subsequent efforts for example.

Once inculturated, WTN then aids in tailoring the boiler plate, defining and documenting the draft work plan, and finally coordinating and revising both until the

agreement is signed. An article, if approved by both parties, is then prepared for publication in WTN's newsletter announcing the project's initiation. Additional articles are generated for major breakthroughs during the project as well as at its conclusion in order to publicize the results. These articles, in some cases, are published in journals, such as Aviation Week & Space Technology, that encompass the transfer's area of interest. During the actual performance of the transfer, its involvement is reduced to monthly status checks to ensure the transfer is progressing. Upon completion, WTN also produces an internal final report providing a synopsis of the effort.

Regardless of the project, according to WTN, the basic activities performed are fairly consistent with variance only in the scope of the effort. Thus, based on the interview with WTN, an *average* level of effort was determined for each of the five sub-steps WTN performs for these transfers resulting in a typical WTN resource *footprint*. This information was then integrated into the life of each of the four projects in which WTN was involved. The only difference between the final dollar value of WTN's effort for each project is the project's life span; increasing the life of the project correspondingly increases the expenditures for maintenance of the relationship and results in a greater total expenditure for WTN.

Project 93-267-wl-02, GE Process Property. The second of the four *WTN-created* CRDAs, this is the second of the two process-type transfers. As with the previous project, this CRDA was initiated without the goal of actually transferring any technology, rather, truly cooperative research. Other than its purpose, to evaluate the effects of the processing conditions on the texture and mechanical properties of near-gamma and gamma titanium aluminide alloys, this CRDA is nearly identical with the project previously discussed including continuance of the trends noted in the previous project. These trends are reinforced through examination of the three project figures; Figure 4-12 (Cost/Month), Figure 4-13 (Sub-Step Cost), and Figure 4-14 (Spend Rate). The final

statistics on this transfer show the average cost per month was $1,530 and the ratio of *transfer* sub-step E6 to all others was 2.3 to 1.

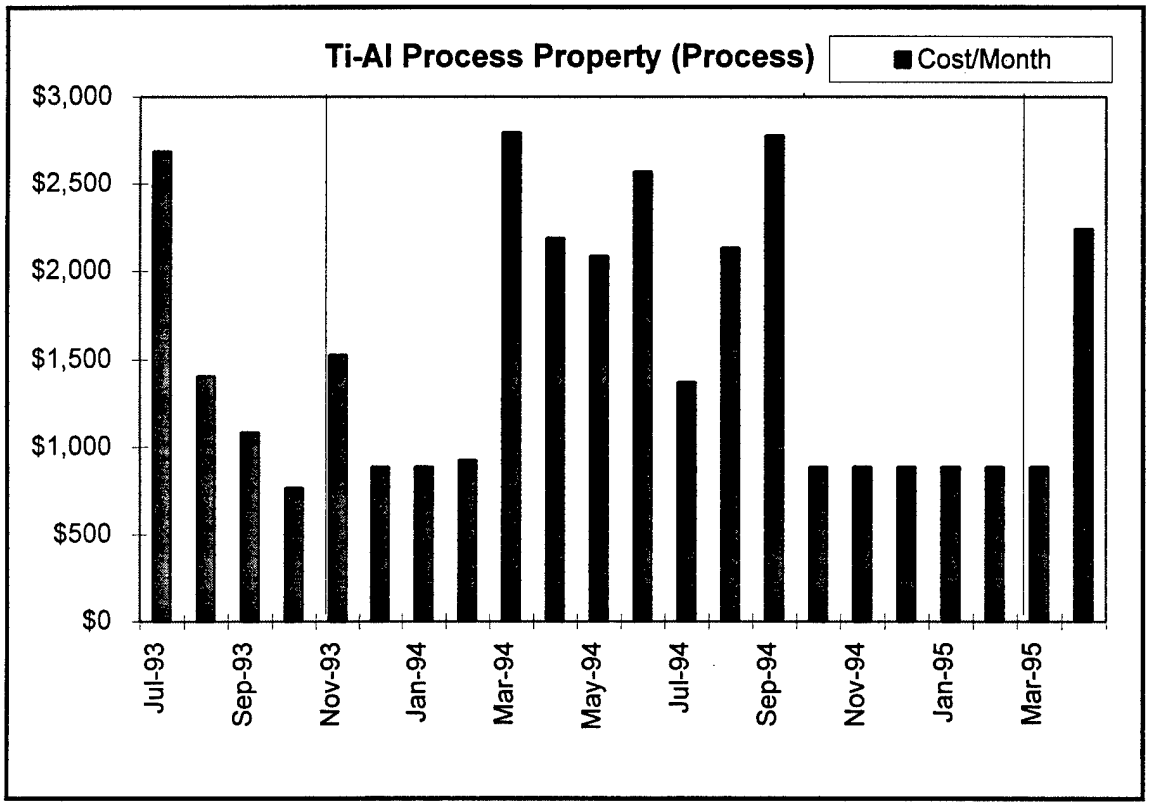

Figure 4-12. Project 93-267 Cost/Month

Minor differences include: 1) travel, one business trip was taken to Schnectady, NY in order to facilitate the agreement on the *desired results* (sub-step E1), and 2) the accounting of the S&E's efforts, split 50/50 between *monitoring administrative aspects* of the project (sub-step E7), and performing the technical *transfer* (sub-step E6).

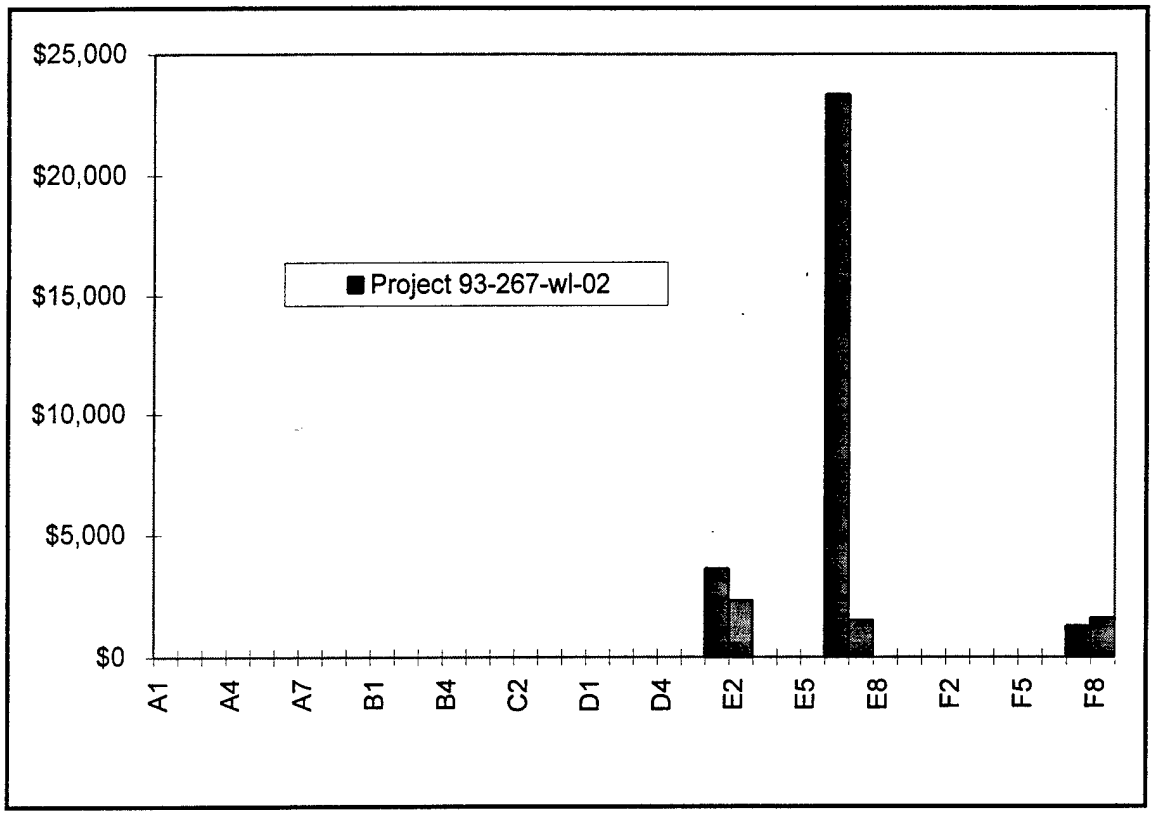

Figure 4-13. Project 93-267 Sub-Step Cost

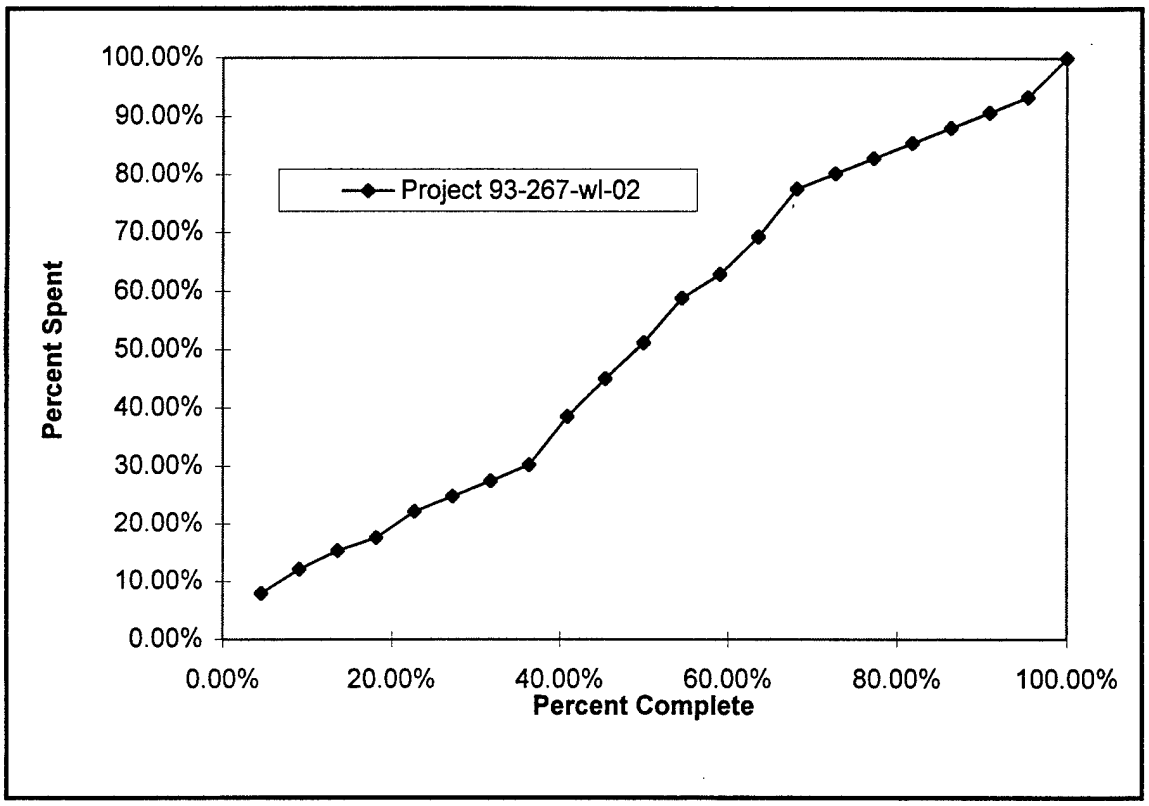

Figure 4-14. Project 93-267 Spend Rate

Project 93-207-wl-01, Interface Property Data Test Stand. The third *WTN-created* CRDA, Project 93-207 is the second product-type effort and accumulated a total cost of $15,998. The purpose of this transfer was to commercialize Wright Laboratory's existing prototype machine for testing fiber matrix interface boundary properties in ceramic and metal composites, as well as to facilitate the development of industry test standards. The collaborator, a manufacturer of precision machinery, was to improve and "repackage" the machine into a standard size model for sale or lease. Note that no equipment or travel were identified for this project.

In addition to creating the agreement, WTN also conducted a market survey to identify the interest of potential buyers, necessary and desirable features, as well as the approximate price that potential buyers would be willing to pay for such a capability.

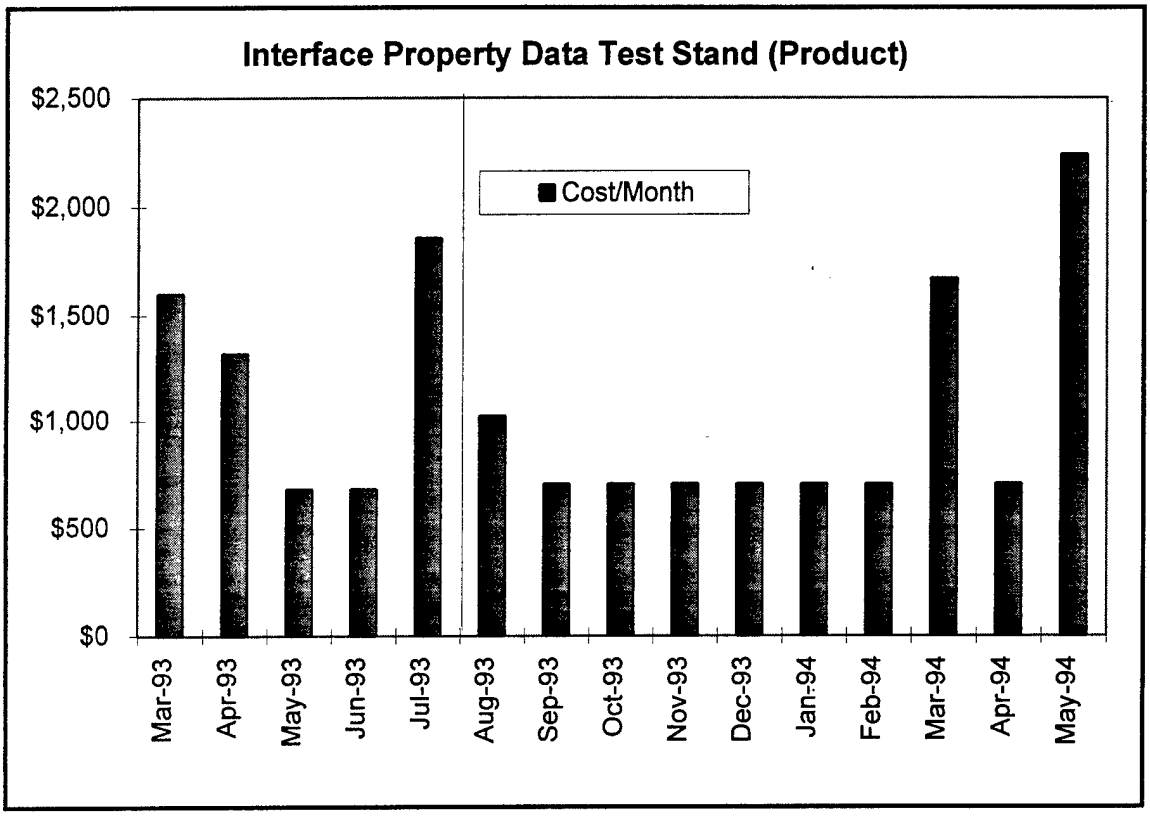

Figure 4-15. Project 93-207 Cost/Month

Categorized as an evaluation of the technology assets, activity B2, this is the only instance of effort expended to perform any activities in the first three major steps of the TMP. While breaking the trend of no resource expenditure in the first three major steps in the TMP, it is interesting to note this only occurrence in all eight cases was not by either the S&E or the TFP, but a third party. Therefore, the trend, with respect to the S&E and TFP, is unanimous considering these projects studied.

Note that both, in the workbook in Appendix D and also in Figure 4-15, Project 93-207 Cost/Month, there is only one time-line. Corresponding to the CRDA's signature date, the expiration time-line is not shown because this project culminated with the participant's attendance at a trade show in April 1994 and therefore was complete about three months prior to the agreement's formal expiration. Although continuing the trend of resource expenditure before signature (4 months in this case), it is one of two that

were completed prior to formal CRDA expiration. Figure 4-15 reveals the cost per month plot to be comparable (except Project 93-208) with fairly consistent per month cost at about $1,070 and buildups prior to both signature and termination.

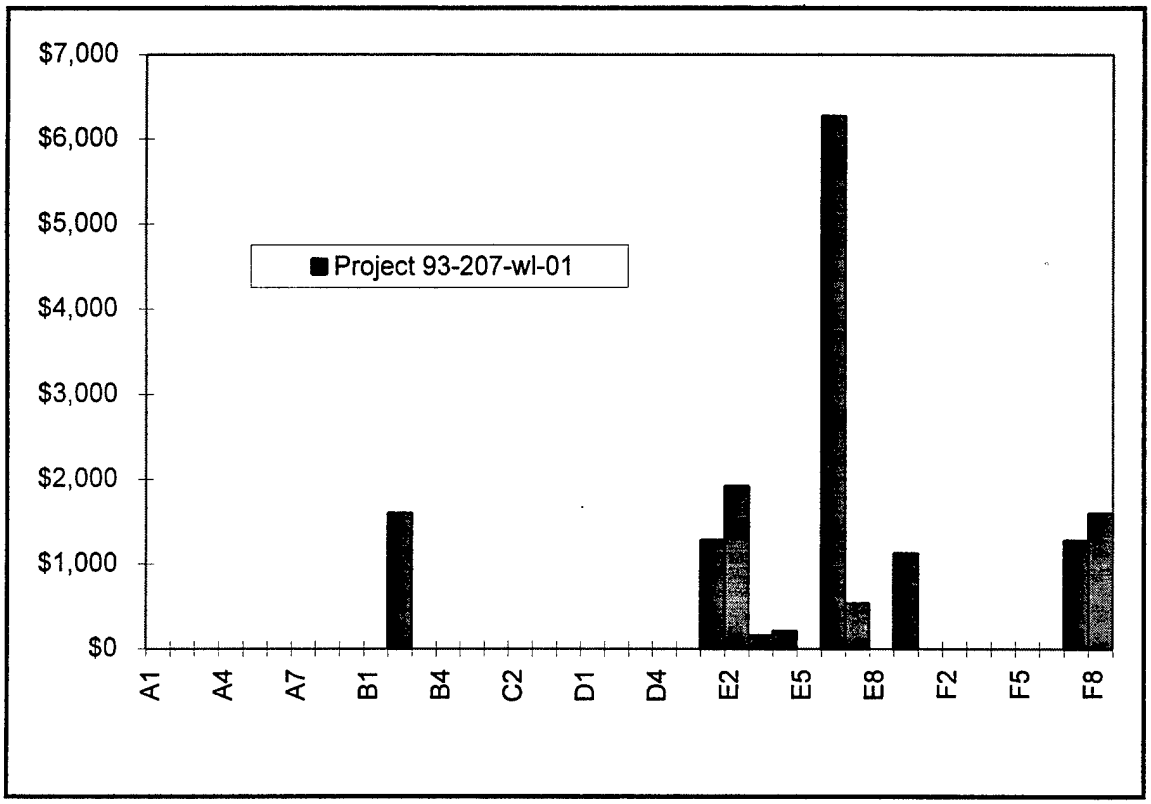

Figure 4-16. Project 93-207 Sub-Step Cost

Figure 4-16, Project 93-207 Sub-Step Cost, shows the cost of performing the *transfer* sub-step (E6) compared to all other activities, is the lowest at about a 0.6 to 1, but remains consistent in that the transfer activity is much greater than any of the others. Figure 4-17, Project 93-207 Spend Rate, is again consistent with the previously discussed CRDAs appearing both linear and fairly consistent.

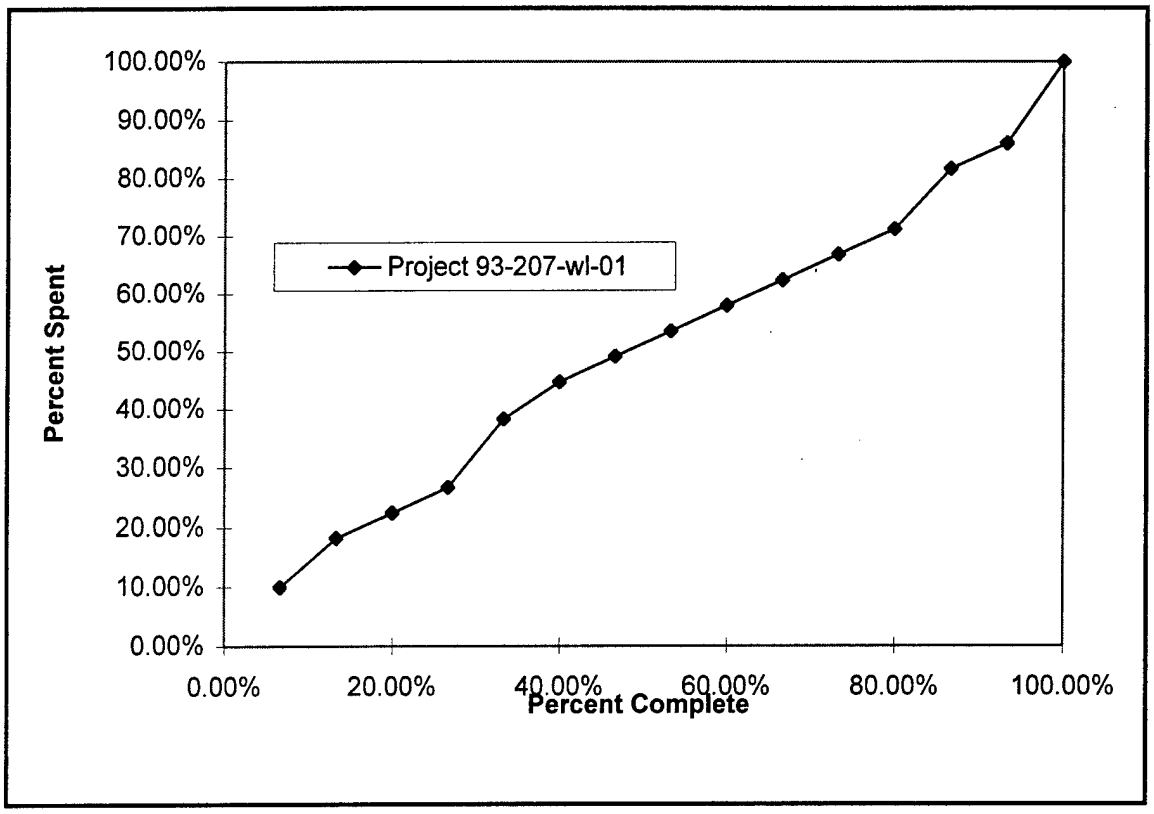

Figure 4-17. Project 93-207 Spend Rate

Project 93-221-wl-01, Compressor Casing Treatments. The objective of this product-type CRDA, the shortest of the eight projects investigated in-depth, was to test the effects of two new advanced tip treatment designs on compressor efficiency and stall margin. At the time, the Compressor Research Facility (CRF) was already involved in testing the Augmented Damping Low Aspect Ratio Fan two stage compressor. This agreement, accounting for the expenditure of $17,603 added a small amount of testing to an active test plan to assess the value of these new tip treatments. If these treatments proved to increase the stall margin while minimally impacting efficiency, the government would have the right to use these new treatments for government use without the cost of royalties. Equipment and travel accounted for none of the project's resources.

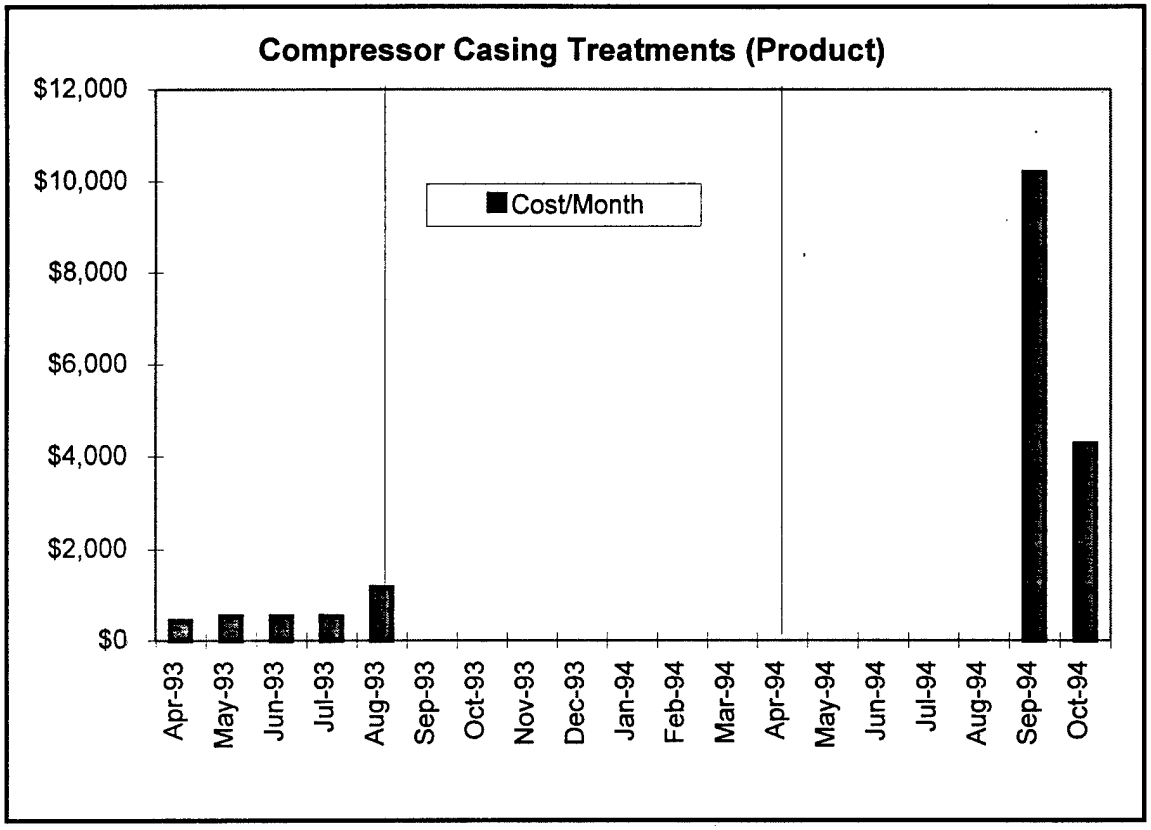

Figure 4-18. Project 93-221 Cost/Month

It may be noted that this CRDA, with very little technical interchange and mostly the joint use of the CRF, is very similar to Project 93-208 which was categorized as the only facility-use type transfer agreement of the eight studied. However, this transfer, Project 221, was initiated anticipating positive results and the right for government use of new tip treatments, whereas Project 93-208's goal was strictly for the generation of test data.

Because of the nature of this type of testing, the cost-over-time curve, Figure 4-18, Project 93-221 Cost/Month, for this effort proved to be quite unique. The small effort at the beginning was expended in order to formalize the agreement. Once in place, no additional effort was required until just prior to the scheduled testing of the compressor, thus yielding a $927 per month average cost. Originally scheduled for April 1994 and

coinciding with the expiration of the agreement, tests were delayed and not actually performed until early-to-mid September 1994, beyond the expiration. This test effort is represented by the large spike in the cost-over-time.

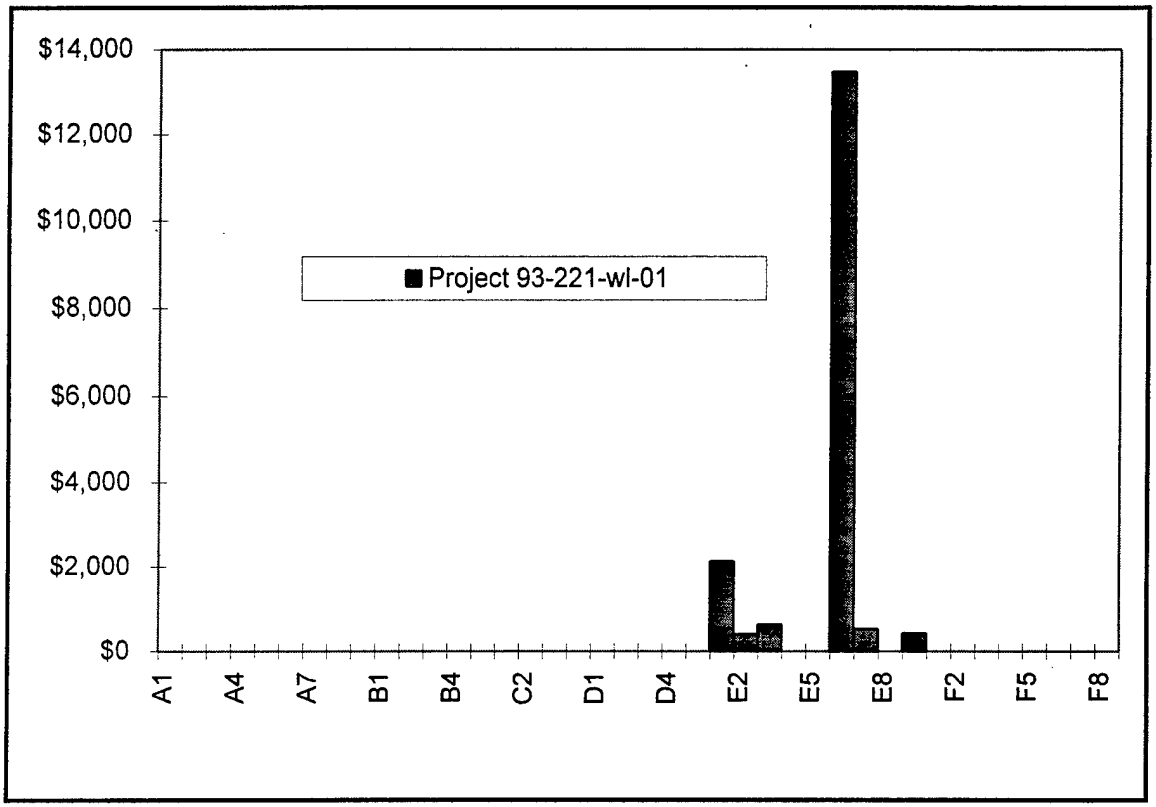

Figure 4-19. Project 93-221 Sub-Step Cost

Although supporting the trends of activity both before signature and after expiration and the *transfer* sub-step accounting for the *lion's share* of the total resources, it doesn't follow the trend in average cost per month but is usual in that it was not consistently pursued. Resources were expended to achieve an agreement that went *dormant* until only one month prior to the scheduled test. Due to this dormancy, the project's spend rate shown in Figure 4-20, Spend Rate, is inconsistent with the other seven projects. However, up until just beyond the 25 percent completion rate, the curve is consistent.

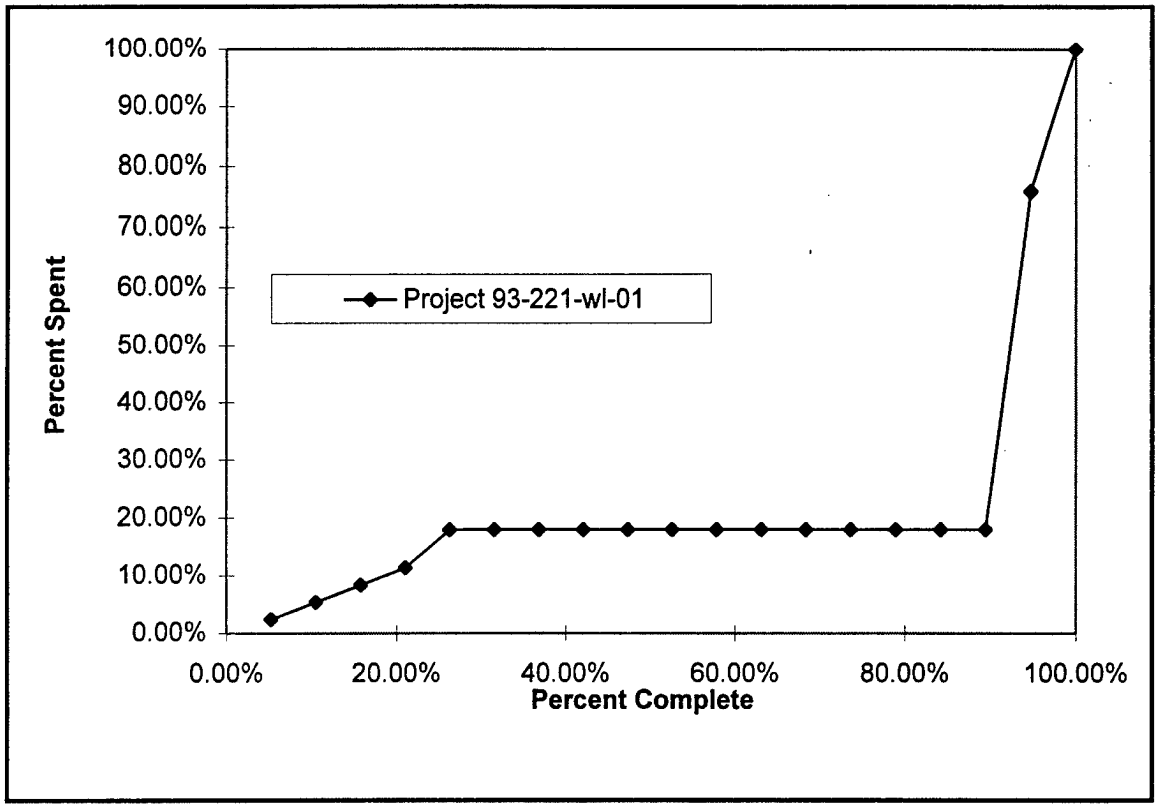

Figure 4-20. Project 93-221 Spend Rate

Project 94-173-wl-02, Aviation Simulation Software. The last of the *WTN-created* CRDAs, Project 93-173 expended $25,382 worth of human resources; no equipment or travel was identified during the interviews. Its purpose was to develop simulation software that could be used in design efforts Air Force-wide as an aid in the development of new military aircraft controls. With access to the source code developed by the collaborator, WL personnel were given permission to modify this code thus creating a software development tool.

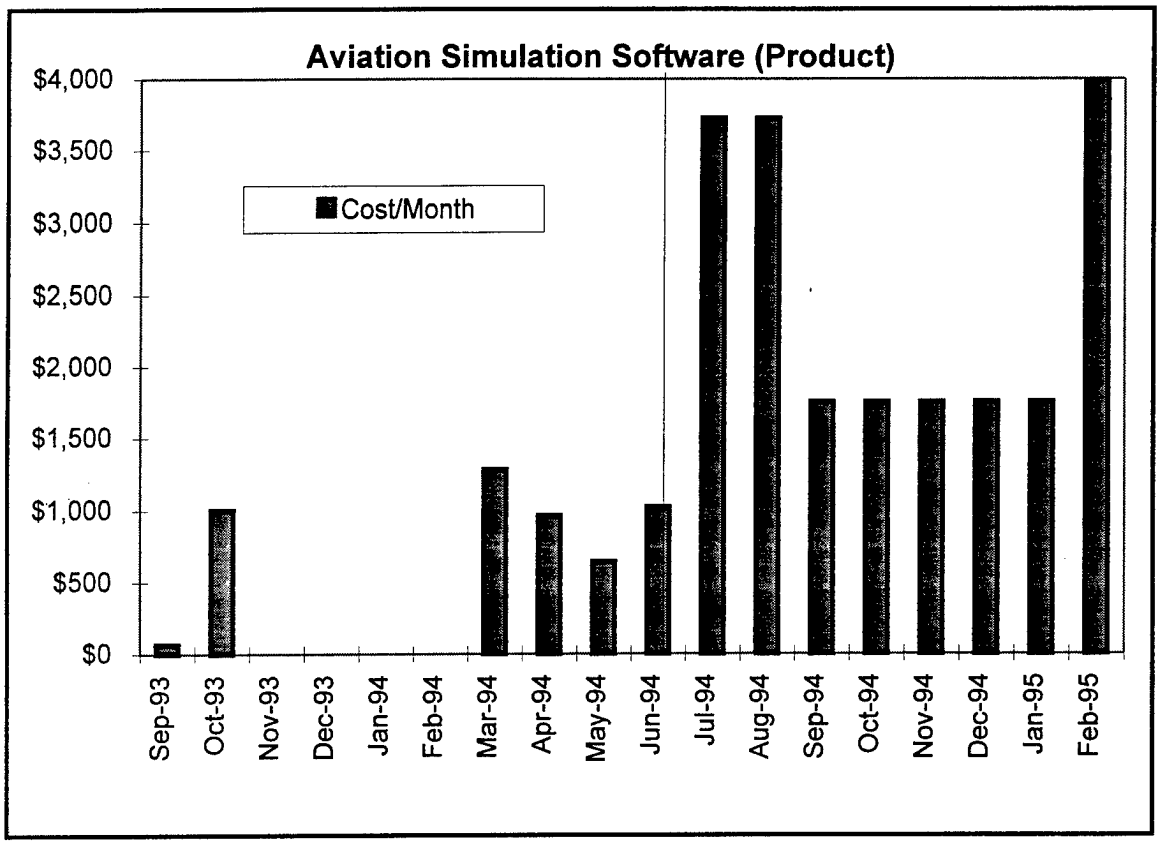

Figure 4-21. Project 94-173 Cost/Month

This project, as did Project 93-207, completed the work prior to the expiration, thus only one time-line appears on the workbook and in Figure 4-21, Project 94-173 Cost/Month. Note that this transfer is also atypical in that the cost per month is higher than most others at about $1,410 each month. Additionally, note that the spikes in monthly costs are usually before the signature (and close-out) and not after. This variation is explained since the agreement was facilitated by WTN and, once given the go ahead, great activity was begun in the modifying the computer source code.

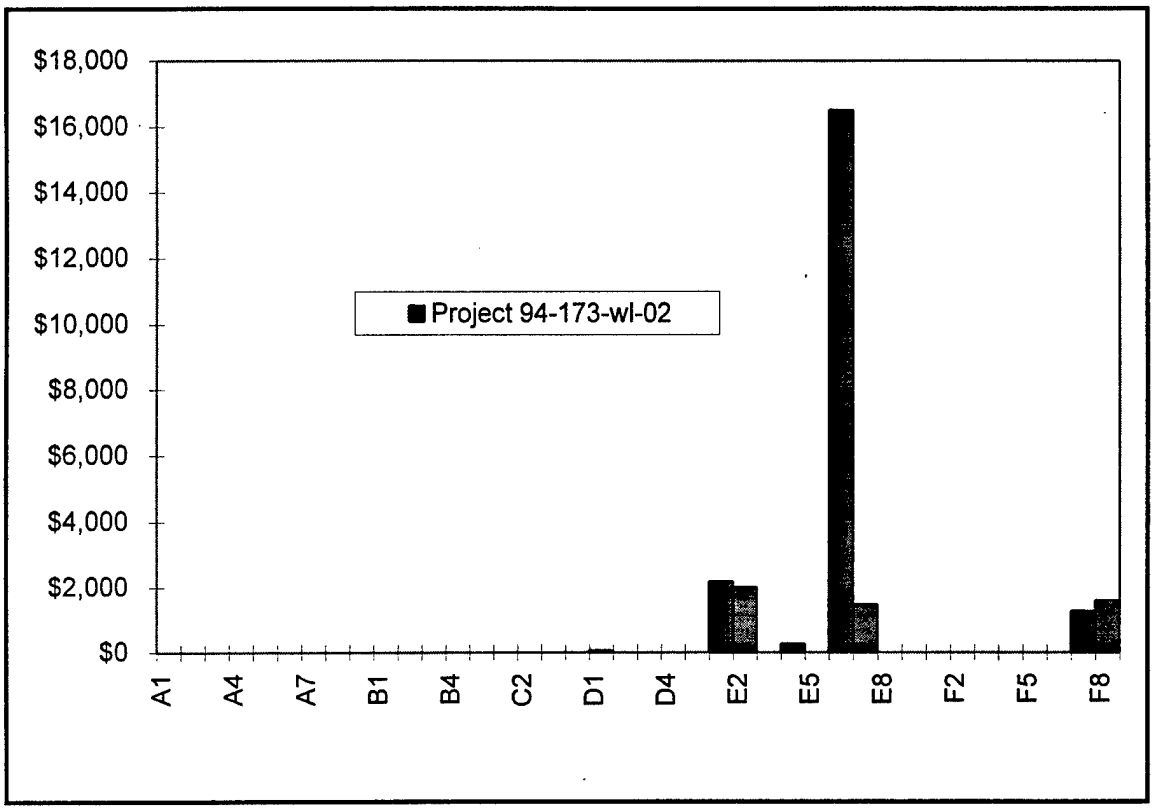

Figure 4-22. Project 94-173 Sub-Step Cost

Figure 4-22, Project 94-173 Sub-Step Cost, indicates the *transfer* sub-step (E6) again is the primary resource driver, consuming about twice all other activities combined. Figure 4-23, Project 94-173 Spend Rate, indicates a slow spend rate for the first half of the project, attributable to a lengthy period for formalizing the agreement, finally pushed through with help from WTN, but then a more usual spend rate, with respect to the previous projects in this study, develops during the balance of the effort following signature.

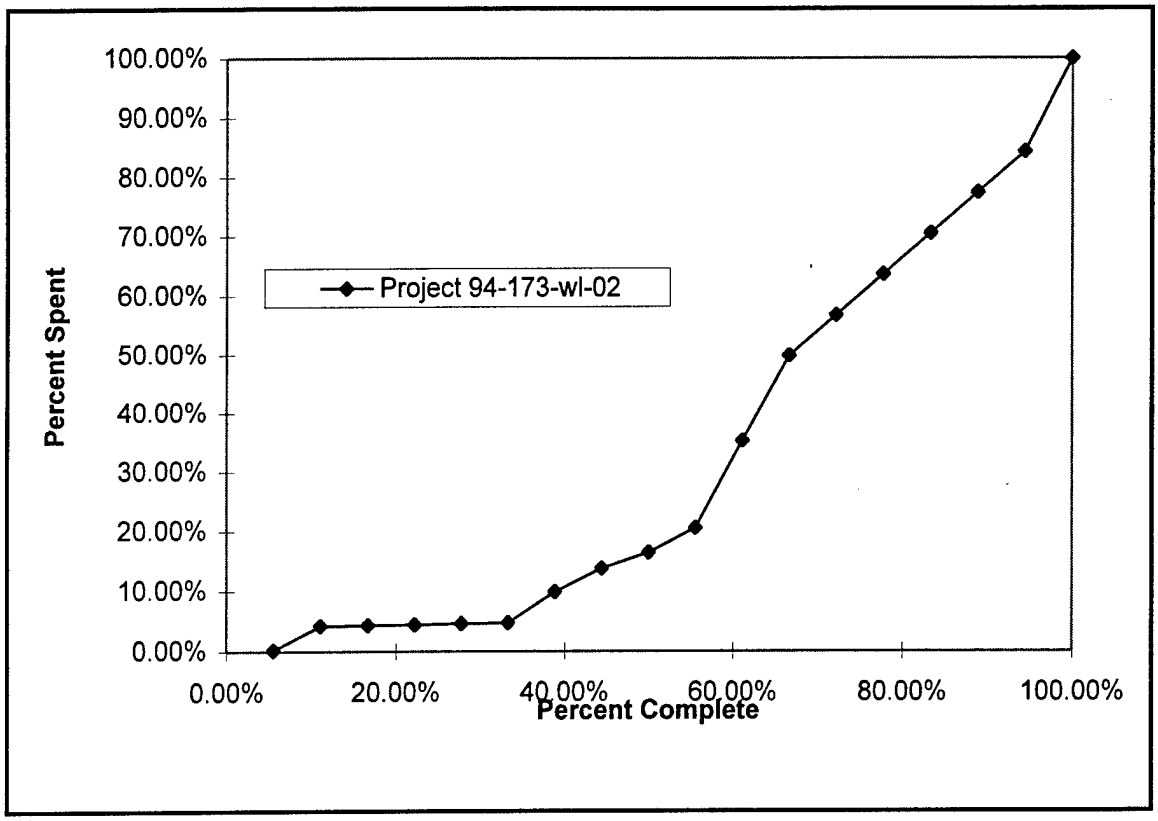

Figure 4-23. Project 94-173 Spend Rate

Project 94-047-wl-01, In-Flight Mission Planner. Through modification of the mission planner portion of an existing air-to-air route planner, a decision support system would be incorporated to provide an on-board in-flight mission planning capability for both commercial and military airlifters. The most costly of the eight CRDAs studied, totaling $189,100, it is also one of the more interesting, identifying training as a factor to be accounted as a direct resource (the same as travel), as well as the idea that direct resources consumed in support of a technology transfer agreement are actually attributed to both pure technology transfer and cooperative research.

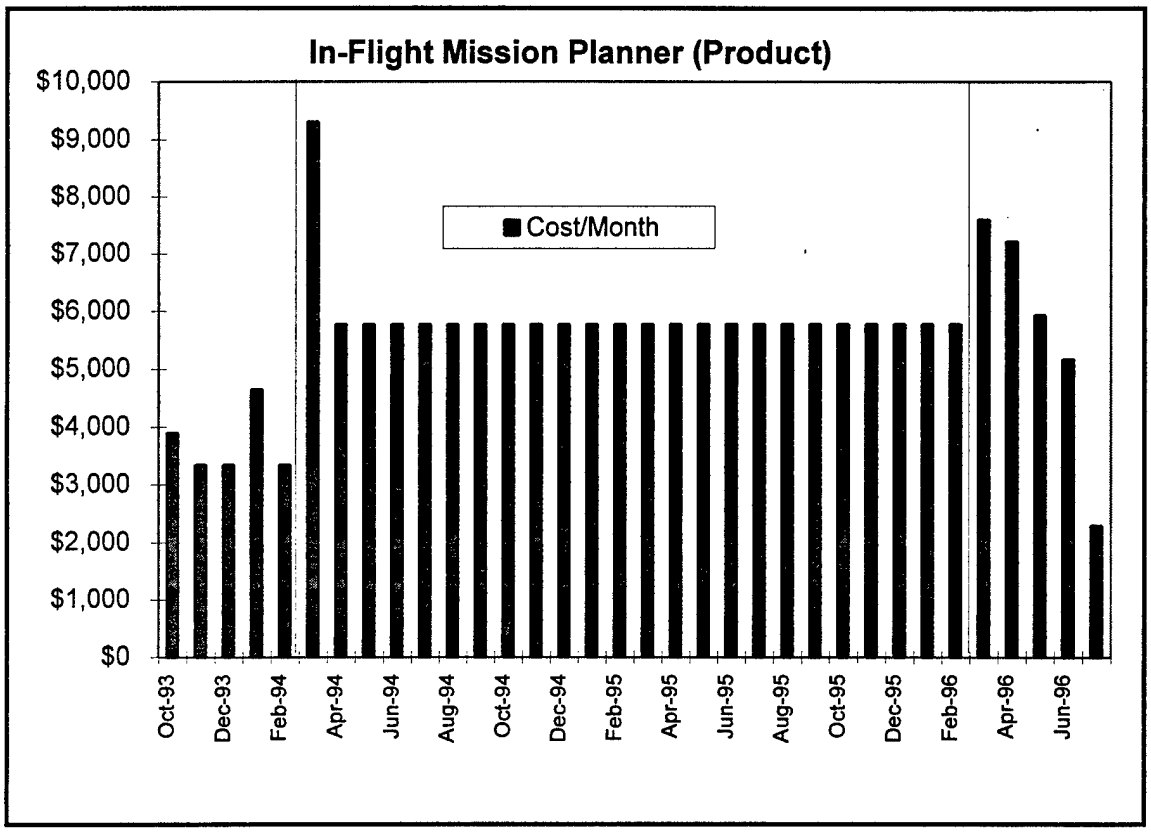

Figure 4-24. Project 94-047 Cost/Month

The first item of note is that during the interview of the lead S&E on this effort, the cost of training personnel involved on the project was identified. Although *generic* questions were included in the questionnaire in order to probe for unanticipated activities requiring resources, training was not identified in any of the other case studies. Specific questions addressing the cost of training project personnel were not included in the questionnaire developed for the interviews. This does not mean that training resources were not utilized in any of the other projects however, it simply means that it was not identified except by this one S&E.

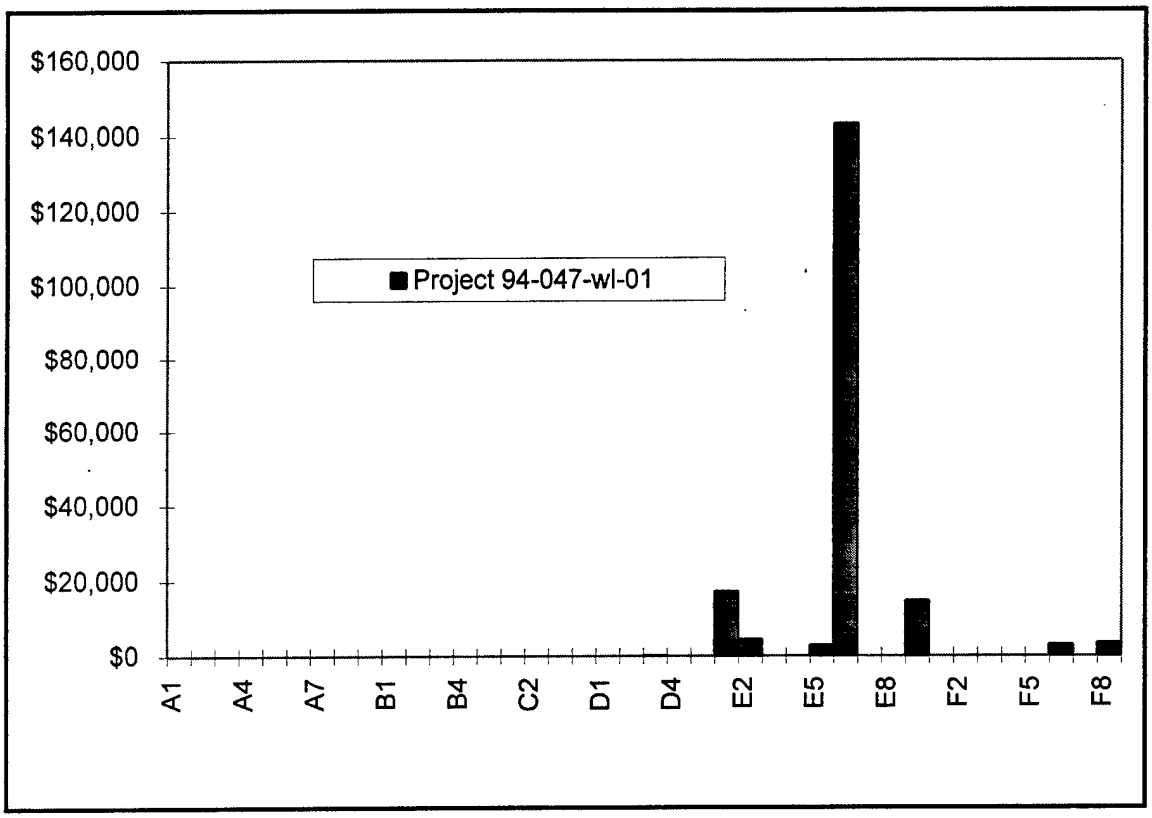

Figure 4-25. Project 94-047 Sub-Step Cost

In order to accommodate the inclusion of training in the workbook for this project in Appendix D, the basic format of Sheet 1 had to be modified, adding a *boxed* section above Row 8 in the header section. Month-by-month details of the expenditures for training were not known and therefore, as usual, a level expenditure was estimated.

Month-by-month detail regarding both equipment and travel was also not known but was estimated to have expended $40,000 for each over the life of the project; again, consistently applied. The S&E's records showed approximately $20,000 per year for each of the two years was used for travel to the collaborator's facility. Details regarding business trips made for specific events such as the formal review to conclude the effort, when known, are included in the project's workbook in Appendix D.

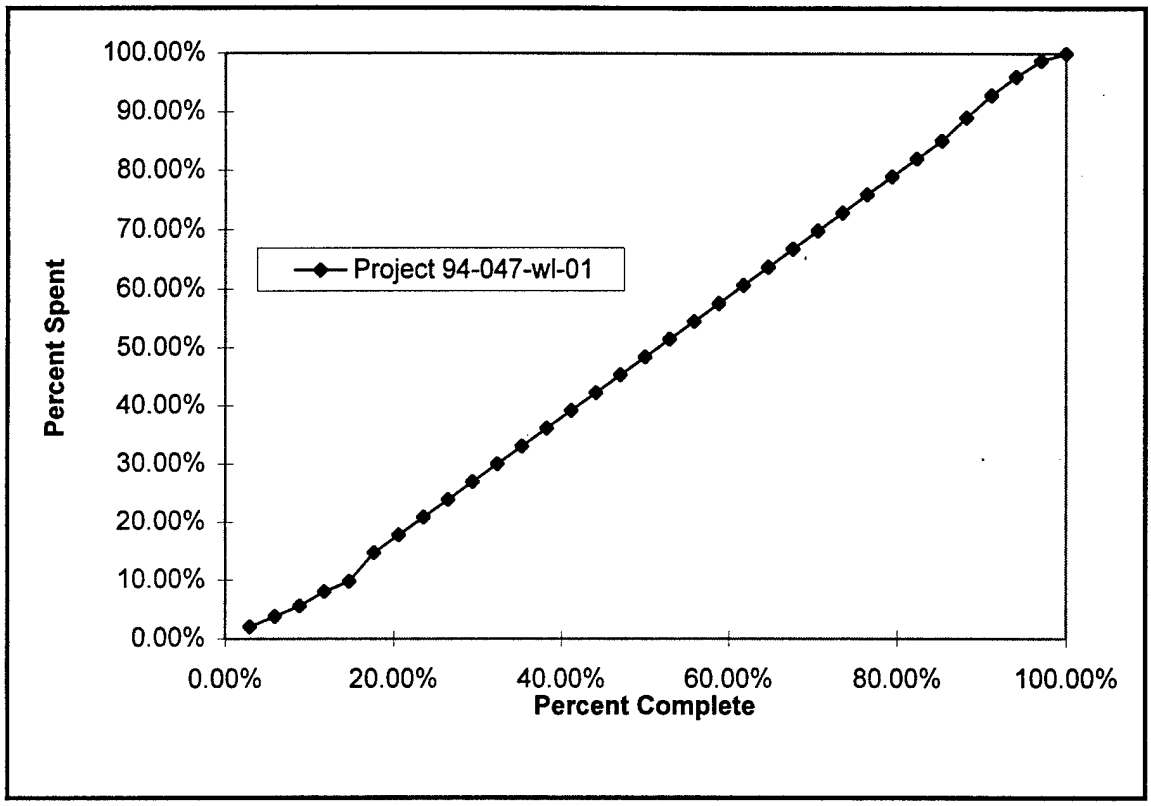

Figure 4-26. Project 94-047 Spend Rate

It may be observed that a large effort was expended by legal for the *close-out* sub-step E9 (Cell 3B49), and broken out in cells 3AG49 through 3AI49. This expenditure of $8,621 was attributed to settlement of difficulties regarding final disposition instructions for the $40,000 of equipment purchased.

All tolled, the above results in the highest cost per month of the cases studied at about $5,560. Shown, in Figure 4-24, Project 94-047 Cost/Month, as a very consistent level throughout most of the transfer's life, the cost per month would be much less consistent if more detail was known regarding the period of expenditure vice only totals applied evenly over the period as is the case for nearly all the resources for this transfer. This also results in a very linear spend rate in Figure 4-26, Project 94-047 Spend Rate.

Figure 4-25, Project 94-047 Sub-Step Cost, shows *transfer* sub-step E6 accounting for over $143,000, 3.1 times all other activities totaling about $46,000 combined.

In the next section, in addition to the analysis of the eight projects individually, analysis is completed comparing each to the whole, or *composite*. The composite is a summation of all of the data from each of the eight products. As in the previous paragraph, projects are also grouped according to transfer type (product, facility, or process) and compared with the composite. However, as discussed earlier, the hours expended by the Test Technicians ($591,163) for Project 93-208 are excluded from the composite.

Analysis

Before getting into the details, some general trends, noted with respect to the final eight projects investigated during this effort, are of interest. First, the oldest CRDAs dated back to August of 1993. The average *formal life*, defined as the time from signature to expiration, for these eight transfers was 15 months; the shortest 8 months, and a tie for the longest with two being 24 months. The most recent expiration date was in September 1995. All eight projects investigated were CRDAs, including three transfers with collaborators in Ohio and the others in California (2), Georgia, New York, and Tennessee. Interestingly, considering WTN's charter as discussed previously, only two of the four CRDAs they helped create were with firms in Ohio. The other two collaborators were from California and New York. Regarding the S&Es, only two of the eight were military with the remaining six being government civilians, usually possessing a doctorate, employed by the laboratories.

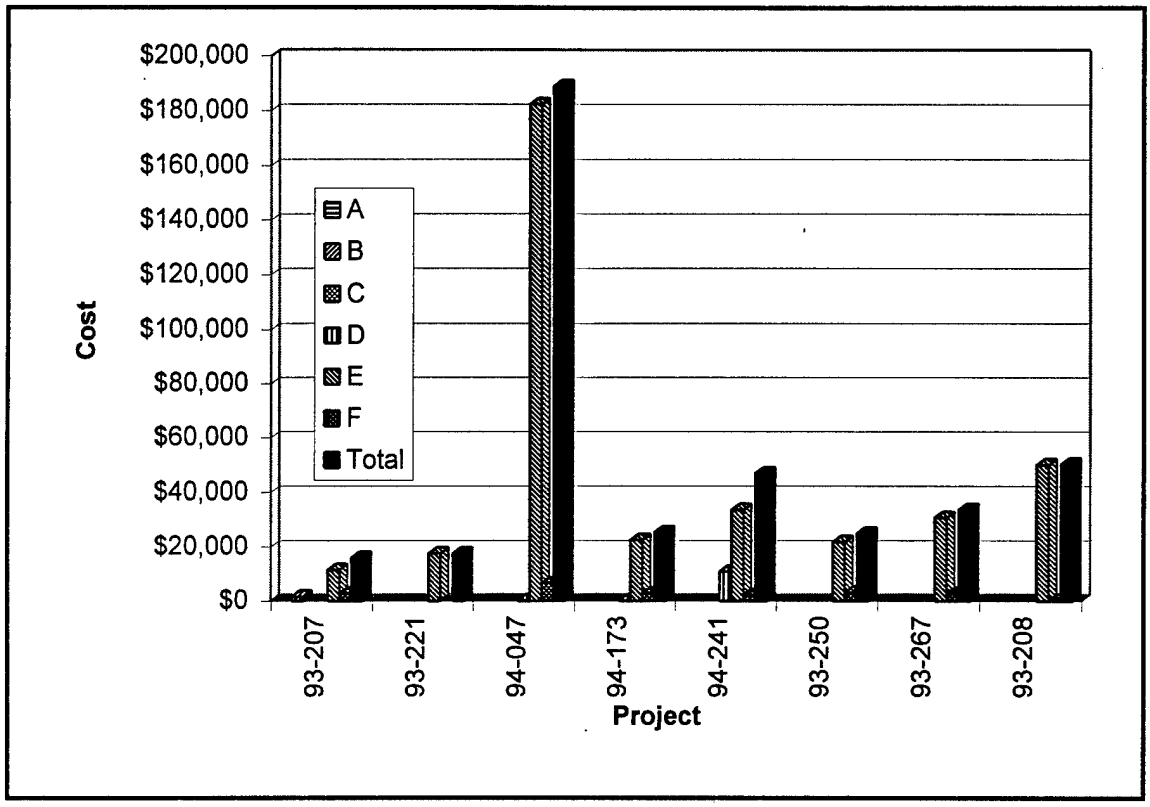

Figure 4-27. Project Comparison

As a summary for the eight projects discussed previously, Figure 4-27, Project Comparison, shows the direct resource total, represented by a solid black bar, for each project relative to each other. Beginning on the left and proceeding to the right, the first five projects (9-207, 9-221, 94-047, 94-173, and 94-241) are product-type transfers, the next two are process-type (93-250 and 93-267) with the lone facility-type transfer (93-208) on the far right. Additionally, each of the totals are broken out by TMP major step and are represented by bars of various patterns. What becomes evident, from this *macro* point of view is that, for all projects, the main resource driver is major step E, *Transfer*, with all other steps, with few exception, being difficult to even distinguish. Additionally, Figure 4-28, Summary by Major Step, breaks the TMP out by major steps but irrespective of project. Again, the dominance of the *Transfer* step (E), with most of the pie, is evident.

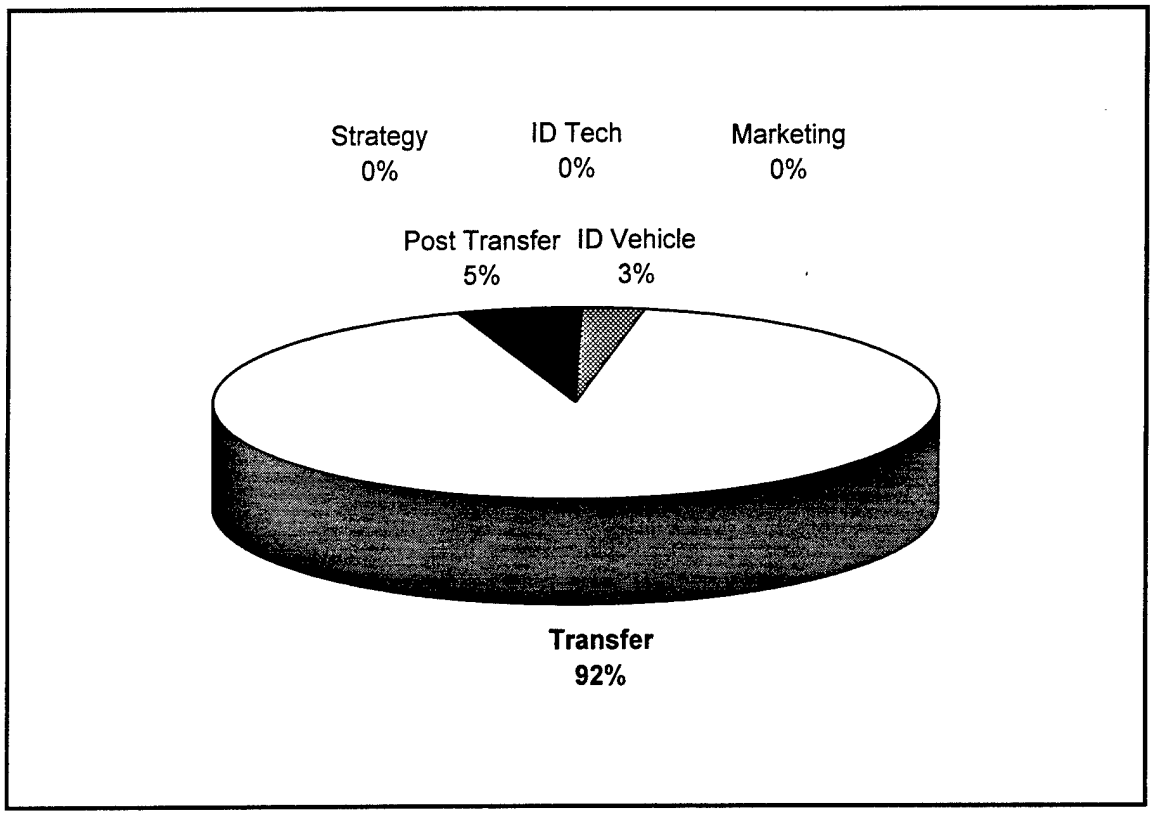

Figure 4-28. Summary by Major Step

The First Three Steps. Referring again to Figure 4-28, Summary by Major Step, the first result is evident. The first three major steps in AFMC's transfer master process, all combined, accounted for less than one percent of the total direct resources expended over the *lives* of all eight TT projects investigated. More specifically, only one incidence of resource expenditure was noted in any of the cases during this entire research effort; a small market survey conducted by WTN for Project 93-207 costing only $1,600, less than 0.5 percent of the total direct resources consumed by all projects. This market survey was categorized as an evaluation of the technology and accounted for in sub-step *evaluate technology assets* (B2). Breaking out the entire 40-step TMP by activity, Figure 4-29, Activity Analysis, confirms both the dearth of resources expended in the first three steps as well as the vast majority of resources being confined to the *Transfer* major step. Additionally, Figure 4-29 shows that, despite the poor resolution afforded while looking

at the whole picture, this pattern is consistent across all four groups; the three different transfer types as well as for the composite. Therefore, the last three steps in the process, *ID Vehicle* (D), *Transfer* (E), and *Post-Transfer* (F), accounting for about 99.9 percent of the total, are due attention.

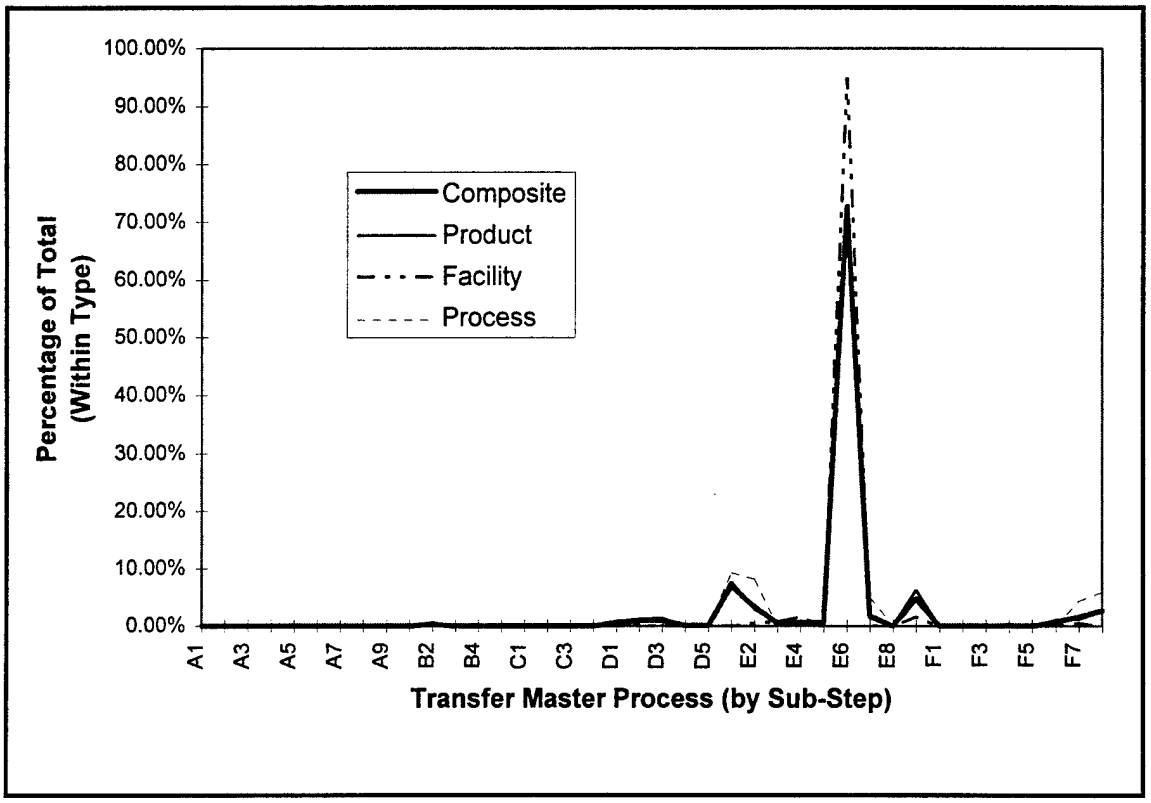

Figure 4-29. Activity Analysis

The Last Three Steps. As stated at the close of the previous section, when excluding the skewing effects of the Test Technicians from Project 93-208, Figure 4-28 shows that *Transfer* major step (E) accounted for about 92 percent of the total direct resources expended by all of the eight projects for each of the TMP's six major steps. This equates to $370,237 of the total $403,899, leaving the remaining for the *Identify Vehicle* step (D), consuming $11,166 (less than 3 percent), and the *Post-Transfer* step (F),

accounting for $20,896 (just over 5 percent). Considering this, and the confirmation by Figure 4-29, the *Transfer* major step (E) deserves more attention and is broken out by transfer type, for better resolution, in Figure 4-30, Transfer Step Analysis. Referring to Table 4-3 above the chart, of the total $370,237 spent in *Transfer* step (E), $267,649 was spent by the five projects of the product-type, $50,050 by the lone facility-type, and $52,538 by the two the process-type transfers. Continuing to focus more closely on the

Table 4-3. Figure 4-30 Source Data

	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH
12	Figure 4-30		Relative Percentage of Sub-Step - Transfer							
13		Composite		Product		Facility		Process		
14	E1	$28,455	7.69%	$23,000	8.59%	$0	0.00%	$5,455	10.38%	E1
15	E2	$13,759	3.72%	$8,736	3.26%	$241	0.48%	$4,782	9.10%	E2
16	E3	$2,266	0.61%	$1,864	0.70%	$402	0.80%	$0	0.00%	E3
17	E4	$2,361	0.64%	$1,011	0.38%	$798	1.59%	$552	1.05%	E4
18	E5	$2,780	0.75%	$2,780	1.04%	$0	0.00%	$0	0.00%	E5
19	E6	$293,846	79.37%	$207,253	77.43%	$47,804	95.51%	$38,789	73.83%	E6
20	E7	$7,399	2.00%	$4,439	1.66%	$0	0.00%	$2,960	5.63%	E7
21	E8	$0	0.00%	$0	0.00%	$0	0.00%	$0	0.00%	E8
22	E9	$19,371	5.23%	$18,566	6.94%	$805	1.61%	$0	0.00%	E9
23		$370,237		$267,649	100%	$50,050	100%	$52,538	100%	
24		91.67%								

five product-type transfers within the *Transfer* step (E), it can be seen that the *transfer* sub-step (E6) accounts for the expenditure of $207,253 (about 77 percent) of the $267,649 spent. This is graphically displayed in the chart as the light dotted bar in sub-step E6. As can be seen, the relative percentages are fairly consistent with the other two types, facility and process being 95.5 percent and about 74 percent respectively. Additionally, considering the composite of the eight projects, 79 percent was dedicated to the *transfer* sub-step. Finally, Figure 4-30 also shows the other eight sub-steps in the *Transfer* step (E), regardless of the transfer type, at or below 10 percent.

Further analysis of the relationship of the *transfer* sub-step (E6) to all 40 others in the TMP, showed that, besides one *outlier*, Project 93-208 at nearly 19-to-1, the ratios of step E6 to all 40 other sub-steps for the other 7 projects ranged from a low of 0.6-to-1 to a

high of 3.3-to-1. Including all projects the average ratio was 2.7-to-1 and excluding Project 93-208, the ratio fell to 2.3-to-1. A ratio of 2.3 to 1, when converted to a percentage, is equivalent to sub-step E6 accounting for about 70-75 percent of the entire project's total cost.

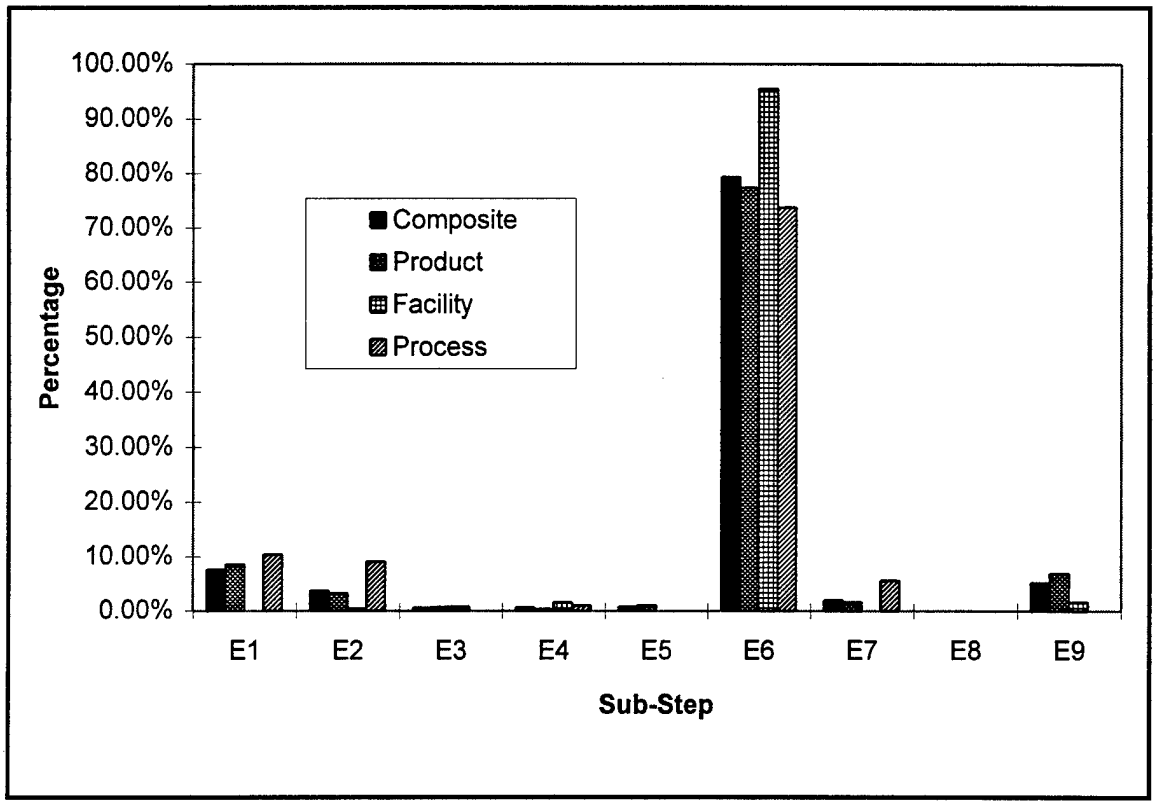

Figure 4-30. Transfer Step Analysis

Transfer Role. While it's important for planning purposes to be able to predict how much something will cost and how the funds will be spent (on which activities for example), it is also important to understand the types of input needed. Figure 4-31, Summary by Transfer Role, is a graphic display of, with respect to the total resources expended across all projects, the relative percentage of resources types consumed in the TT process. Again, excluding technician hours identified in Project 93-208, S&Es

accounted for about 58 percent of the total direct resources consumed to conduct a technology transfer. Four other transfer roles identified in this study (Legal, Technicians, TFP, and WTN) accounted for just under three percent to just over seven percent. Hours spent supervising technicians for Projects 93-250 and 93-267 were negligible totaling only 0.2 percent. All combined, the hours expended by all of the participants in the TT process, totaled just over 79 percent of the total direct resources. This is a confirmation that TT is a *high body-contact* process. The remaining twenty percent can be categorized into either travel, accounting for just over ten percent, equipment at just under nine percent, or lastly, training which consumed only about one percent of the total direct resources.

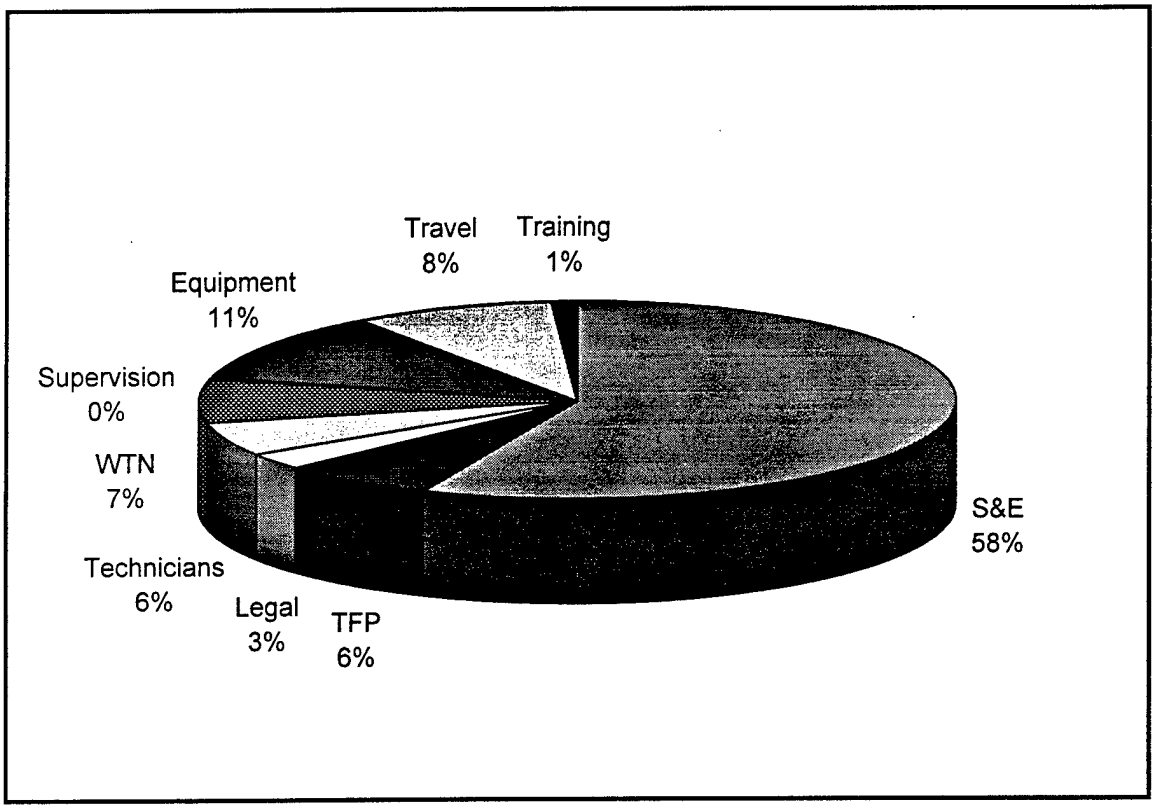

Figure 4-31. Summary by Transfer Role

Typically viewed as important to the continued growth and productivity of a unit's personnel, training was overlooked by the researcher as a potential expenditure. Not intended at the start, no specific questions were developed or included to quantify the resources expended in this category. Not until one of the last interviews was training identified as a consumer of project resources. Therefore, with more attention, training's relative share of TT's direct resources may increase. However, although this is only a single data point, training accounted for less than 3 percent with respect to the total expended for the project *in which it was identified.* Therefore, it is not expected to be a major contributor to the cost of other projects.

Another aspect of this study is that these results indicate, although the transfer master process was originally written from the viewpoint of the transfer focal point, the TFP accounted for only about six percent of the total direct resources and also directly performed only one of these activities; sub-step Coordinate w/Appropriate Players (E2). This finding excludes the resources consumed by the TFP for Project 94-047, since he was not the designated TFP for the WL directorate. As the supervisor of the S&E, more direct and intimate interaction is expected from this *TFP*, merely acting in a similar capacity, than would be expected from the actual TFP in a directorate. This, however, is not to say that TFPs are not an important participant in the TT process or that they do not perform these activities, but does indicate that if they do, they do so almost exclusively overseeing many projects simultaneously. Therefore, these resources would have to be accumulated at the directorate level and then allocated to the individual transfer efforts as project *overhead.*

Finally, in addition to accounting for the most direct resources, the S&E also directly performed the broadest range of activities. S&E activity was identified in fourteen of the forty sub-steps identified in the TMP. The second most diverse participant, with six, was the Wright Technical Network consultant; a transfer third-party.

With indications as to who is contributing the bulk of the direct resources (as well as who is not) and what they are doing, the next issue is how fast the resources are expended and when over the life of the transfer.

Spend Rate. As a review, Figure 4-32, Spend Rate Comparison, is a composite of all projects' spend rates; their percentage spent versus their percentage complete. It can be see that the consumption of resources for six of eight project's was nearly linear over

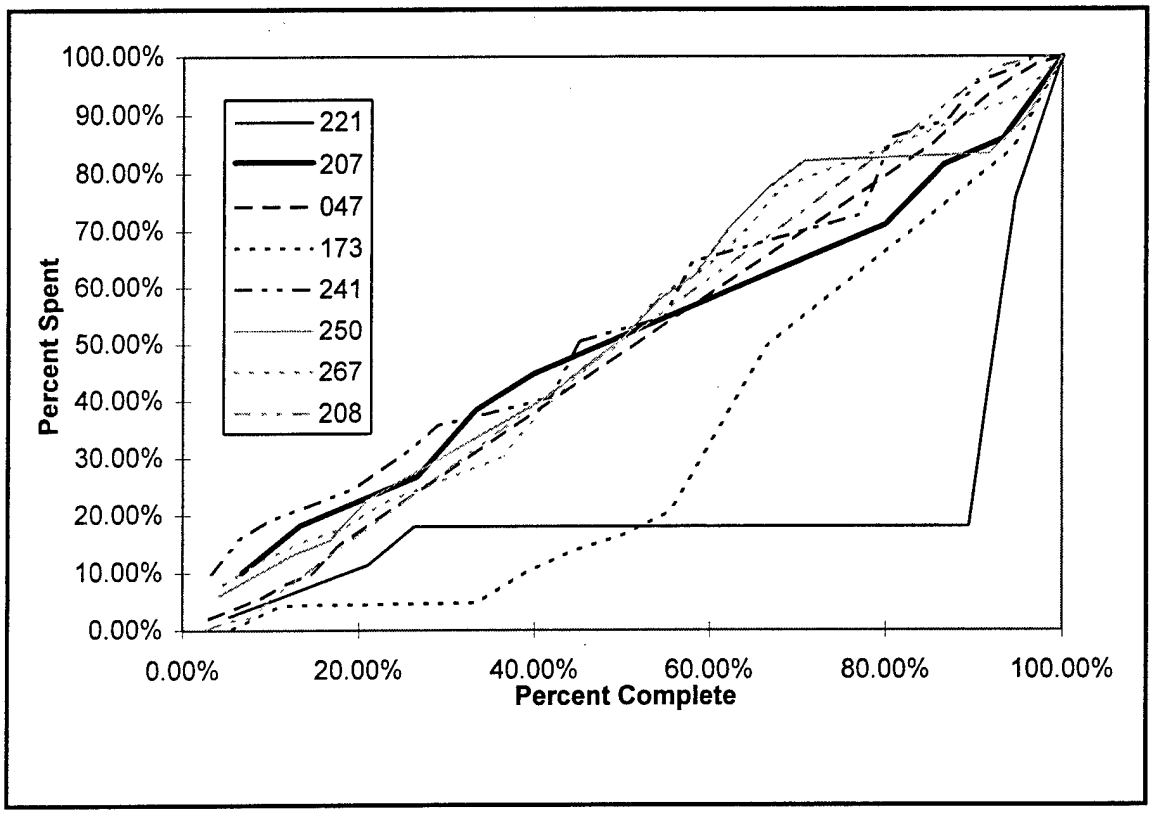

Figure 4-32. Spend Rate Comparison

the life of the projects. Additionally, these spend rates are grouped by transfer type and shown as Figure 4-33, Product-Type Spend Rate, and Figure 4-34, Process-Type Spend Rate. A separate figure for the facility-type transfers is not provided since, with only one transfer in the category, Figure 4-8, Project 93-208 Spend Rate is the same figure.

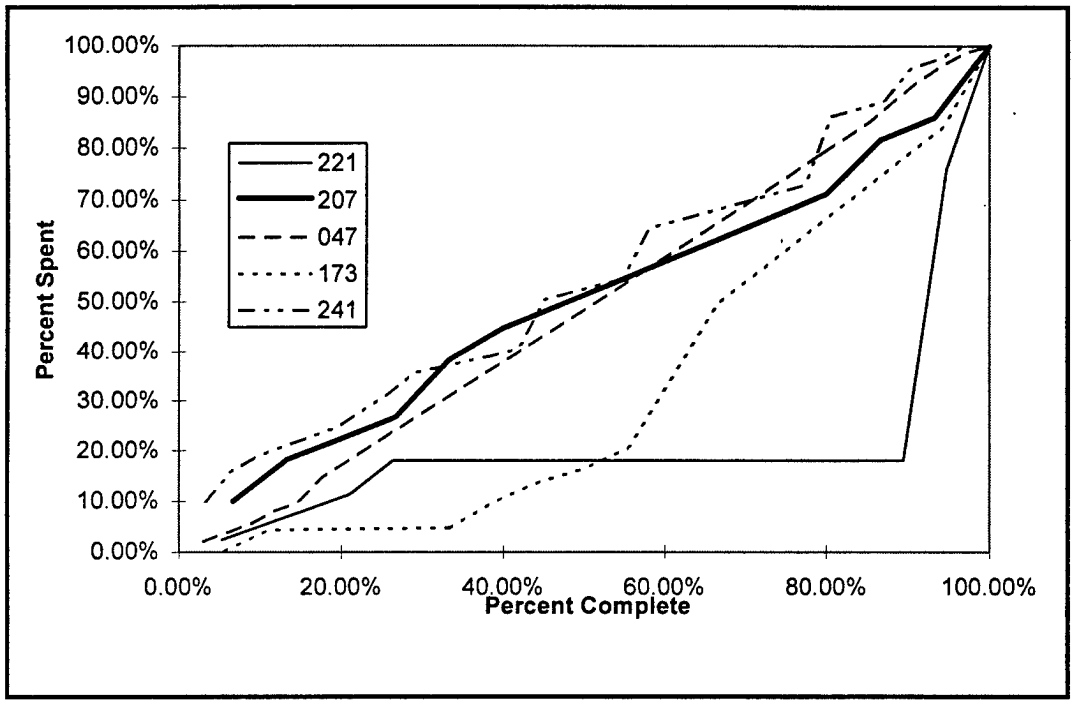

Figure 4-33. Product-Type Spend Rate

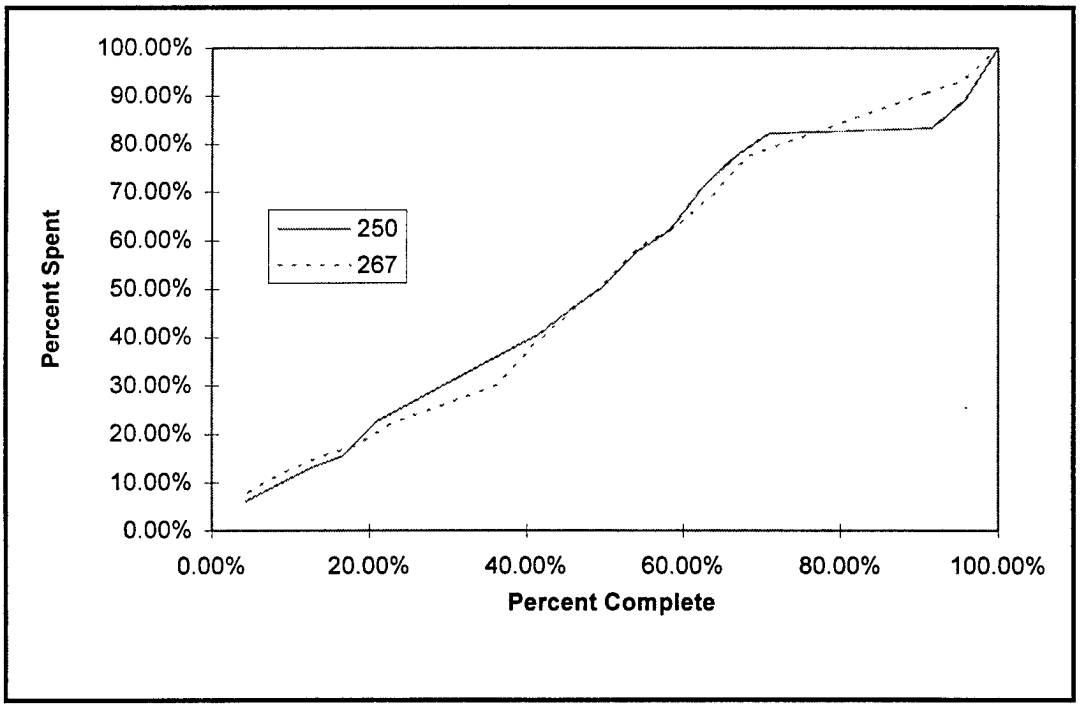

Figure 4-34. Process-Type Spend Rate

For the two outliers, Projects 93-221 and 94-173, unusual spend rates can be explained since both were not consistently pursued. Project 93-221 after signature became dormant until the just prior to the start of test fourteen months later. Likewise, Project 94-173 became inactive, albeit only four months, following some initial work toward an agreement in October 1993 until March 1994 when WTN got involved and successfully completed the agreement. All considered, Figure 4-32 suggests predictability of the resources expenditure rate for TT projects regardless of type.

For an alternate look at expenditure over time, the average cost per month was calculated for each of the projects as mentioned previously in the discussions for each project. Table 4-4, Average Cost/Month shows Project 94-047 to the one outlier. While the other six projects' average cost per month ranged from $927 (Project 93-221) to $1,530 (Project 93-267), Project 94-047's average cost per month was $5,562. Including all eight in a composite average cost per month yielded an even $2,000 per month. Excluding Project 94-047 reduced this amount to $1,279.

Table 4-4. Average Cost/Month

Project	Average Cost/Month
93-207	$1,067
93-221	$927
94-047	$5,562
94-173	$1,410
94-241	$1,513
93-250	$1,038
93-267	$1,530
93-208	$1,291
Composite	$2,000
Composite w/o 94-047	$1,279

Overtime. Another important finding is that a significant amount of resources are expended both prior to the signature as well as following expiration. Termed *lead*, all eight projects began, consuming resources between 3 and 9.5 months earlier than

signature for an average lead of 5.7 months. This equates to an approximate 38 percent lead with respect to the formal life of the project. Understanding that at signature, both parties have agreed to and documented a formal transfer agreement, it can be expected that resources had been expended on all projects prior to this point in the TT project's life. However, not expected is that six of the eight projects continued to consume resources, ranging from just two months to as high as twelve months, following expiration of the formal CRDA. Termed *lag*, the average was over 5 months or 35 percent of the formal length of the CRDA.

The average formal length of a CRDA, defined as the time from signature until expiration, taking into account all eight projects, was just over 15 months. The process and product type transfers averages were about 14 months with the facility-type's one data point (Project 93-208) as the outlier at 24 months. Considering the *actual life* of the projects, from first expenditure until the last, product- and process-types again tie at 23 months while the facility-type lasted 39 months.

TT and Cooperative Research. One final consideration, mentioned previously, is that with respect to the total resources expended in support of a technology transfer, only a portion of the total expenditures can be credited to the transfer of technology with the balance being attributed to cooperative research. Bearing in mind, all transfers investigated in this study utilized the Cooperative Research and Development Agreement as a transfer vehicle, this split is understandable. This was brought to light during an interview on Project 94-047 in which the S&E estimated that of the total resources expended for this project, only about 25 percent could be attributed to the transfer of technology with the remaining 75 percent being cooperative research. This percentage will vary from project to project, as well as from activity to activity and over time within a project. Projects 93-250 and 93-267, for example, approach 100 percent cooperative research since the initial objective of the *transfer* was not for the transfer of information.

Conclusion

Having provided and fully analyzed the data collected for each of the eight transfer projects studied, the final chapter will present a discussion of the implications of these results and provide recommendations and conclusions.

V. Conclusions and Recommendations

Introduction

The objective of this research is to identify trends with respect to the cost of performing a transfer of technology from Wright Laboratories to the commercial sector. This chapter will first review the results of the data analysis presented in Chapter Four, as well as the limitations of this study. Next, a discussion of the implications of these findings is provided as well as the resulting recommendations. Finally, future studies will be proposed in order to continue this research.

Results Review

The following are the major findings resulting from the data gathered via personal interviews with personnel directly involved in the eight technology transfer projects studied. These projects, managed by personnel at Wright Laboratories, had been completed within the last two years and involved projects of all three transfer types including product (or hardware), process, and facility. Subsequent to these interviews, analysis performed on these data revealed the following.

1) Activities or sub-steps in the first three major steps in the transfer master process, *Strategy* (A), *ID Tech* (B), as well as *Market* (C), with one small exception, accounted for less than one percent of the total resources expended in the performance of the eight transfers studied.
2) Similarly, transfer master process steps *ID Vehicle* (D) and *Post-Transfer* (F) accounted for only about eight percent of the total resources expended in all eight of the projects investigated leaving major step *Transfer* (E) accountable for nearly 92 percent of the total. More specifically, sub-step *transfer* (E6), consumed over 79 percent alone.

3) With respect to these resources, the scientific and engineering (S&E), personnel directly expended about 58 percent of the total. When combined with the other human resources contributing directly to the transfer projects (Wright Technology Network, transfer focal point, technicians, and legal), the human resources input to the total climbed to 80 percent. Additionally, the S&E also performs the widest range of tasks (fourteen of the forty in the master process), while the transfer focal point, for whom the master process was written, directly performed only one of the forty contributing only about six percent of the total resources expended.

4) The spend rate or consumption rate, a plot of the relationship between the percent complete and the percent spent over the life of a transfer, for six of the eight transfer projects examined was linear and fairly consistent over their life. Two projects, not consistently pursued, had more erratic consumption patterns. Also, the average cost per month for all eight of the projects equaled approximately $2,000 conservatively (including one outlier) or about $1,300 considering seven of the eight.

5) Direct resources were consumed by all projects prior to the signature, officially authorizing the transfer, an average of about 38 percent of the formal life, from signature to expiration, of the project. Additionally, resources were expended after the expiration of the CRDA, for an additional 35 percent of the CRDA's formal life.

Limitations

It is important to understand the limitations of this study before discussion the implications of the above findings.

As stated, in order to examine the entire range of activities in the transfer master process which span from a project's conception until well beyond its close-out, only

projects that had passed formal expiration were studied. Previously discussed, this meant that all projects were initiated as long as three years ago. It is understandable that recollection of specific details regarding a project become less accurate as time progresses.

Additionally, the projects in the original sample of 33, were initiated in the formative years of the TT process resulting in the exclusion of as many as 15 projects. This, combined with many other reasons, including the dynamic environment in the defense industry, and continued down-sizing, resulted in further study of only 8 projects of the original 33 past expiration within Wright Laboratory. This is a small sample size and limits the value of the conclusions drawn.

Next, this study was conducted at one location only investigating transfer projects within Wright Laboratory and only at Wright-Patterson AFB, OH. The impact and applicability of these findings are not as great if not repeated and supported by similar research at other locations as well as outside Wright Laboratory.

Forth, with respect to the relatively old projects investigated, the effects of the passing of time would not be as great if an effective and efficient cost accounting system was in use. While interviews yielded valuable data, detailed accounting data should be better. Throughout this effort, numerous (as well as large) pools of resources had to be *consistently applied* over the time period in question as a result of not knowing details regarding their time-phasing. Perhaps useful in some instances, this type of application results in less-than-accurate information. This method, unless the resources are actually expended consistently, yields cost curves that are more linear and less accurate and useful than they could be.

Additionally, although not deemed to be significant for this research due to the relatively short time period, it is important to note that for future studies, the effects of inflation may be deemed significant thus requiring consideration.

Finally, training was over-looked by the researcher as a potential expenditure and therefore, no specific questions were developed or included to quantify the resources expended in this category. Although *generic* questions were included in the questionnaire in order to probe for unanticipated activities requiring resources, training was not identified until one of the final transfer efforts studied. With more attention, training's share of TT's direct resources may increase. However, considering the relative percentage of resources accountable to training for the one project was less than three percent, training is not expected to become a major resource.

Management Implications/Recommendations

The previous sections have detailed both the major findings of this research as qualified by its limitations. In consideration of the above, this section will discuss the findings of this research in more practical terms.

Two possible explanations are apparent with respect to the finding that the first three major steps in the transfer master process, and including steps D and F, resulted in a combined total of only eight percent of the total direct resources identified for all eight projects. The first possibility is that this these steps are not being accomplished at all requiring more attention to ensure their completion. One possible factor, as discussed, is the relative advanced age of these projects and their initiation prior to formalization, publication, dissemination, and acceptance of the current transfer master process.

Secondly, and the more likely explanation however, is that these steps are accomplished almost exclusively at a *higher level* addressing multiple projects thus, not being captured as a result of a study into the expenditure of direct resources.

The purpose of the TT process is obviously to transfer a technology from the government to the commercial sector. Resources expended conducting other activities may detract from affecting the transfer. The finding that about 92 percent of resources expended were actually spent doing the transfer suggests the process is efficient.

This result is an encouraging indicator that, despite the initiation of these transfers early in the era of TT formalization, WL's transfers are performed using an efficient process. With the goal of effecting a transfer, just over eight percent of the direct resources were expended on non-direct transfer activities. In other words, the S&E, as the primary direct labor category, is being left to do the work while the non-transfer work (overhead) is being accomplished at a higher level. However, as a result of the crude focus of the activities as defined in AFMC's Transfer Master Process (used as the baseline for this research), details regarding exactly what sub-activities WL personnel are performing, within the transfer sub-step E6, are not known. Thus, if more detailed information is desired, further analysis will be required. Nevertheless, these results did yield one lead for future study in an effort to determine the expenditure of these resources. S&Es accounted for the majority of direct resources.

Additionally, the results suggesting the nearly linear fashion of expenditure of resources over the actual life of the project, the trend in the average cost per month over the life of the project, as well as the lead and lag beyond the formal life of the transfer, may be useful in the short-term as rules of thumb for planning and programming future requirements for TT resources.

The actual life of a CRDA is composed of its formal length, from signature until expiration of the CRDA, as well as both lead, before signature, and lag, which follows the expiration of the agreement. When planning or programming resources, not only the CRDA's formal life should be considered. For the projects investigated, the lead averaged over five months and the lag, except in two cases, also averaged about five months.

Another result of this research is a confirmation of a statement oft made, that technology transfer is a high body-contact process. The human element in the eight projects studied accounted for 80 percent of the total. Therefore, the major considerations

are the human resources and, as previously noted, more specifically the S&E, with equipment and travel responsible for nearly all of the balance at 11 percent and 8 percent respectively.

One final implication is that, due to poor visibility into actual resource expenditure, management's abilities to manage and control costs are presently hampered. While this study does provides some insight, it is limited by the factors previously noted, such as personal recollection and degradation over time.

It is generally accepted that government cost accounting systems are effective at accounting for the resource totals. It is also generally accepted that they are not effective at providing details of time-phasing (usually only by fiscal year) or how these resources were spent (usually only tracked to the program level and by money type or *color*). The accounting system presently employed by Wright Laboratory, as with most government organizations, is limited to the basic accounting of employee hours. Although a new accounting system, called JOCAS (Job Order Cost Accounting System) is presently being implemented to account for employee hours by project and month, it is not yet fully operational. Considering this, as well as understanding that the programs investigated for this effort had passed expiration prior to introduction of JOCAS, reliable historical data did not exist, thus this new accounting system was not pertinent to this research nor was it evaluated.

However, a system employed by the government contractors in Projects 93-250 and 93-267, in order to track costs that should be billed to the government, should be used as a model for an effective system. Within minutes of request, the manager for the government contractor was able to, from the computer at his desk, provide detailed information regarding his technician's hours spent, the dates of expenditure, and also the work order of task that consumed the resources. Using this, future researchers and

managers could gain valuable insight into the cost patterns of managing technology of transfer actions.

Future Studies

Further investigation should be made into the issue regarding whether the first three major steps in the TMP are being done at all and if so by whom. As stated, it is expected that these activities are being accomplished, but indirectly applied via either the TFP or the ORTA and not directly by the S&E. Recommend research into capturing and characterizing the actual activities performed by the TFP and the ORTA as well as investigating how these costs should be traced to the individual projects. If these steps are in fact not being done, then determine why they are not and devise and propose a new transfer master process that better reflects the *real world.*

In order to overcome one of the limitations of this effort, it is important to expand this study to include other laboratories such as Rome Laboratory, Phillips Laboratory, or Armstrong. This is required to validate the results of this research.

Since nearly 92 percent of the total resources are included in the *Transfer* (E) major step as well as over 79 percent specifically to the *transfer* sub-step (E6), recommend a more focused study investigating only this portion of the TMP in order to break out this mountain of resources and allowing better insight into their expenditure. Recommend focusing in only on the portion of the technology transfer's life from signature until expiration. This has benefits in that signature is a well defined start, it will be more recent, and additionally, JOCAS information may be available. Additionally, as done in this study, do not constrain the end at expiration and account for the resources possibly expended after this date.

ABC was developed to more accurately allocate overhead to activities which can then be used to calculate the cost of producing a product by accumulating the activities consumed in the production of the product. This effort, due to limited time and

researcher ability, focused on only the very first in the ABC process, identifying the direct costs. The next step would be to analyze the "blocks" of overhead and then allocate these to the various steps and sub-steps. This could account for the resources expended for major steps A through C. However, this step will require a more accurate accounting of resources relating their expenditure to both the activities and time.

Appendix A. The History of Technology Transfer

Successfully transferring a technology from a federal laboratory to industry is an complex endeavor. It requires a commitment of measurable resources, including both time and money, and can be performed using a number of non-standard processes and methods each yielding varied success, measured using multiple ratings, due to a number of factors. This complexity acts as a disincentive for laboratories to seriously engage in technology transfers (TTs). Additionally Carr points out that TT involves risk-taking at many levels including the risks of criticism or censure from parent agencies, the General Accounting Office, or the Congress, as well as legal suit over such issues as fairness and US preference (Carr, 1992:11). To increase TT activities, Congress provided incentives via legislation in order to motivate federal laboratories. "TT imposes on the time and interest of laboratory scientists and tests the legal framework in which the laboratories operate" (Carr, 1992:11). Finally, Carr identifies several factors that limit and impede TTs from the federal laboratories to the commercial sector. These include cultural limits (government vs. business perspectives, procedures, priorities, and motives), as well as structural (national security, US preference over foreign businesses, fairness, and the potential for conflict of interest) (Carr, 1992:17-19).

Although the concept of federal technology transfer (FTT) dates back to the 1950s, and was identified as an important, yet under-emphasized, issue as early as the 1960s, it is still a fairly recent area of development. The Army-Navy Instrumentation Program in the 1950s was a source of numerous technological breakthroughs that ultimately appeared in both military and civilian products (Scott, 1993:64). NASA, as well as other federal R&D laboratories, first became aware of the potential for their technology to "spin-off" into other markets in the early 1960s. This lead to the establishment of the Technology Utilization Office in 1963 (Riddlebaugh, 1994:213). However, TT activities remained informally organized through the 1970s and it was not

until 1980 that the first significant legislation was enacted to facilitate the TT process. This began the transformation from mostly passive involvement by increasing the requirement for active participation in transfer programs (Dawson, 1986:54).

Stevenson-Wydler Technology Innovation Act of 1980. Officially Public Law 96-480, the Stevenson-Wydler Technology Innovation Act of 1980 defined a primary mission of federal labs to be technology transfer (Riddlebaugh, 1994:213). Additionally, it required that each federal laboratory with 200 or more full-time scientific, engineering, and related positions establish an Office of Research and Technology Application (ORTA) with at least one full-time position (AFMC, 1995:C-2). An ORTA is a technology transfer office located within a federal laboratory whose primary purpose is to disseminate information and to help transfer technology from the laboratory to the public and private sector (AFMC, 1995:O-3). Encompassing the major thrust of the Act, Section 11 stipulated both the functions and reporting requirements of the ORTAs as well as required laboratories with budgets exceeding $20 million to commit at least 0.5% of their R&D budget to support technology transfer functions (Dawson, 1986:3). However, although a step forward, the Stevenson-Wydler Technology Innovation Act of 1980 did have some deficiencies, thus a revision was necessary (Olsen, 1987:14).

The Federal Technology Transfer Act of 1986. Public Law 99-502, the first revision to the Stevenson-Wydler Technology Innovation Act, is better known as the Federal Technology Transfer Act of 1986 (Olsen, 1987:14). Three major changes required by this revision included; 1) the establishment of the Federal Laboratory Consortium (FLC) for Technology Transfer, 2) the strengthening of Section 11 requiring each laboratory director to ensure technology transfer is considered positively in all laboratory operations, and 3) granting each federal agency the power to permit the director of any of its laboratories to enter into cooperative research and development agreements, known as CRDAs, between the government and private industry (Olsen,

1987:27). Again, some shortfalls were identified which resulted in the next major legislative action three years later.

National Competitiveness Technology Transfer Act of 1989. The NCTTA of 1989, P.L. 101-189, extended the authorization to enter into CRDAs to the 39 not-for-profit Federally Funded Research and Development Centers (FFRDCs). Additionally, the NCTTA also mandated these FFRDCs to "include national competitiveness as part of their mission" (Shahidi and Xue, 1994:155). Referring back to the discussion of funding expenditures earlier in this chapter, in order to help understand the significance, these FFRDCs spent approximately $6 billion in 1994 (Shahidi and Xue, 1994:151). This equates to nearly nine percent of that year's R&D total.

The Small Business Innovation Research Program. While CRDAs involve private firms of all sizes in the technology transfer process, they are only 1 of the 2 significant mechanisms for promoting the commercialization of new technologies. The second is the Small Business Innovation Research Program and is exclusively reserved for small businesses (Widman, 1995:x). Known as SBIR, this program was established by Congress in 1982 (Friedman, 1994:210). A SBIR is a program under which a portion of a federal agency's research or research and development is reserved for award to small business through a uniform, two-phase process that; 1) determines the scientific and technical merit and feasibility of ideas with apparent commercial potential, and 2) further develops proposals that meet particular program needs. With the objective of stimulating technological innovation with small business, defined as businesses employing less than 500 personnel, the SBIR has been a success. This evaluation is based on the products that have resulted and the number of submissions received in response to requests for proposals. The SBIR Program was extended in 1992 until the year 2000. (Friedman, 1994:211)

A summary of the legislation enacted that formalized and shaped the environment of TT, is provided in Table A-1.

Table A-1. Summary of Technology Transfer

Summary of Technology Transfer Legislation, Executive Orders, and Air Force Directives			
Year	**Public Law (P.L.)**	**Name**	**Major Elements (Purpose)**
1966	P.L. 89-554	Freedom of Information Act (FOIA)	• Provided a vehicle to inform the public about Federal Government activities • Provided the right to request agency records and have them made available promptly
1980	P.L. 96-480	Stevenson-Wydler Technology Innovation Act	• Established technology transfer as a mission of the Federal Government • Established ORTAs
1980	P.L. 96-517	Bayh-Dole Act	• Superseded all previous laws that give small businesses and nonprofit organizations (including universities) certain rights related to inventions they developed under funding agreements with the Government (Did not give maintenance and operation (M&O) contractors right to elect title to its inventions.) • Protected descriptions of inventions from public dissemination and FOIA for reasonable period of time to file patent applications
1984	P.L. 98-620	Trademark Clarification Act	• Amended Bayh-Dole to permit M&O contractors to elect title to inventions in exceptional circumstances and national security-funded technologies

Table A-1. Summary of Technology Transfer (Continued)

Summary of Technology Transfer Legislation, Executive Orders, and Air Force Directives			
Year	**Public Law (P.L.)**	**Name**	**Major Elements (Purpose)**
1986	P.L. 99-502	Federal Technology Transfer Act (FTTA)	• Authorized CRDAs for Government-owned Government-operated (GOGOs) organizations • Established FLC • Provided a preference to U.S. based businesses and those who agree to manufacture substantially in the United States • Established technology transfer as a laboratory mission
1987	N/A	Executive Order 12591, Facilitating Access to Science and Technology	• Emphasized U.S. commitment to technology transfer • Required Government agencies to delegate authority to Government-operated laboratories to enter into cooperative agreements to the extent they are legally capable and provided authority to improve the global trade position of the United States
1988	P.L. 100-418	Omnibus Trade and Competitive-ness Act	• Mandated establishment of regional university-based Manufacturing Technology Centers for transferring advanced manufacturing techniques to small- and medium-sized firms through development of CRDAs in the United States
1988	DoD 3200.12-R-4	Domestic Technology Transfer Program Regulation	• DoD Response to P.L. 99-502 • Stipulates responsibilities for heads of DOD Components • Authorizes use of CRDAs • Stipulates use of awards and royalties
1989	P.L. 101-189	National Competitivene ss Technology Transfer Act (NCTTA)	• Authorized CRDAs for Government-owned Contractor-operated (GOCOs) organizations • Protects trade secret information brought into, or developed under, a CRDA from disclosure under FOIA

Table A-1. Summary of Technology Transfer (Continued)

Summary of Technology Transfer Legislation, Executive Orders, and Air Force Directives			
Year	**Public Law (P.L.)**	**Name**	**Major Elements (Purpose)**
1990	Air Force Policy Directive (AFPD) 61-3	Air Force Domestic Technology Transfer Policy Directive	• Established Air Force policy for technology transfer • Provides procedures for CRDAs • Defines responsibilities of ORTAs
1991	P.L. 101-510	Defense Authorization Act	• Authorized federal laboratories and FFRDCs to award contracts to a partnership intermediary for services that increase the likelihood of laboratory success in joint activities with small business firms • Extended FLC mandate through 1996
1991	P.L. 102-245	American Technology Preeminence Act	• Allowed exchange of intellectual property between participants in a CRDA • Required a report on the advisability of CRDAs that would permit federal contribution of funds • Allowed laboratory directors to give excess equipment to educational institutions or nonprofit organizations as a gift
1992	P.L. 102-564	Small Business Technology Transfer (STTR) Act	• Established the STTR program

Appendix B: The Transfer Master Process

The Technology Transfer Process (AFMC, 1995)

This Appendix describes the transfer process from the hierarchical perspective of senior Air Force leadership and from the perspective of the individual organization's transfer focal points (TFPs). The details of the process at the bench scientist and engineer perspective will not be described as this lowest-level perspective requires the specifics of the "how" at each laboratory and center. While each transfer focal point has the freedom, and is encouraged, to develop site-specific detailed process steps defining how they will accomplish the responsibilities of each of these steps, for the purposes of this research, the thirty-nine sub-steps will be used as the basic activities in the transfer process.

The Master Process Perspective

Figure 1 shows the top view of the multi-layered transfer "Master Process."

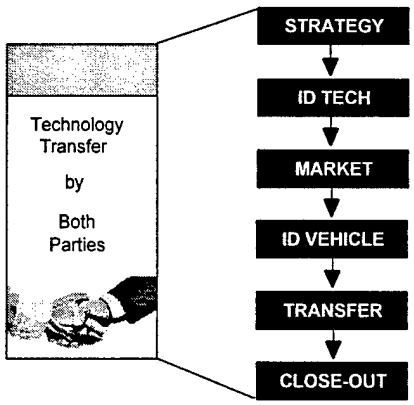

Figure 1
The Master Process

The Master Process is broken into six major steps. These steps refer to the entire process. Some of the steps are not performed sequentially, some steps are done only by headquarters, and some only by the S&Es who work the technologies that are transferred. Additionally, some of these steps, such as strategy, are an annual activity, while others, like post-transfer administration, occur for every transfer agreement.

Transfer Focal Point Process

The next six sections describe the activities of the transfer focal point in terms of each of the six master process steps.

Major Step A Strategy

The strategy steps' purpose is to integrate technology transfer into the AFMC technology investment strategy. The nine sub-steps of this process take the local technology strategies and the administration (overhead) requirements and coordinate them into a single command strategy. Figure 2 depicts these nine sub-steps with the numbering system of "A" for the master process step followed by the number of the sub-step.

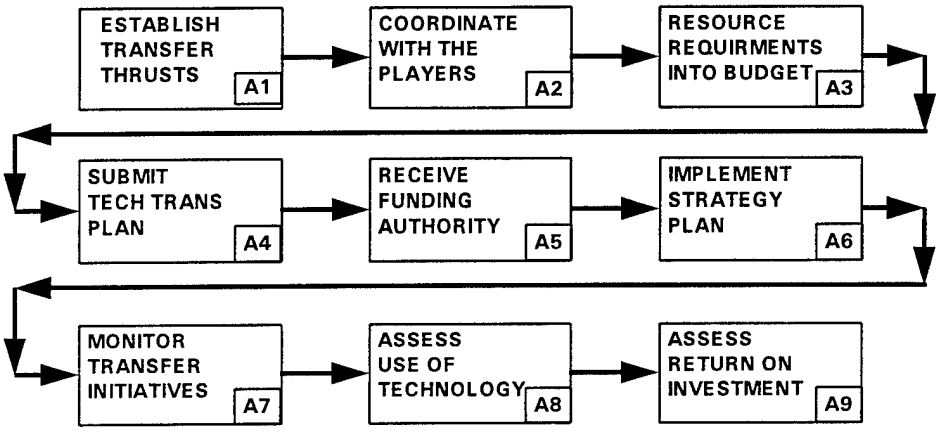

Figure 2
Strategy Process Steps

Each laboratory and center needs to [A1] establish an annual business plan (ABP). The ABP describes the local near-term and long-term plans for achieving local goals and objectives. It describes the role of all of the support functionaries at the location, such as legal, procurement, public affairs, and comptroller. The plan needs to be [A2] coordinated among all of the local players. This coordination will help achieve buy-in by those support people not directly assigned to the transfer focal point office.

The budgetary requirements [A3] for running the transfer program need to be stated and justified. At this time, there is no program element for transfer activities, hence all funding must come from the organization's internal funds. These requirements need to be folded into the local Biennial Planning, Programming, and Budgeting System (BPPBS).

The ABP is submitted [A4] to the Command Transfer Team located in the technology transfer office (AFMC/TTO) by April 1 each year. The TTO will aggregate all the local plans into a composite command transfer business plan for use at the headquarter's level. The focal point receives his or her funding [A5] from the local organization budget and implements [A6] local business plans in concert with the support from the focal point's organization. The focal point also monitors [A7] his or her organization's ability to meet local transfer goals.

The last part of the strategy section is to assess technologies [A8] for matching up with prior requests and transfers of technologies during the previous year. This assessment should be done in concert with the return on investment [A9] for prior transfers. This information will allow the focal point to provide efficient allocation of limited resources toward those technologies that appear to be in greater demand by outside partners.

Major Step B Identify Technology

Identifying the technology helps the focal point ascertain which technologies are available for transfer and which technologies have a greater potential for successful transfer. Technologies include products, processes, people, and their unique facilities.

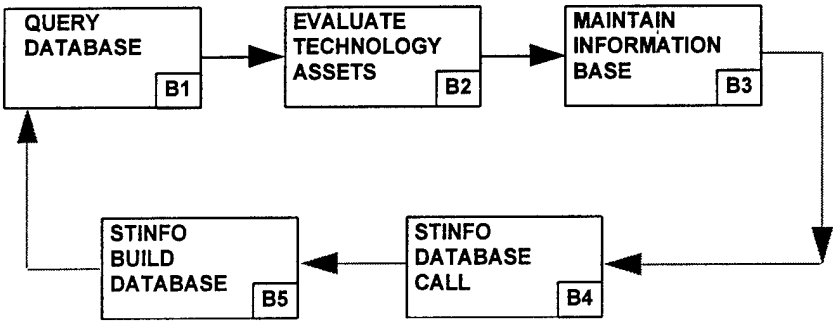

Figure 3
ID Technology Process Steps

When these process steps were developed, the command Science and Technical Information Office (STINFO) was developing a single technology database. Steps [B4] and [B5] refer to the effort of keeping this database populated with up-to-date information. Once the organization's technologies (which are available for transfer) have been identified, then it is necessary to evaluate [B2] these technologies for their transfer potential. This transfer potential also includes an analysis of how successful a commercialization will be. While most technologies have some commercial potential, not all the technologies can readily be commercialized.

These high-potential technologies need to be identified in some easily queried database. This procedure will help the transfer focal point quickly identify technologies when potential outside partners begin looking at possible candidates. This process will also help the Air Force's TECH CONNECT Office search for technologies to match with customers' needs.

Major Step C Marketing

The purpose of the marketing steps is to promote those technologies with high commercial potential. These steps also help coordinate and synergistically help the laboratories and centers pool their marketing through the Command Transfer Team.

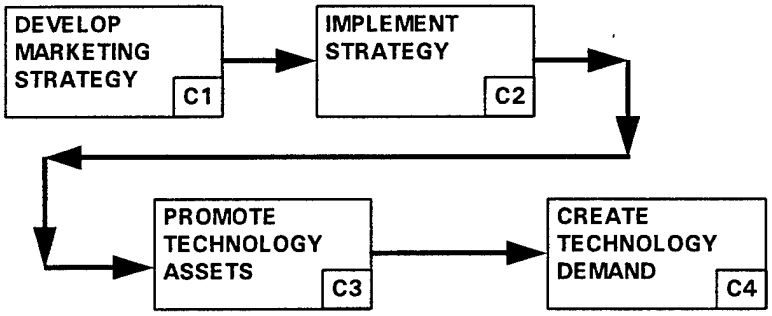

Figure 4
Marketing Process Steps

The marketing strategy [C1] has its beginnings in the organization's transfer business plan. It helps the focal point focus limited resources onto those efforts that will have the higher payoffs. Strategies include, but are not limited to, placing ads in technical magazines, printing brochures, hosting technical symposia, and displaying technology transfer information in convention exhibit halls. Once developed, the overall marketing strategy needs to be implemented.[C2]

Marketing [C3] may be highly focused on a specific technology (market push) or it may be a broad brush stroke in order to develop interest in the organization's technologies from multiple sources (market pull). The basic idea is to create demand [C4] for those technologies among your target audience.

The TTO often coordinates displays and magazine ads for the command. These advertisements provide an excellent opportunity for increasing a technology's exposure, which otherwise might go unnoticed.

Major Step D Identify Vehicle

The purpose of identifying the transfer vehicle is to match the best transfer agreement vehicle with the needs of the outside partner and the Air Force. Not all the transfer vehicles are appropriate for all technologies and all conditions.[D1]

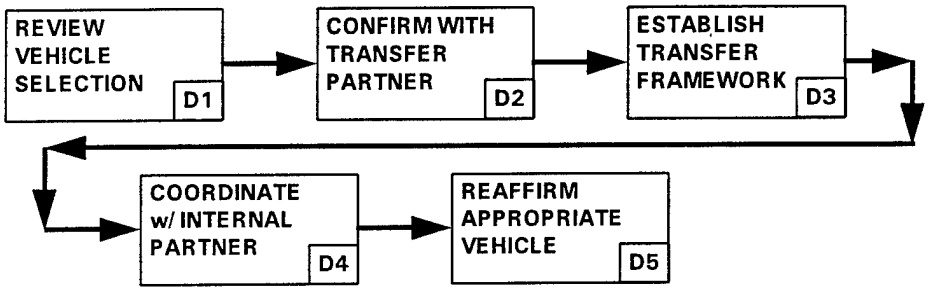

Figure 5
ID Vehicle Process Steps

Once the focal point understands the needs of the outside partner [D2] and the complexities of the technology to be transferred, they are in a better position to help determine the most appropriate transfer vehicle. The initial negotiations [D3] occur by virtue of agreeing on the transfer vehicle. As the transfer details are worked out for the technology itself, many financial and legal issues are identified. This situation gives the focal point the opportunity to enlist the help and support from the organization's comptroller and legal offices. By having this Air Force team work together during these initial negotiations, the focal point is able to establish common goals.[D4]

When all the parties agree in principle, the focal point reaffirms [D5] the appropriateness of the transfer vehicle. During the discussions, the scope of the transfer may have changed or the amount of intellectual property rights may have changed. At the end of these process steps, the transfer is ready to become final.

Major Step E Transfer

The purpose of the transfer process steps is to execute the transfer. These steps ensure the Air Force and the outside partner comply with all the applicable public laws. The process formalizes the transfer in writing and commits both the Air Force and the outside partner to the transfer effort.

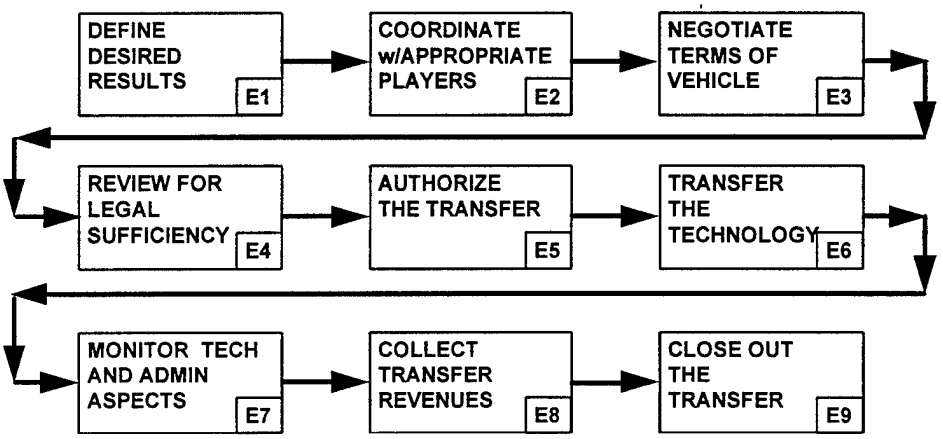

Figure 6
Transfer Process Steps

First, agree on the purpose and desired results [E1] of the transfer. At this time, the focal point should get the outside partner to quantify their expectations of the benefits of using the technology. This step also helps the Air Force state their expectations on what they are receiving in return for the transfer.

Then the agreement is formally coordinated [E2] among all the Air Force players. This coordination provides Air Force participants with a written commitment of their responsibilities of the transfer and outlines what to expect in return for completing the transfer. This process is the Air Force's last formal chance to negotiate [E3] the terms of the transfer agreement.

To ensure the transfer agreement is in compliance with public law, the Air Force completes its review [E4] for legal sufficiency. At this point, both the outside partner and the Air Force official authorized to commit the Air Force, sign the transfer agreement.[E5]

Once approved, the transfer occurs.[E6] The focal point is required to report all formal transfer agreements to the Command Transfer Team. The transfer may be a simple one-time interchange or it may take anywhere from several months to several years to complete. During the transfer period, the focal point has the responsibility to monitor [E7] the transfer to ensure it meets stated objectives and results. Throughout the life of the transfer, the Air Force collects [E8] revenues generated by the transfer.

Once the formal transfer is complete,[E9] the focal point ensures that all obligations (other than future royalty payments) by both parties are completed. Once completed, the focal point sends a Customer Questionnaire to the outside partner. They

also send an Air Force Partner Feedback form to the Air Force in-house scientist or engineer. The focal point sends a copy of the completed Customer Questionnaire to the Command Transfer Team.

Major Step F Post-transfer Administration

The purpose of the post-transfer administration steps: account for all the transfer activities, advertise the successful transfer, and reward and recognize the Air Force participants. These steps track success against the goals set in the investment strategy and the business plan. They provide accountability and the feedback of metrics as well as lessons learned and public relations.

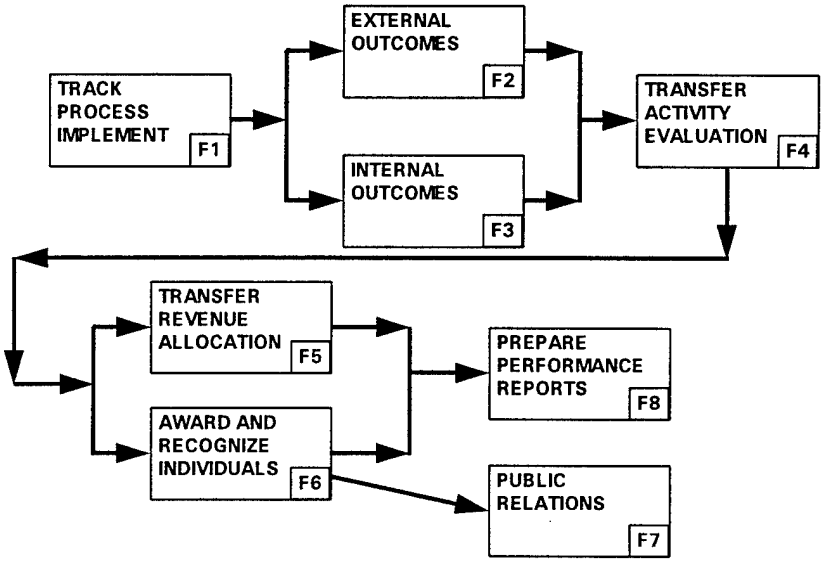

Figure 7
Post-transfer Administration Process Steps

Each focal point needs to track [F1] the transfer process at his or her organization. This tracking includes local metrics (core and tool) for managing the process. Both the external [F2] and internal [F3] outcomes are documented. Together with the local metrics, the focal point will be able to pinpoint successful activities [F4] that need to be continued and activities that need to be changed or eliminated. This information will help the focal point develop future transfer strategies to maximize meeting organizational goals.

The focal point should also be working with the local comptroller office and the organizational commander for distribution and expenditure of the collected revenues.[F5] Many of these revenues can be used to help fund the focal point office and activities.

The focal point has the responsibility to ensure those organizational people, involved in making transfer a success, are adequately recognized for their efforts.[F6] The command encourages each focal point to establish a local awards program to supplement the command awards program.

The local public affairs office has the responsibility to publicize [F7] successful transfer agreements. These releases may include local media and AFSTHR's efforts. Every successful transfer needs to have a success story written and submitted to the

Command Transfer Team. This information will give the command an up-to-date source of success data to use in command brochures, senior leadership speeches, and presentations. The Public Affairs Office and the transfer focal point need to evaluate their marketing strategy, their successes, and their lessons learned. This annual review needs to feed the marketing process in Major Step C.

Finally, the focal point has the responsibility to report transfer activities [F8] in the organization's annual business plans. The focal point must maintain information databases for response to Office of Management and Budget (OMB) and Secretary of the Air Force (SAF) inquiries into local transfer activities. This reporting requirement includes Defense Technology Transfer Information System (DTTIS) that is operated by Defense Technical Information Center (DTIC). The Command Transfer Team will attempt to answer all inquiries from the command transfer tracking database. When they do not have the required information, it will be requested from each focal point.

Appendix C: Interview Questionnaire

INTERVIEW QUESTIONNAIRE
SCIENTIST & ENGINEER/TRANSFER FOCAL POINT

I have no preconceived notions nor do I have any hidden agendas. I am interested in obtaining factual information only in order to identify and quantify the resources required to perform a technology transfer project. Information collected will be used for this research only. Additionally, names will be used for reference only and will not be published in the final report. To reschedule the interview or update any information following the interview, please call Capt James (Jamey) Boyd at either X5-7777 Ext. 2226 or 879-0878.

PERSONAL INFORMATION

01. Person Interviewed: _____ Work Phone: _____
02. Rank/Grade: _____ Step: ____ 03. Position/Title: _____

TRANSFER PROJECT INFORMATION

04. When did you **begin** working on the project (date)? _____
05. What event marked the beginning of the project for you?

06. When was the project **completed** (date)? _____
07. What event marked the end of the project for you?

OVERALL PROCESS

Human Resources

08. Of the total time spent on the project, and with respect to the 6 major steps in the AFMC Transfer Master Process, what percentage of time was spent on each step?

Strategy:	_____ (08-1)	
Identify Technology:	_____ (08-2)	
Market Technology:	_____ (08-3)	All must total 100%
Identify Vehicle:	_____ (08-4)	(100% ÷ 6 ≅ 17%)
Transfer Technology:	_____ (08-5)	
Post-Transfer Administration:	_____ (08-6)	

Physical Resources

09. Was any <u>new</u> equipment **or** supplies required to complete this transfer project?

09-1. What equipment was required? _____ (09-1-1)
How much did it cost? _____ (09-1-2)
When was it purchased? _____ (09-1-3)
Considering its overall use, in your estimate, what **percentage** of time was this equipment used for this specific project? _____% (09-1-4)

09-2. What equipment was required? _____ (09-2-1)
How much did it cost? _____ (09-2-2)
When was it purchased? _____ (09-2-3)
Considering its overall use, in your estimate, what **percentage** of time was this equipment used for this specific project? _____% (09-2-4)

STRATEGY

Purpose: To integrate technology transfer into the AFMC technology investment strategy.

A1. Establish transfer thrusts.
A2. Coordinate with the players.
A3. Resource requirements into budget.
A4. Submit technology transfer plan.
A5. Receive funding authority.
A6. Implement strategy plan.
(Actions required in preparation for transfer with respect to the plan.)
A7. Monitor transfer initiatives.
(Gauging actual transfer progress versus progress projected in the strategy.)
A8. Assess use of technology.
A9. Assess return on investment.

These activities deal specifically with the development, implementation, and monitor of the Annual Business Plan (ABP) to be submitted by the transfer focal point (TFP) to the Command TTO.

11 When, what month and year, did you begin developing the investment strategy for this technology?
_____ (11)

12-1. If the tasks listed above (A1 - A9) are done at a macro level **covering many technologies** ("big picture"), about how many hours were spent developing and/or coordinating business plan inputs with the transfer focal point for this specific project? _____ (12-1)

12-2. Based on the total time spent on this major step as reported in 12-1, and with respect to the 9 sub-steps in the AFMC Transfer Master Process for this major step, about what percentage of time was spent on each of these sub-steps?

Establish transfer thrusts:	_____ (12-2-1)	
Coordinate with the players:	_____ (12-2-2)	
Resource requirements into budget:	_____ (12-2-3)	
Submit technology transfer plan:	_____ (12-2-4)	
Receive funding authority:	_____ (12-2-5)	All must total 100%
Implement strategy plan:	_____ (12-2-6)	(100% ÷ 9 ≅ 11%)
Monitor transfer initiatives:	_____ (12-2-7)	
Assess use of technology:	_____ (12-2-8)	
Assess return on investment:	_____ (12-2-9)	

13. If these tasks are completed for each **individual technology**, about how many hours were spent on this specific project to complete each of the 9 sub-steps as defined in the AFMC Transfer Master Process?
    - A1. Establish transfer thrusts: _____ (13-1)
    - A2. Coordinate with the players: _____ (13-2)
    - A3. Resource requirements into budget: _____ (13-3)
    - A4. Submit technology transfer plan: _____ (13-4)
    - A5. Receive funding authority: _____ (13-5)
    - A6. Implement strategy plan: _____ (13-6)
    - A7. Monitor transfer initiatives: _____ (13-7)
    - A8. Assess use of technology: _____ (13-8)
    - A9. Assess return on investment: _____ (13-9)

14. When, what month and year, was the investment strategy finalized or completed for this technology? _____ (14)

15. Where periodic updates to this investment strategy required? If so:
    - 15-1. About how many hours were required for each update? _____ (15-1)
    - 15-2. When were these updates done? _____ (15-2)

16. Where there any other activities performed in support of this step that consumed a significant amount of either time or resources?

    16-1 What was the activity? _____ (16-1-1)
    Resources required: Time (hours) _____ (16-1-2)
    Money ($) _____ (16-1-3)
    Other resources _____ (16-1-4)
    Over what time period were these resources expended? _____ (16-1-5)

    16-2 What was the activity? _____ (16-2-1)
    Resources required: Time (hours) _____ (16-2-2)
    Money ($) _____ (16-2-3)
    Other resources _____ (16-2-4)
    Over what time period were these resources expended? _____ (16-2-5)

IDENTIFY TECHNOLOGY

Purpose: Provides a database of information for use by the TFP enabling a timely and informed response to requests for a technology.

B1. Query database.
B2. Evaluate technology assets.
B3. Maintain information base.
B4. Science & Technical Information Office (STINFO) database call.
B5. STINFO build database.

The main emphasis of the TFP is development, population, manipulation, and maintenance of the STINFO database. The evaluation of technology assets including the identification and assessment of individual technologies is primarily done by the S&E.

21. About how many hours were required to evaluate this technology's transfer potential as well as the resources required to effect the transfer? _____ (21)

22. After the initial assessment, about how many hours were spent updating information regarding this technology? _____ (22)

23 About how may hours were spent responding to any STINFO requests for information regarding this technology? _____ (23)

24. Did need arise during this project to query the STINFO's technology data base? If so, how many hours were required? _____ (24)

25. Where there any other activities performed in support of this step that consumed a significant amount of either time or resources?

25-1 What was the activity? _____ (25-1-1)
Resources required: Time (hours) _____ (25-1-2)
Money ($) _____ (25-1-3)
Other resources _____ (25-1-4)
Over what time period were these resources expended? _____ (25-1-5)

25-2 What was the activity? _____ (25-2-1)
Resources required: Time (hours) _____ (25-2-2)
Money ($) _____ (25-2-3)
Other resources _____ (25-2-4)
Over what time period were these resources expended? _____ (25-2-5)

MARKET TECHNOLOGY

Purpose: Promote technologies with high commercial potential.

C1. Develop marketing strategy.
C2. Implement strategy.
C3. Promote technology assets.
C4. Create technology demand.

31. Keeping in mind that major step A directed the development of a comprehensive investment strategy for this technology to be included in the annual business plan, about how many additional hours were spent developing a market strategy? _____ (31)
    31-1. Over what time period were these additional hours spent developing this marketing strategy? _____ (31-1)

32. Again, considering the response to previous questions regarding this technology's overall strategy, about how many additional hours were spent implementing the marketing strategy for this project (design of advertisements, hosting of technical symposia, etc.)? _____ (32)

33. About how much money was spent on the implementation of this strategy (design of advertisements, hosting of technical symposia, etc.)? $_____ (33) *For each area*:
    33-1. Type of marketing _____ (33-1-1)
    Amount of funding spent. $_____ (33-1-2)
    Over what time period were these resources expended? _____ (33-1-3)

    33-2. Type of marketing _____ (33-2-1)
    Amount of funding spent. $_____ (33-2-2)
    Over what time period were these resources expended? _____ (33-2-3)

34 How many trips were taken while marketing this technology?
    34-1. Where was the location? _____ (34-1-1)
    How many trips were made to this location? _____ (34-1-2)
    When was each trip taken (month/year)? _____ (34-1-3)
    How many days on average was each trip? _____ (34-1-4)
    Who else went on this trips? _____ (34-1-5)

    34-2. Where was the location? _____ (34-2-1)
    How many trips were made to this location? _____ (34-2-2)
    When was each trip taken (month/year)? _____ (34-2-3)
    How many days on average was each trip? _____ (34-2-4)
    Who else went on this trips? _____ (34-2-5)

35. In marketing this technology, what was the relative emphasis on the promotion of this specific asset (technology push) versus the creation of demand for a larger group of technologies in which this specific technology is included (technology pull)?

Push _____% (35-1)
Pull _____% (35-2)
100%

36. Where there any other activities performed in support of this step that consumed a significant amount of either time or resources?

36-1 What was the activity? _____ (36-1-1)
Resources required: Time (hours) _____ (36-1-2)
Money ($) _____ (36-1-3)
Other resources _____ (36-1-4)
Over what time period were these resources expended? _____ (36-1-5)

36-2 What was the activity? _____ (36-2-1)
Resources required: Time (hours) _____ (36-2-2)
Money ($) _____ (36-2-3)
Other resources _____ (36-2-4)
Over what time period were these resources expended? _____ (36-2-5)

IDENTIFY VEHICLE

Purpose: Match the best transfer agreement vehicle with the needs of the outside partner and the Air Force. Note, this step entails vehicle development only and NOT agreement negotiations.

D1. Review vehicle alternatives.
D2. Confirm with transfer partner.
(E1). Define desired results.
(E2). Coordinate with appropriate players.
D3. Establish transfer framework.
D4. Coordinate with internal partner.
D5. Reaffirm appropriate vehicle.

41. About how many hours were spent reviewing the possible transfer vehicle alternatives before conferring with the transfer partners? _____ (41)

42. About how many hours were spent <u>for this specific project</u> in the **local area** with the **external** transfer partner to fully understand the outside partner's needs and the complexities of the technology to be transferred?

On the telephone _____ (42-1)
In meetings _____ (42-2)
On E-Mail _____ (42-3)

43. How many business trips were required to fully understand the needs of the **external** partner and the complexities of the technology to be transferred for this specific project? *For each location*:

43-1. Where was the location? _____ (43-1-1)
How many trips were made to this location? _____ (43-1-2)
When was each trip taken (month/year)? _____ (43-1-3)
How many days on average was each trip? _____ (43-1-4)
Who else went on this trips? _____ (43-1-5)

43-2. Where was the location? _____ (43-2-1)
How many trips were made to this location? _____ (43-2-2)
When was each trip taken (month/year)? _____ (43-2-3)
How many days on average was each trip? _____ (43-2-4)
Who else went on this trips? _____ (43-2-5)

44. About how many hours were spent for this specific project in the **local** area, with the **external** partner, defining the desired results of the transfer?

On the telephone _____ (44-1)
In meetings _____ (44-2)
On E-Mail _____ (44-3)

45. How many business trips were required to define the desired results with the **external** partner for this specific project? *For each location:*

45-1. Where was the location? _____ (45-1-1)
How many trips were made to this location? _____ (45-1-2)
When was each trip taken (month/year)? _____ (45-1-3)
How many days on average was each trip? _____ (45-1-4)
Who else went on this trips? _____ (45-1-5)

45-2. Where was the location? _____ (45-2-1)
How many trips were made to this location? _____ (45-2-2)
When was each trip taken (month/year)? _____ (45-2-3)
How many days on average was each trip? _____ (45-2-4)
Who else went on this trips? _____ (45-2-5)

46. About how many hours were spent for this specific project in the local area with the **external** partner coordinating these desired results?:

On the telephone _____ (46-1)
In meetings _____ (46-2)
On E-Mail _____ (46-3)

47. How many business trips were required to coordinate these desired results with the **external** partner for this specific project? *For each location:*

47-1. Where was the location? _____ (47-1-1)
How many trips were made to this location? _____ (47-1-2)
When was each trip taken (month/year)? _____ (47-1-3)
How many days on average was each trip? _____ (47-1-4)
Who else went on this trips? _____ (47-1-5)

47-2. Where was the location? _____ (47-2-1)
How many trips were made to this location? _____ (47-2-2)
When was each trip taken (month/year)? _____ (47-2-3)
How many days on average was each trip? _____ (47-2-4)
Who else went on this trips? _____ (47-2-5)

48. About how many hours were spent establishing the actual transfer framework including documenting all agreements? _____ (48)

48-1. During what time period was this work accomplished? (48-1)

49. About how many hours of consulting support were required for this specific project during this step from a:

49-1. Financial consultant regarding the resolution of financial issues? _____ (49-1)

49-2. Legal consultant regarding the resolution of legal issues? _____ (49-2)

410. About how many hours were spent for this specific project coordinating with the **internal** transfer partner?

On the telephone _____ (410-1)

In meetings _____ (410-2)

On E-Mail _____ (410-3)

411. About how many hours were spent, with the **external** partner, reconfirming the details of the transfer vehicle? _____ (411)

412. Where there any other activities performed in support of this step that consumed a significant amount of either time or resources?

412-1 What was the activity? _____ (412-1-1)

Resources required: Time (hours) _____ (412-1-2)

Money ($) _____ (412-1-3)

Other resources _____ (412-1-4)

Over what time period were these resources expended? _____ (412-1-5)

412-2 What was the activity? _____ (412-2-1)

Resources required: Time (hours) _____ (412-2-2)

Money ($) _____ (412-2-3)

Other resources _____ (412-2-4)

Over what time period were these resources expended? _____ (412-2-5)

TRANSFER TECHNOLOGY

Purpose: To execute the transfer. Note, this step includes the formalization of the transfer agreement in writing including final negotiations through the close-out of the transfer.

E3. Negotiate terms of vehicle.
E4. Review for legal sufficiency.
E5. Authorize the transfer.
E6. Transfer the technology.
E7. Monitor the technology and administrative aspects.
E8. Collect transfer revenues.
E9. Close-out the transfer.

51. Approximately when did negotiations occur to finalize and formalize the terms for this transfer project? _____ (51)

52. About how many hours were spent in the **local area** actually negotiating the final terms of the transfer agreement? _____ (52)

53. How many business trips were required to negotiation of the final terms for this specific project?
For each location:

53-1. Where was the location? _____ (53-1-1)
How many trips were made to this location? _____ (53-1-2)
When was each trip taken (month/year)? _____ (53-1-3)
How many days on average was each trip? _____ (53-1-4)
Who else went on this trips? _____ (53-1-5)

53-2. Where was the location? _____ (53-2-1)
How many trips were made to this location? _____ (53-2-2)
When was each trip taken (month/year)? _____ (53-2-3)
How many days on average was each trip? _____ (53-2-4)
Who else went on this trips? _____ (53-2-5)

54. Who was involved in the actual negotiations and about how many hours for each?
_____ (54-1)
_____ (54-2)
_____ (54-3)
_____ (54-4)
_____ (54-5)
_____ (54-6)

55. About how many hours of support were required from a legal consultant **following** negotiations for the review of legal sufficiency for this specific project? _____ (55)

56. About how many hours were expended in receiving authorization to proceed with the transfer?
_____ (56)

57 About how many hours were spent, in the **local area** during the actual transfer of the technology?
Total: _____ (57)
Hours each week _____
Number of weeks _____

58. How many business trips were required during the actual transfer of the technology for this specific project? *For each location*:

58-1. Where was the location? _____ (58-1-1)
How many trips were made to this location? _____ (58-1-2)
When was each trip taken (month/year)? _____ (58-1-3)
How many days on average was each trip? _____ (58-1-4)
Who else went on this trips? _____ (58-1-5)

58-2. Where was the location? _____ (58-2-1)
How many trips were made to this location? _____ (58-2-2)
When was each trip taken (month/year)? _____ (58-2-3)
How many days on average was each trip? _____ (58-2-4)
Who else went on this trips? _____ (58-2-5)

59. Considering the numbers reported in the previous two questions, about what relative percentage of these hours was spent on:
Monitoring the transfer project with respect to technical aspects? _____% (59-1)
Handling the administrative aspects of the transfer project? _____% (59-2)
100%

510. About how many hours were spent on this specific project collecting the revenues generated by this project? _____ (510)

511. About how many hours were spent in the **local area** during close-out of this transfer project? _____ (511)

512. How many business trips were required during close-out of this transfer project? *For each location*:

512-1. Where was the location? _____ (512-1-1)
How many trips were made to this location? _____ (512-1-2)
When was each trip taken (month/year)? _____ (512-1-3)
How many days on average was each trip? _____ (512-1-4)
Who else went on this trips? _____ (512-1-5)

512-2. Where was the location? _____ (512-2-1)
How many trips were made to this location? _____ (512-2-2)
When was each trip taken (month/year)? _____ (512-2-3)
How many days on average was each trip? _____ (512-2-4)
Who else went on this trips? _____ (512-2-5)

513. During close-out, about how many hours of consulting support were required from a:

513-1. Financial consultant regarding the resolution of financial issues?
_____ (513-1)

513-2 Legal consultant regarding the resolution of legal issues?
_____ (513-2)

514. Where there any other activities performed in support of this step that consumed a significant amount of either time or resources?

514-1 What was the activity? _____ (514-1-1)
Resources required: Time (hours) _____ (514-1-2)
Money ($) _____ (514-1-3)
Other resources _____ (514-1-4)
Over what time period were these resources expended? _____ (514-1-5)

514-2 What was the activity? _____ (514-2-1)
Resources required: Time (hours) _____ (514-2-2)
Money ($) _____ (514-2-3)
Other resources _____ (514-2-4)
Over what time period were these resources expended? _____ (514-2-5)

POST-TRANSFER ADMINISTRATION

Purpose: To track success against the goals set in the investment strategy and business plan.

F1. Track process implementation.
F2. Document external outcomes.
F3. Document internal outcomes.
F4. Transfer activity evaluation.
F5. Transfer revenue allocation.
F6. Award and recognize individuals.
F7. Public relations.
F8. Prepare performance reports.

61. After the close-out of this transfer project, about how many hours were required to calculate, finalize, and document the local transfer metrics? _____ (61)
    61-1. Over what time period did this work occur? _____ (61-1)

62. About how many hours were required to document the **external** outcomes for this specific project? _____ (62)

63. About how many hours were required to document the **internal** outcomes for this specific project? _____ (63)

64. Approximately when were these outcomes documented? _____ (64)

65. Considering the local metrics and the final outcomes achieved during this transfer, about how many hours did it require to evaluate and document the specific activities that either were or were not successful during this transfer project? _____ (65)
    65-1. Over what time period did this work occur? _____ (65-1)

66. About how many hours did you spend, regarding the distribution and expenditure of the revenue that was collected on this specific project, with the:
    Comptroller's office _____ (66-1)
    Organizational commander _____ (66-2)
    When were these hours expended? _____ (66-3)

67. Regarding recognizing those organizational personnel responsible for ensuring this transfer project was a success, about how many hours were required? _____ (67)
    67-1. Over what time period did this work occur? _____ (67-1)

68. With respect to the outcomes of this project, what types of publicity were used and about how many hours were required for each?
    Local news media _____ (68-1)
    AFSTHR's _____ (68-2)
    "Success story"? _____ (68-3)
    Other _____ (68-4)
    Over what time period did this work occur? _____ (68-6)

69. What types of performance reports were generated and about how many hours did it require to complete the report?

Lessons learned _____ (69-1)
Update of the marketing strategy _____ (69-2)
Update of the annual business plan _____ (69-3)
Reporting results to DTTIS _____ (69-4)
Other _____ (69-5)
Over what time period did this work occur? _____ (69-6)

610. Where there any other activities performed in support of this step that consumed a significant amount of either time or resources?

610-1 What was the activity? _____ (610-1-1)
Resources required: Time (hours) _____ (610-1-2)
Money ($) _____ (610-1-3)
Other resources _____ (610-1-4)
Over what time period were these resources expended? _____ (610-1-5)

610-2 What was the activity? _____ (610-2-1)
Resources required: Time (hours) _____ (610-2-2)
Money ($) _____ (610-2-3)
Other resources _____ (610-2-4)
Over what time period were these resources expended? _____ (610-2-5)

TECHNOLOGY TRANSFER PROCESS

71. In hindsight and considering ALL of the information already provided in this interview, are there any other activities (**NOT** previously identified) that were required in support of the entire technology transfer process for this project that consumed either a significant amount of time or resources?

71-1 What was the activity? _____ (71-1-1)
Resources required: Time (hours) _____ (71-1-2)
Money ($) _____ (71-1-3)
Other resources _____ (71-1-4)
Over what time period were these resources expended? _____ (71-1-5)

71-2 What was the activity? _____ (71-2-1)
Resources required: Time (hours) _____ (71-2-2)
Money ($) _____ (71-2-3)
Other resources _____ (71-2-4)
Over what time period were these resources expended? _____ (71-2-5)

Appendix D: Interview Data

The following is a listing of the projects included and the page number at which the Microsoft Excel Workbook, containing all spreadsheets for each project, begins.

PROJECT 94-241-wl-01

"Pilot Project"

Workstation-Based Simulation System

Project 94-241-wl-01 Workstation-Based Simulation Systems

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	94-241-wl-01			Workstation-based Simulation System						Personnel			Salary	Hourly				
2	Xfer type:	Product		Office:	WL/AAAS-2					GS-12	S&E		63,405	30.48				
3	Signature:	29-Sep-94			X5-4827					GM-14	"TFP"		110,688	53.22				
4	Expiratio	29-Sep-95			WPAFB					GS-12	Engr Support		63,405	30.48				
5	Location:	Redondo Beach CA			Contractor:		Shaw Custom Systems			GS-14	Legal*		110,688	53.22	$426	8 hrs: Sep 94, Sub-step D3		
6		Airfare:	353								*No separate sheet attached.							
7		Per Diem	135															
8	(Dollars)	$46,908	Jan-94	Feb-94	Mar-94	Apr-94	May-94	Jun-94	Jul-94	Aug-94	Sep-94	Oct-94	Nov-94	Dec-94	Jan-95	Feb-95	Mar-95	Apr-95
9	Total	$46,908	$4,561	$2,912	$1,422	$890	$890	$890	$1,591	$1,591	$2,017	$532	$563	$563	$624	$4,635	$654	$654
10	Sum	$18,748	$0	$305	$305	$305	$305	$305	$1,006	$1,006	$1,432	$0	$30	$30	$91	$1,855	$122	$122
11	Human	$10,974	$0	$305	$305	$305	$305	$305	$1,006	$1,006	$1,006	$0	$30	$30	$91	$1,097	$122	$122
12	Equip	$5,500																
13	Travel	$2,274														$758		
14	Strategy	0																
15	A1	0																
16	A2	0																
17	A3	0																
18	A4	0																
19	A5	0																
20	A6	0																
21	A7	0																
22	A8	0																
23	A9	0																
24	ID Tech	0																
25	B1	0																
26	B2	0																
27	B3	0																
28	B4	0																
29	B5	0																
30	Marktng	0																
31	C1	0																
32	C2	0																
33	C3	0																
34	C4	0																
35	ID Vehcle	4,968																
36	D1	305		305														
37	D2	1,219			305	305	305	305			Includes 8 hours Legal.							
38	D3	3,444							1,006	1,006	1,432	(as noted above)						
39	D4	0																
40	D5	0																
41	Transfer	7,182																
42	E1	152											30	30	91			
43	E2	0																
44	E3	0																
45	E4	0																
46	E5	0																
47	E6	3,406														549	61	61
48	E7-50/50	1,890														549	61	61
49	E8	0																
50	E9	1,733																
51	Post-Tfr	1,524																
52	F1	0																
53	F2	0																
54	F3	0																
55	F4	0																
56	F5	0																
57	F6	0																
58	F7	610																
59	F8	914																

Project 94-241-wl-01 Workstation-Based Simulation Systems

	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG
1															
2															
3															
4															
5															
6															
7															
8	May-95	Jun-95	Jul-95	Aug-95	Sep-95	Oct-95	Nov-95	Dec-95	Jan-96	Feb-96	Mar-96	Apr-96	May-96	Jun-96	Jul-96
9	$654	$4,635	$654	$654	$654	$654	$654	$654	$6,207	$707	$707	$2,973	$876	$1,181	$53
10	$122	$1,855	$122	$122	$122	$122	$122	$122	$5,622	$122	$122	$1,855	$610	$914	$0
11	$122	$1,097	$122	$122	$122	$122	$122	$122	$122	$122	$122	$1,097	$610	$914	$0
12									$5,500						
13		$758										$758			
14															
15															
16															
17															
18															
19															
20															
21															
22															
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40															
41															
42															
43															
44															
45															
46															
47	61	549	61	61	61	61	61	61	61	61	61	61			
48	61	549	61	61	61	61	61	61	61	61	61	61			
49															
50												975			
51															
52															
53															
54															
55															
56															
57															
58													610		
59														914	

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	**94-241-wl-01**			Workstation-based Simulation System						Personnel			Salary	Hourly				
2	Xfer type:	Product		Office:	WL/AAAS-2					GS-12	S&E		63,405	30.48				
3	Signature:	Sep-94			X5-4827					**GM-14**	**"TFP"**		**110,688**	**53.22**				
4	Expiration	Sep-95			WPAFB					GS-12	Engr Support		63,405	30.48				
5	Location:	Redondo Beach CA			Contractor:		Shaw Custom Systems			GS-14	Legal*		110,688	53.22	$426	8 hrs: Sep 94, Sub-step D		
6		Airfare:	353								***No separate sheet attached.**							
7		Per Diem:	135															
8	(Dollars)	$24,756	Jan-94	Feb-94	Mar-94	Apr-94	May-94	Jun-94	Jul-94	Aug-94	Sep-94	Oct-94	Nov-94	Dec-94	Jan-95	Feb-95	Mar-95	Apr-95
9	Sum	$24,756	$4,561	$2,608	$1,118	$585	$585	$585	$585	$585	$585	$532	$532	$532	$532	$1,290	$532	$532
10	Human	$22,617	$3,938	$2,608	$1,118	$585	$585	$585	$585	$585	$585	$532	$532	$532	$532	$532	$532	$532
11	Equip	$0																
12	Travel	$2,139	$623													$758		
13	Strategy	0																
14	A1	0																
15	A2	0																
16	A3	0																
17	A4	0																
18	A5	0																
19	A6	0																
20	A7	0																
21	A8	0																
22	A9	0																
23	ID Tech	0																
24	B1	0																
25	B2	0																
26	B3	0																
27	B4	0																
28	B5	0																
29	Marketing	0																
30	C1	0																
31	C2	0																
32	C3	0																
33	C4	0																
34	ID Vehicle	5945																
35	D1	2129	2,129															
36	D2	2592	1,277	692														
37	D3	426		53	53	53	53	53	53	53	53							
38	D4	532		532														
39	D5	266		266														
40	Transfer	18013																
41	E1	0																
42	E2	0																
43	E3	1064	532	532														
44	E4	532			532													
45	E5	0																
46	E6	0																
47	E7	15884		532	532	532	532	532	532	532	532	532	532	532	532	532	532	532
48	E8	0																
49	E9	532																
50	Post-Tfr	798																
51	F1	0																
52	F2	0																
53	F3	0																
54	F4	373																
55	F5	0																
56	F6	0																
57	F7	426																
58	F8	0																
59																		

	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG
1															
2															
3															
4															
5															
6															
7															
8	May-95	Jun-95	Jul-95	Aug-95	Sep-95	Oct-95	Nov-95	Dec-95	Jan-96	Feb-96	Mar-96	Apr-96	May-96	Jun-96	Jul-96
9	$532	$1,290	$532	$532	$532	$532	$532	$532	$585	$585	$585	$1,118	$266	$266	$53
10	$532	$532	$532	$532	$532	$532	$532	$532	$585	$585	$585	$1,118	$266	$266	$53
11															
12		$758													
13															
14															
15															
16															
17															
18															
19															
20															
21															
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43															
44															
45															
46															
47	532	532	532	532	532	532	532	532	532	532	532	532			
48															
49												532			
50															
51															
52															
53															
54									53	53	53	53	53	53	53
55															
56															
57													213	213	
58															
59															

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	**94-241-wl-01**			Workstation-based Simulation System						Personnel			Salary	Hourly				
2	Xfer type:	Product		Office:	WL/AAAS-2					GS-12	S&E		63,405	30.48				
3	Signature:	Sep-94			X5-4827					GM-14	"TFP"		110,688	53.22				
4	Expiration	Sep-95			WPAFB					**GS-12**	**Engr Support**		**63,405**	**30.48**				
5	Location:	Redondo Beach CA			Contractor:		Shaw Custom Systems			GS-14	Legal*		110,688	53.22	$426	8 hrs: Sep 94, Sub-step D		
6		Airfare:	353								***No separate sheet attached.**							
7		Per Diem:	135															
8	(Dollars)	$2,979	Jan-94	Feb-94	Mar-94	Apr-94	May-94	Jun-94	Jul-94	Aug-94	Sep-94	Oct-94	Nov-94	Dec-94	Jan-95	Feb-95	Mar-95	Apr-95
9	Sum	$2,979	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,490	$0	$0
10	Human	$1,463	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$732	$0	$0
11	Equip	$0																
12	Travel	$1,516														$758		
13	Strategy	0																
14	A1	0																
15	A2	0																
16	A3	0																
17	A4	0																
18	A5	0																
19	A6	0																
20	A7	0																
21	A8	0																
22	A9	0																
23	ID Tech	0																
24	B1	0																
25	B2	0																
26	B3	0																
27	B4	0																
28	B5	0																
29	Marketing	0																
30	C1	0																
31	C2	0																
32	C3	0																
33	C4	0																
34	ID Vehicle	0																
35	D1	0																
36	D2	0																
37	D3	0																
38	D4	0																
39	D5	0																
40	Transfer	2979																
41	E1	0																
42	E2	0																
43	E3	0																
44	E4	0																
45	E5	0																
46	E6	2979														732		
47	E7	0																
48	E8	0																
49	E9	0																
50	Post-Tfr	0																
51	F1	0																
52	F2	0																
53	F3	0																
54	F4	0																
55	F5	0																
56	F6	0																
57	F7	0																
58	F8	0																

EngrSupp

	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG
1															
2															
3															
4															
5															
6															
7															
8	May-95	Jun-95	Jul-95	Aug-95	Sep-95	Oct-95	Nov-95	Dec-95	Jan-96	Feb-96	Mar-96	Apr-96	May-96	Jun-96	Jul-96
9	$0	$1,490	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
10	$0	$732	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
11															
12		$758													
13															
14															
15															
16															
17															
18															
19															
20															
21															
22															
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42															
43															
44															
45															
46		732													
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57															
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PROJECT 94-173-wl-02

Aviation Simulation Software

Project 94-173-wl-02 Aviation Simulation S/W

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	94-173-wl-02			Aviation Simulation S/W						Personnel			Salary	Hourly						
2	Xfer type	Product		Office:	WL/FIGS					Capt	S&E		64,959	$31.23						
3	Signature	18-Jun-94			X-58427, 58429					GS-12	S&E		63,405	$30.48						
4	Expiratio	18-Jun-95			WPAFB, OH					GS-14*	Legal		110,688	$53.22	>>>>>	$266	5 hrs: Oct 93-Jun 94,			
5	Location:	Palo Alto, CA			Contractor:		Artificial Horizons Inc			WTN	Consult		83,200	$40.00			Sub-step E4.			
6		Airfare:	N/A								*No separate sheet attached.									
7		Per Die	N/A																	
8	(Dollars)	$25,382	Sep-93	Oct-93	Nov-93	Dec-93	Jan-94	Feb-94	Mar-94	Apr-94	May-94	Jun-94	Jul-94	Aug-94	Sep-94	Oct-94	Nov-94	Dec-94	Jan-95	Feb-95
9	Total	25,382	62	999	0	0	0	0	1,280	960	640	1,020	3,718	3,718	1,746	1,746	1,746	1,746	1,746	3,986
10	Sum	11,180	62	999	0	0	0	0	0	0	0	0	0	0	1,686	1,686	1,686	1,686	1,686	1,686
11	Human	11,180	62	999	0	0	0	0	0	0	0	0	0	0	1,686	1,686	1,686	1,686	1,686	1,686
12	Equip	N/A																		
13	Travel	N/A																		
14	Strategy	0																		
15	A1	0																		
16	A2	0																		
17	A3	0																		
18	A4	0																		
19	A5	0																		
20	A6	0																		
21	A7	0																		
22	A8	0																		
23	A9	0																		
24	ID Tech	0																		
25	B1	0																		
26	B2	0																		
27	B3	0																		
28	B4	0																		
29	B5	0																		
30	Marktng	0																		
31	C1	0																		
32	C2	0																		
33	C3	0																		
34	C4	0																		
35	ID Vehcl	62																		
36	D1	62	62																	
37	D2	0																		
38	D3	0																		
39	D4	0																		
40	D5	0																		
41	Transfer	11,118																		
42	E1	906		906																
43	E2	94		94																
44	E3	0																		
45	E4	0																		
46	E5	0																		
47	E6	9,182													1,530	1,530	1,530	1,530	1,530	1,530
48	E7-90/10	937													156	156	156	156	156	156
49	E8	0																		
50	E9	0																		
51	Post-Tfr	0																		
52	F1	0																		
53	F2	0																		
54	F3	0																		
55	F4	0																		
56	F5	0																		
57	F6	0																		
58	F7	0																		
59	F8	0																		

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	94-173-wl-02			Aviation Simulation S/W						Personnel			Salary	Hourly						
2	Xfer type	Product		Office:	WL/FIGS					Capt	S&E		64,959	$31.23						
3	Signature	18-Jun-94			X-58427, 58429					**GS-12**	**S&E**		**63,405**	**$30.48**						
4	Expiratio	18-Jun-95			WPAFB, OH					GS-14*	Legal		110,688	$53.22	>>>>>	$266	5 hrs: Oct 93-Jun 94,			
5	Location:	Palo Alto, CA			Contractor:		Artificial Horizons Inc			WTN	Consult		83,200	$40.00			Sub-step E4.			
6		Airfare:	N/A								***No separate sheet attached.**									
7		Per Die	N/A																	
8	(Dollars)	$7,316	Sep-93	Oct-93	Nov-93	Dec-93	Jan-94	Feb-94	Mar-94	Apr-94	May-94	Jun-94	Jul-94	Aug-94	Sep-94	Oct-94	Nov-94	Dec-94	Jan-95	Feb-95
9	Sum	$7,316	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$3,658	$3,658	$0	$0	$0	$0	$0	$0
10	Human	$7,316	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$3,658	$3,658	$0	$0	$0	$0	$0	$0
11	Equip																			
12	Travel																			
13	Strategy	0																		
14	A1	0																		
15	A2	0																		
16	A3	0																		
17	A4	0																		
18	A5	0																		
19	A6	0																		
20	A7	0																		
21	A8	0																		
22	A9	0																		
23	ID Tech	0																		
24	B1	0																		
25	B2	0																		
26	B3	0																		
27	B4	0																		
28	B5	0																		
29	Marktng	0																		
30	C1	0																		
31	C2	0																		
32	C3	0																		
33	C4	0																		
34	ID Vehcl	0																		
35	D1	0																		
36	D2	0																		
37	D3	0																		
38	D4	0																		
39	D5	0																		
40	Transfer	7,316																		
41	E1	0																		
42	E2	0																		
43	E3	0																		
44	E4	0																		
45	E5	0																		
46	E6	7,316											3,658	3,658						
47	E7-100/0	0																		
48	E8	0																		
49	E9	0																		
50	Post-Tfr	0																		
51	F1	0																		
52	F2	0																		
53	F3	0																		
54	F4	0																		
55	F5	0																		
56	F6	0																		
57	F7	0																		
58	F8	0																		
59																				

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	94-173-wl-02			Aviation Simulation S/W						Personnel			Salary	Hourly						
2	Xfer type	Product		Office:	WL/FIGS					Capt	S&E		64,959	$31.23						
3	Signature	18-Jun-94			X-58427, 58429					GS-12	S&E		63,405	$30.48						
4	Expiratio	18-Jun-95			WPAFB, OH					GS-14*	Legal		110,688	$53.22	>>>>>	$266	5 hrs: Oct 93-Jun 94,			
5	Location:	Palo Alto, CA			Contractor:		Artificial Horizons Inc			WTN	**Consult**		**83,200**	**$40.00**			Sub-step E4.			
6		Airfare:	N/A								***No separate sheet attached.**									
7		Per Die	N/A																	
8	(Dollars)	$6,620	Sep-93	Oct-93	Nov-93	Dec-93	Jan-94	Feb-94	Mar-94	Apr-94	May-94	Jun-94	Jul-94	Aug-94	Sep-94	Oct-94	Nov-94	Dec-94	Jan-95	Feb-95
9	Sum	6,620	0	0	0	0	0	0	1,280	960	640	1,020	60	60	60	60	60	60	60	2,300
10	Human	6,620	0	0	0	0	0	0	1,280	960	640	1,020	60	60	60	60	60	60	60	2,300
11	Equip	0																		
12	Travel	0																		
13	Strategy	0																		
14	A1	0																		
15	A2	0																		
16	A3	0																		
17	A4	0																		
18	A5	0																		
19	A6	0																		
20	A7	0																		
21	A8	0																		
22	A9	0																		
23	ID Tech	0																		
24	B1	0																		
25	B2	0																		
26	B3	0																		
27	B4	0																		
28	B5	0																		
29	Marktng	0																		
30	C1	0																		
31	C2	0																		
32	C3	0																		
33	C4	0																		
34	ID Vehcl	0																		
35	D1	0																		
36	D2	0																		
37	D3	0																		
38	D4	0																		
39	D5	0																		
40	Transfer	3,740																		
41	E1	1,280							640	320	320									
42	E2	1,920							640	640	320	320								
43	E3	0																		
44	E4	0																		
45	E5	0																		
46	E6	0																		
47	E7	540										60	60	60	60	60	60	60	60	60
48	E8	0																		
49	E9	0																		
50	Post-Tfr	2,880																		
51	F1	0																		
52	F2	0																		
53	F3	0																		
54	F4	0																		
55	F5	0																		
56	F6	0																		
57	F7	1,280										640								640
58	F8	1,600																		1,600

PROJECT 94-047-wl-01

In-Flight Mission Planner

Project 94-047-wl-01 In-Flight Mission Planner

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	94-047-wl-01			In-Flight Mission Planner						Personnel			Salary	Hourly				
2	Xfer type:	Product		Office:	WL/FIP					Maj		S&E	79,636	$38.29				
3	Signature:	7-Mar-94			X-55520					Capt		S&E	64,959	$31.23				
4	Expiration	7-Mar-96			WPAFB, OH					GS-14		Legal	110,688	$53.22	Consulting			
5	Location:	Atlanta GA			Contractor:		Lockheed Aero Systems											
6		Airfare:	$414	*Includes Tech Training:			Total	Monthly average:										
7		Per Diem:	$119	Tech. Training (personnel			5000	200	200	200	200	200	200	200	200	200	200	200
8	(Dollars)	$189,101	Oct-93	Nov-93	Dec-93	Jan-94	Feb-94	Mar-94	Apr-94	May-94	Jun-94	Jul-94	Aug-94	Sep-94	Oct-94	Nov-94	Dec-94	Jan-95
9	Total	189,101	3,902	3,347	3,347	4,651	3,347	9,312	5,782	5,782	5,782	5,782	5,782	5,782	5,782	5,782	5,782	5,782
10	Sum*	95,369	752	100	100	100	100	4,615	3,083	3,083	3,083	3,083	3,083	3,083	3,083	3,083	3,083	3,083
11	Human	14,281	100	100	100	100	100	1,593	61	61	61	61	61	61	61	61	61	61
12	Equip (E6)	40,000						1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600
13	Travel	36,088	652					1,422	1,422	1,422	1,422	1,422	1,422	1,422	1,422	1,422	1,422	1,422
14	Strategy																	
15	A1	0																
16	A2	0																
17	A3	0																
18	A4	0																
19	A5	0																
20	A6	0																
21	A7	0																
22	A8	0																
23	A9	0																
24	ID Tech	0																
25	B1	0																
26	B2	0																
27	B3	0																
28	B4	0																
29	B5	0																
30	Marktng	0																
31	C1	0																
32	C2	0																
33	C3	0																
34	C4	0																
35	ID Vehcle	191																
36	D1	0																
37	D2	0																
38	D3	191	38	38	38	38	38											
39	D4	0																
40	D5	0																
41	Transfer	11,451																
42	E1	958	61	61	61	61	61											
43	E2	0																
44	E3	0																
45	E4	0																
46	E5	1,531						1,531										
47	E6	2,835						61	61	61	61	61	61	61	61	61	61	61
48	E7 - 100/0	0																
49	E8	0																
50	E9	6,126																
51	Post-Tfr	4,594																
52	F1	0																
53	F2	0																
54	F3	0																
55	F4	0																
56	F5	0																
57	F6	3,063																
58	F7	0																
59	F8	1,531																

Project 94-047-wl-01 In-Flight Mission Planner

	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ
1																		
2																		
3																		
4																		
5																		
6																		
7	200	200	200	200	200	200	200	200	200	200	200	200	200	200				
8	Feb-95	Mar-95	Apr-95	May-95	Jun-95	Jul-95	Aug-95	Sep-95	Oct-95	Nov-95	Dec-95	Jan-96	Feb-96	Mar-96	Apr-96	May-96	Jun-96	Jul-96
9	5,782	5,782	5,782	5,782	5,782	5,782	5,782	5,782	5,782	5,782	5,782	5,782	5,782	7,592	7,213	5,937	5,171	2,297
10	3,083	3,083	3,083	3,083	3,083	3,083	3,083	3,083	3,083	3,083	3,083	3,083	3,083	2,965	3,063	3,063	2,297	2,297
11	61	61	61	61	61	61	61	61	61	61	61	61	61	61	3,063	3,063	2,297	2,297
12	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600				
13	1,422	1,422	1,422	1,422	1,422	1,422	1,422	1,422	1,422	1,422	1,422	1,422	1,422	1,304				
14																		
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43																		
44																		
45																		
46																		
47	61	61	61	61	61	61	61	61	61	61	61	61	61	61				
48																		
49																		
50															1,531	1,531	1,531	1,531
51																		
52																		
53																		
54																		
55																		
56																		
57															766	766	766	766
58																		
59															766	766		

Captain

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	94-047-wl-01			In-Flight Mission Planner						Personnel			Salary	Hourly				
2	Xfer type:	Product		Office:	WL/FIP					Maj		S&E	79,636	$38.29				
3	Signature:	7-Mar-94			X-55520					**Capt**		**S&E**	**64,959**	**$31.23**				
4	Expiration	7-Mar-96			WPAFB, OH					GS-14		Legal	110,688	$53.22	Consulting			
5	Location:	Atlanta GA			Contractor:		Lockheed Aero Systems											
6		Airfare:	$414															
7		Per Diem:	$119															
8	(Dollars)	$85,111	Oct-93	Nov-93	Dec-93	Jan-94	Feb-94	Mar-94	Apr-94	May-94	Jun-94	Jul-94	Aug-94	Sep-94	Oct-94	Nov-94	Dec-94	Jan-95
9	Sum	85,111	3,150	3,248	3,248	4,552	3,248	4,497	2,498	2,498	2,498	2,498	2,498	2,498	2,498	2,498	2,498	2,498
10	Human	81,199	2,498	3,248	3,248	3,248	3,248	4,497	2,498	2,498	2,498	2,498	2,498	2,498	2,498	2,498	2,498	2,498
11	Equip	0																
12	Travel	3,912	652			1,304												
13	Strategy	0																
14	A1	0																
15	A2	0																
16	A3	0																
17	A4	0																
18	A5	0																
19	A6	0																
20	A7	0																
21	A8	0																
22	A9	0																
23	ID Tech	0																
24	B1	0																
25	B2	0																
26	B3	0																
27	B4	0																
28	B5	0																
29	Marktng	0																
30	C1	0																
31	C2	0																
32	C3	0																
33	C4	0																
34	ID Vehcle	0																
35	D1	0																
36	D2	0																
37	D3	0																
38	D4	0																
39	D5	0																
40	Transfer	83,862																
41	E1	16,295	2,498	2,498	2,498	2,498	2,498	2,498										
42	E2	4,400		750	750	750	750	750										
43	E3	0																
44	E4	0																
45	E5	1,249						1,249										
46	E6	61,918							2,498	2,498	2,498	2,498	2,498	2,498	2,498	2,498	2,498	2,498
47	E7 - 100/0																	
48	E8	0																
49	E9	0																
50	Post-Tfr	1,249																
51	F1	0																
52	F2	0																
53	F3	0																
54	F4	0																
55	F5	0																
56	F6	0																
57	F7	0																
58	F8	1,249																

Captain

	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ
1																		
2																		
3																		
4																		
5																		
6																		
7																		
8	Feb-95	Mar-95	Apr-95	May-95	Jun-95	Jul-95	Aug-95	Sep-95	Oct-95	Nov-95	Dec-95	Jan-96	Feb-96	Mar-96	Apr-96	May-96	Jun-96	Jul-96
9	2,498	2,498	2,498	2,498	2,498	2,498	2,498	2,498	2,498	2,498	2,498	2,498	2,498	4,427	1,277	0	0	0
10	2,498	2,498	2,498	2,498	2,498	2,498	2,498	2,498	2,498	2,498	2,498	2,498	2,498	3,123	625	0	0	0
11																		
12														1,304	652			
13																		
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46	2,498	2,498	2,498	2,498	2,498	2,498	2,498	2,498	2,498	2,498	2,498	2,498	2,498	2,498				
47																		
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54																		
55																		
56																		
57																		
58														625	625			

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	94-047-wl-01			In-Flight Mission Planner						Personnel			Salary	Hourly				
2	Xfer type:	Product		Office:	WL/FIP					Maj		S&E	79,636	$38.29				
3	Signature:	7-Mar-94			X-55520					Capt		S&E	64,959	$31.23				
4	Expiration	7-Mar-96			WPAFB, OH					**GS-14**		**Legal**	**110,688**	**$53.22**	**Consulting**			
5	Location:	Atlanta GA			Contractor:		Lockheed Aero Systems											
6		Airfare:	$414															
7		Per Diem:	$119															
8	(Dollars)	$8,621	Oct-93	Nov-93	Dec-93	Jan-94	Feb-94	Mar-94	Apr-94	May-94	Jun-94	Jul-94	Aug-94	Sep-94	Oct-94	Nov-94	Dec-94	Jan-95
9	Sum	8,621	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	Human	8,621	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	Equip	0																
12	Travel	0																
13	Strategy	0																
14	A1	0																
15	A2	0																
16	A3	0																
17	A4	0																
18	A5	0																
19	A6	0																
20	A7	0																
21	A8	0																
22	A9	0																
23	ID Tech	0																
24	B1	0																
25	B2	0																
26	B3	0																
27	B4	0																
28	B5	0																
29	Marktng	0																
30	C1	0																
31	C2	0																
32	C3	0																
33	C4	0																
34	ID Vehcle	0																
35	D1	0																
36	D2	0																
37	D3	0																
38	D4	0																
39	D5	0																
40	Transfer	8,621																
41	E1	0																
42	E2	0																
43	E3	0																
44	E4	0																
45	E5	0																
46	E6	0																
47	E7	0																
48	E8	0																
49	E9	8,621																
50	Post-Tfr	0																
51	F1	0																
52	F2	0																
53	F3	0																
54	F4	0																
55	F5	0																
56	F6	0																
57	F7	0																
58	F8	0																

	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ
1																		
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3																		
4																		
5																		
6																		
7																		
8	Feb-95	Mar-95	Apr-95	May-95	Jun-95	Jul-95	Aug-95	Sep-95	Oct-95	Nov-95	Dec-95	Jan-96	Feb-96	Mar-96	Apr-96	May-96	Jun-96	Jul-96
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,874	2,874	2,874	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,874	2,874	2,874	0
11																		
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45																		
46																		
47																		
48																		
49															2,874	2,874	2,874	
50																		
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53																		
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56																		
57																		
58																		

PROJECT 93-267-wl-02

TiAl Process Property

Project 93-267-wl-02 TiAl Process Property

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	**93-267-wl-02**			TiAl Process Property						Personnel			Salary	Hourly	
2	Xfer type:	Process		Office:	WL/MLLN					**GS-15**		**S&E**	**143,472**	**$68.98**	
3	Signature:	3-Nov-93			X5-1345					GS-13*		TFP	83,697	$40.24	
4	Expiration	4-Mar-95			WPAFB					Technicians		Gov't Cont'r		$37.50	
5	Location:	Schenectady, NY			Contractor:		General Electric			Supervision*		Gov't Cont'r		N/A	
6		Airfare:	362							WTN		Consult	83,200	$40.00	
7	33,661	Per Diem:	119								***No separate sheet attached.**				
8	(Dollars)	$33,661	Jul-93	Aug-93	Sep-93	Oct-93	Nov-93	Dec-93	Jan-94	Feb-94	Mar-94	Apr-94	May-94	Jun-94	Jul-94
9	Total	$33,661	$2,689	$1,406	$1,086	$766	$1,528	$888	$888	$925	$2,797	$2,187	$2,084	$2,572	$1,372
10	Sum	$16,415	$1,309	$345	$345	$345	$828	$828	$828	$828	$828	$828	$828	$828	$828
11	Human	$15,934	$828	$345	$345	$345	$828	$828	$828	$828	$828	$828	$828	$828	$828
12	Equip	N/A													
13	Travel	$481	$481												
14	Strategy	0													
15	A1	0													
16	A2	0													
17	A3	0													
18	A4	0													
19	A5	0													
20	A6	0													
21	A7	0													
22	A8	0													
23	A9	0													
24	ID Tech	0													
25	B1	0													
26	B2	0													
27	B3	0													
28	B4	0													
29	B5	0													
30	Marktng	0													
31	C1	0													
32	C2	0													
33	C3	0													
34	C4	0													
35	ID Vehcle	0													
36	D1	0													
37	D2	0													
38	D3	0													
39	D4	0													
40	D5	0													
41	Transfer	16,415													
42	E1	2,343	828	345	345	345									
43	E2	0													
44	E3	0													
45	E4	0													
46	E5	0													
47	E6	7,036					414	414	414	414	414	414	414	414	414
48	E7 - 50/50	7,036					414	414	414	414	414	414	414	414	414
49	E8	0													
50	E9	0													
51	Post-Tfr	0													
52	F1	0													
53	F2	0													
54	F3	0													
55	F4	0													
56	F5	0													
57	F6	0													
58	F7	0													
59	F8	0													

Project 93-267-wl-02 TiAl Process Property

	P	Q	R	S	T	U	V	W	X
1									
2									
3		GS-13*		$402	<10 hours: Jul-Sep 93,				
4					Sub-step E2.				
5		Supervision*		$500	<10 hours: Mar-Sep 94,				
6					Sub-step E7.				
7									
8	Aug-94	Sep-94	Oct-94	Nov-94	Dec-94	Jan-95	Feb-95	Mar-95	Apr-95
9	$2,131	$2,778	$888	$888	$888	$888	$888	$888	$2,240
10	$828	$828	$828	$828	$828	$828	$828	$828	$0
11	$828	$828	$828	$828	$828	$828	$828	$828	$0
12									
13									
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19									
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44									
45									
46									
47	414	414	414	414	414	414	414	414	
48	414	414	414	414	414	414	414	414	
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59									

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	**93-267-wl-02**			TiAl Process Property						Personnel			Salary	Hourly	
2	Xfer type:	Process		Office:	WL/MLLN					GS-15		S&E	143,472	$68.98	
3	Signature:	3-Nov-93			X5-1345					GS-13*		TFP	83,697	$40.24	
4	Expiration	4-Mar-95			WPAFB					**Technicians**		**Gov't Cont'r**		**$37.50**	
5	Location:	Schenectady, NY			Contractor:		General Electric			Supervision*		Gov't Cont'r		N/A	
6		Airfare:	362							WTN		Consult	83,200	$40.00	
7		Per Diem:	119								***No separate sheet attached.**				
8	(Dollars)	$9,244	Jul-93	Aug-93	Sep-93	Oct-93	Nov-93	Dec-93	Jan-94	Feb-94	Mar-94	Apr-94	May-94	Jun-94	Jul-94
9	Sum	$9,244	$0	$0	$0	$0	$0	$0	$0	$38	$1,838	$1,228	$1,125	$1,613	$413
10	Human	$9,244	$0	$0	$0	$0	$0	$0	$0	$38	$1,838	$1,228	$1,125	$1,613	$413
11	Equip	$0													
12	Travel	$0													
13	Strategy	0													
14	A1	0													
15	A2	0													
16	A3	0													
17	A4	0													
18	A5	0													
19	A6	0													
20	A7	0													
21	A8	0													
22	A9	0													
23	ID Tech	0													
24	B1	0													
25	B2	0													
26	B3	0													
27	B4	0													
28	B5	0													
29	Marktng	0													
30	C1	0													
31	C2	0													
32	C3	0													
33	C4	0													
34	ID Vehcle	0													
35	D1	0													
36	D2	0													
37	D3	0													
38	D4	0													
39	D5	0													
40	Transfer	9,244													
41	E1	0													
42	E2	0													
43	E3	0													
44	E4	0													
45	E5	0													
46	E6	9,244								38	1,838	1,228	1,125	1,613	413
47	E7	0													
48	E8	0													
49	E9	0													
50	Post-Tfr	0													
51	F1	0													
52	F2	0													
53	F3	0													
54	F4	0													
55	F5	0													
56	F6	0													
57	F7	0													
58	F8	0													

	P	Q	R	S	T	U	V	W	X
1									
2									
3		GS-13*		$402	<10 hours: Jul-Sep 93,				
4					Sub-step E2.				
5		Supervision*		$500	<10 hours: Mar-Sep 94,				
6					Sub-step E7.				
7									
8	Aug-94	Sep-94	Oct-94	Nov-94	Dec-94	Jan-95	Feb-95	Mar-95	Apr-95
9	$1,172	$1,819	$0	$0	$0	$0	$0	$0	$0
10	$1,172	$1,819	$0	$0	$0	$0	$0	$0	$0
11									
12									
13									
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38									
39									
40									
41									
42									
43									
44									
45									
46	1,172	1,819							
47									
48									
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54									
55									
56									
57									
58									

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	93-267-wl-02			TiAl Process Property						Personnel			Salary	Hourly	
2	Xfer type:	Process		Office:	WL/MLLN					GS-15		S&E	143,472	$68.98	
3	Signature:	3-Nov-93			X5-1345					GS-13*		TFP	83,697	$40.24	
4	Expiration	4-Mar-95			WPAFB					Technicians		Gov't Cont'r		$37.50	
5	Location:	Schenectady, NY			Contractor:		General Electric			Supervision*		Gov't Cont'r		N/A	
6		Airfare:	362							WTN		**Consult**	**83,200**	**$40.00**	
7		Per Diem:	119								***No separate sheet attached.**				
8	(Dollars)	$7,100	Jul-93	Aug-93	Sep-93	Oct-93	Nov-93	Dec-93	Jan-94	Feb-94	Mar-94	Apr-94	May-94	Jun-94	Jul-94
9	Sum	$7,100	$1,280	$960	$640	$320	$700	$60	$60	$60	$60	$60	$60	$60	$60
10	Human	$7,100	$1,280	$960	$640	$320	$700	$60	$60	$60	$60	$60	$60	$60	$60
11	Equip	$0													
12	Travel	$0													
13	Strategy	0													
14	A1	0													
15	A2	0													
16	A3	0													
17	A4	0													
18	A5	0													
19	A6	0													
20	A7	0													
21	A8	0													
22	A9	0													
23	ID Tech	0													
24	B1	0													
25	B2	0													
26	B3	0													
27	B4	0													
28	B5	0													
29	Marktng	0													
30	C1	0													
31	C2	0													
32	C3	0													
33	C4	0													
34	ID Vehcle	0													
35	D1	0													
36	D2	0													
37	D3	0													
38	D4	0													
39	D5	0													
40	Transfer	4,220													
41	E1	1,280	640	320	320										
42	E2	1,920	640	640	320	320									
43	E3	0													
44	E4	0													
45	E5	0													
46	E6	0													
47	E7	1,020					60	60	60	60	60	60	60	60	60
48	E8	0													
49	E9	0													
50	Post-Tfr	2,880													
51	F1	0													
52	F2	0													
53	F3	0													
54	F4	0													
55	F5	0													
56	F6	0													
57	F7	1,280					640								
58	F8	1,600													

	P	Q	R	S	T	U	V	W	X
1									
2									
3		GS-13*		$402	<10 hours: Jul-Sep 93,				
4					Sub-step E2.				
5		Supervision*		$500	<10 hours: Mar-Sep 94,				
6					Sub-step E7.				
7									
8	Aug-94	Sep-94	Oct-94	Nov-94	Dec-94	Jan-95	Feb-95	Mar-95	Apr-95
9	$60	$60	$60	$60	$60	$60	$60	$60	$2,240
10	$60	$60	$60	$60	$60	$60	$60	$60	$2,240
11									
12									
13									
14									
15									
16									
17									
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35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47	60	60	60	60	60	60	60	60	
48									
49									
50									
51									
52									
53									
54									
55									
56									
57									640
58									1,600

PROJECT 93-250-wl-01

TiAl Foil into Aircraft Parts

Project 93-250-wl-01 TiAl Foil into Aircraft Parts

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	**93-250-wl-01**			Ti-Al foil into aircraft parts						Personnel			Salary	Hourly	
2	Xfer type:	Process		Office:	WL/MLLN					GS-15		S&E	143,472	$68.98	
3	Signature:	30-Sep-93			X5-1345					GS-13*		TFP	83,697	$40.24	
4	Expiration	30-Sep-94			WPAFB					Technicians		Gov't Cont'r		$37.50	
5	Location:	OH			Contractor:		Ribbon Technology			Supervision*		Gov't Cont'r		N/A	
6		Airfare:	N/A							WTN		Consult	83,200	$40.00	
7		Per Diem:	N/A								*No separate sheet attached.				
8	(Dollars)	$24,913	May-93	Jun-93	Jul-93	Aug-93	Sep-93	Oct-93	Nov-93	Dec-93	Jan-94	Feb-94	Mar-94	Apr-94	May-94
9	Total	$24,913	$1,516	$876	$876	$625	$1,738	$905	$905	$905	$905	$905	$1,318	$1,187	$1,730
10	Sum	$11,450	$138	$138	$138	$207	$621	$828	$828	$828	$828	$828	$828	$828	$828
11	Human	$11,450	$138	$138	$138	$207	$621	$828	$828	$828	$828	$828	$828	$828	$828
12	Equip	N/A													
13	Travel	N/A													
14	Strategy	0													
15	A1	0													
16	A2	0													
17	A3	0													
18	A4	0													
19	A5	0													
20	A6	0													
21	A7	0													
22	A8	0													
23	A9	0													
24	ID Tech	0													
25	B1	0													
26	B2	0													
27	B3	0													
28	B4	0													
29	B5	0													
30	Marktng	0													
31	C1	0													
32	C2	0													
33	C3	0													
34	C4	0													
35	ID Vehcle	0													
36	D1	0													
37	D2	0													
38	D3	0													
39	D4	0													
40	D5	0													
41	Transfer	11,577													
42	E1	552	138	138	138	138									
43	E2	540	80	80	80	149	149								
44	E3	0	**$80/month - TFP**												
45	E4	552					552								
46	E5	0													
47	E6	9,933						828	828	828	828	828	828	828	828
48	E7 - 100/0	0													
49	E8	0													
50	E9	0													
51	Post-Tfr	276													
52	F1	0													
53	F2	0													
54	F3	0													
55	F4	0													
56	F5	0													
57	F6	0													
58	F7	0													
59	F8	276													

Project 93-250-wl-01 TiAl Foil into Aircraft Parts

	P	Q	R	S	T	U	V	W	X	Y	Z
1											
2											
3		GS-13*		$402	<10 hours: May-Sep 93,						
4					Sub-step E2.						
5		Govn't Cont'r*		$300	<10 hours: May 93-Sep 94,						
6					Sub-step E7.						
7											
8	Jun-94	Jul-94	Aug-94	Sep-94	Oct-94	Nov-94	Dec-94	Jan-95	Feb-95	Mar-95	Apr-95
9	$1,093	$2,218	$1,599	$1,181	$60	$60	$60	$60	$60	$1,476	$2,653
10	$828	$828	$828	$1,104	$0	$0	$0	$0	$0	$0	$0
11	$828	$828	$828	$1,104	$0	$0	$0	$0	$0	$0	$0
12											
13											
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37											
38											
39											
40											
41											
42											
43											
44											
45											
46											
47	828	828	828	828							
48											
49											
50											
51											
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54											
55											
56											
57											
58											
59				276							

Technicians

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	93-250-wl-01			Ti-Al foil into aircraft parts						Personnel			Salary	Hourly	
2	Xfer type:	Process		Office:	WL/MLLN					GS-15		S&E	143,472	$68.98	
3	Signature:	30-Sep-93			X5-1345					GS-13*		TFP	83,697	$40.24	
4	Expiration	30-Sep-94			WPAFB					**Technicians**		**Gov't Cont'r**		**$37.50**	
5	Location:	OH			Contractor:		Ribbon Technology			Supervision*		Gov't Cont'r		N/A	
6		Airfare:	N/A							WTN		Consult	83,200	$40.00	
7		Per Diem:	N/A								***No separate sheet attached.**				
8	(Dollars)	$5,541	May-93	Jun-93	Jul-93	Aug-93	Sep-93	Oct-93	Nov-93	Dec-93	Jan-94	Feb-94	Mar-94	Apr-94	May-94
9	Sum	$5,541	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$413	$281	$825
10	Human	$5,541	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$413	$281	$825
11	Equip	N/A													
12	Travel	N/A													
13	Strategy	0													
14	A1	0													
15	A2	0													
16	A3	0													
17	A4	0													
18	A5	0													
19	A6	0													
20	A7	0													
21	A8	0													
22	A9	0													
23	ID Tech	0													
24	B1	0													
25	B2	0													
26	B3	0													
27	B4	0													
28	B5	0													
29	Marktng	0													
30	C1	0													
31	C2	0													
32	C3	0													
33	C4	0													
34	ID Vehcle	0													
35	D1	0													
36	D2	0													
37	D3	0													
38	D4	0													
39	D5	0													
40	Transfer	5,541													
41	E1	0													
42	E2	0													
43	E3	0													
44	E4	0													
45	E5	0													
46	E6	5,541											413	281	825
47	E7	0													
48	E8	0													
49	E9	0													
50	Post-Tfr	0													
51	F1	0													
52	F2	0													
53	F3	0													
54	F4	0													
55	F5	0													
56	F6	0													
57	F7	0													
58	F8	0													

Technicians

	P	Q	R	S	T	U	V	W	X	Y	Z
1											
2											
3		GS-13*		$402	<10 hours: May-Sep 93,						
4					Sub-step E2.						
5		Govn't Cont'r*		$500	<10 hours: May 93-Sep 94,						
6					Sub-step E7.						
7											
8	Jun-94	Jul-94	Aug-94	Sep-94	Oct-94	Nov-94	Dec-94	Jan-95	Feb-95	Mar-95	Apr-95
9	$188	$1,313	$694	$0	$0	$0	$0	$0	$0	$1,416	$413
10	$188	$1,313	$694	$0	$0	$0	$0	$0	$0	$1,416	$413
11											
12											
13											
14											
15											
16											
17											
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41											
42											
43											
44											
45											
46	188	1,313	694							1,416	413
47											
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52											
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54											
55											
56											
57											
58											

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	**93-250-wl-01**			Ti-Al foil into aircraft parts						Personnel			Salary	Hourly	
2	Xfer type:	Process		Office:	WL/MLLN					GS-15		S&E	143,472	$68.98	
3	Signature:	30-Sep-93			X5-1345					GS-13*		TFP	83,697	$40.24	
4	Expiration	30-Sep-94			WPAFB					Technicians		Gov't Cont'r		$37.50	
5	Location:	OH			Contractor:		Ribbon Technology			Supervision*		Gov't Cont'r		N/A	
6		Airfare:	N/A							**WTN**		**Consult**	**83,200**	**$40.00**	
7		Per Diem:	N/A								***No separate sheet attached.**				
8	(Dollars)	$7,220	May-93	Jun-93	Jul-93	Aug-93	Sep-93	Oct-93	Nov-93	Dec-93	Jan-94	Feb-94	Mar-94	Apr-94	May-94
9	Sum	$7,220	$1,280	$640	$640	$320	$1,020	$60	$60	$60	$60	$60	$60	$60	$60
10	Human	$7,220	$1,280	$640	$640	$320	$1,020	$60	$60	$60	$60	$60	$60	$60	$60
11	Equip	N/A													
12	Travel	N/A													
13	Strategy	0													
14	A1	0													
15	A2	0													
16	A3	0													
17	A4	0													
18	A5	0													
19	A6	0													
20	A7	0													
21	A8	0													
22	A9	0													
23	ID Tech	0													
24	B1	0													
25	B2	0													
26	B3	0													
27	B4	0													
28	B5	0													
29	Marktng	0													
30	C1	0													
31	C2	0													
32	C3	0													
33	C4	0													
34	ID Vehcle	0													
35	D1	0													
36	D2	0													
37	D3	0													
38	D4	0													
39	D5	0													
40	Transfer	4,340													
41	E1	1,280	640	320	320										
42	E2	1,920	640	320	320	320	320								
43	E3	0													
44	E4	0													
45	E5	0													
46	E6	0													
47	E7	1,140					60	60	60	60	60	60	60	60	60
48	E8	0													
49	E9	0													
50	Post-Tfr	2,880													
51	F1	0													
52	F2	0													
53	F3	0													
54	F4	0													
55	F5	0													
56	F6	0													
57	F7	1,280					640								
58	F8	1,600													

	P	Q	R	S	T	U	V	W	X	Y	Z
1											
2											
3		GS-13*		$402	<10 hours: May-Sep 93,						
4					Sub-step E2.						
5		Govn't Cont'r*		$500	<10 hours: May 93-Sep 94,						
6					Sub-step E7.						
7											
8	Jun-94	Jul-94	Aug-94	Sep-94	Oct-94	Nov-94	Dec-94	Jan-95	Feb-95	Mar-95	Apr-95
9	$60	$60	$60	$60	$60	$60	$60	$60	$60	$60	$2,240
10	$60	$60	$60	$60	$60	$60	$60	$60	$60	$60	$2,240
11											
12											
13											
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36											
37											
38											
39											
40											
41											
42											
43											
44											
45											
46											
47	60	60	60	60	60	60	60	60	60	60	
48											
49											
50											
51											
52											
53											
54											
55											
56											
57											640
58											1,600

PROJECT 93-221-wl-01

Compressor Casing Treatments

Project 93-221-wl-01 Compressor Casing Treatments

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	**93-221-wl-01**			Compressor Casing Treatments					Personnel		Salary	Hourly	
2	Xfer type:	Product		Office:	WL/POTF				GS-14		110,688	$53.22	S&E
3	Signature:	29-Aug-93			X5-6716				GS-13*		83,697	$40.24	TFP
4	Expiration	26-Apr-94			WPAFB				GS-14*		110,688	$53.22	Legal
5	Location:	Tullahoma TN			Contractor: Davis Engineering				GS-12*		63,405	$30.48	Tech
6		Airfare:	N/A						Test Tech.		63,405	$30.48	
7		Per Diem:	N/A							*No separate sheet attached.			
8	(Dollars)	$17,603	Apr-93	May-93	Jun-93	Jul-93	Aug-93	Sep-93	Oct-93	Nov-93	Dec-93	Jan-94	Feb-94
9	Total	$17,603	$426	$526	$526	$526	$1,165	$0	$0	$0	$0	$0	$0
10	Sum	$8,514	$426	$426	$426	$426	$426	$0	$0	$0	$0	$0	$0
11	Human	8,514	426	426	426	426	426	0	0	0	0	0	0
12	Equip	N/A											
13	Travel	N/A											
14	Strategy	0											
15	A1	0											
16	A2	0											
17	A3	0											
18	A4	0											
19	A5	0											
20	A6	0											
21	A7	0											
22	A8	0											
23	A9	0											
24	ID Tech	0											
25	B1	0											
26	B2	0											
27	B3	0											
28	B4	0											
29	B5	0											
30	Marktng	0											
31	C1	0											
32	C2	0											
33	C3	0											
34	C4	0											
35	ID Vehcle	0											
36	D1	0											
37	D2	0											
38	D3	0											
39	D4	0											
40	D5	0											
41	Transfer	17,603											
42	E1	2,129	426	426	426	426	426						
43	E2	402	*TFP(	101	101	101	101	)					
44	E3	639				*Legal(	639	)					
45	E4	0											
46	E5	0											
47	E6	13,476											
48	E7 - 75/25	532											
49	E8	0											
50	E9	426											
51	Post-Tfr	0											
52	F1	0											
53	F2	0											
54	F3	0											
55	F4	0											
56	F5	0											
57	F6	0											
58	F7	0											
59	F8	0											

Project 93-221-wl-01 Compressor Casing Treatments

	N	O	P	Q	R	S	T	U
1								
2								
3	$402	< 10 hours: May-Aug 93, Sub-step E2.					TFP	
4	$639	12 hrs: Aug 93, Sub-step E3.					Legal	
5	$1,707	56 hrs: Sep 94, Sub-step E6.					Tech	
6	$6,341	208 hrs: Sep 94, Sub-step E6.					Test Tech.	
7								
8	Mar-94	Apr-94	May-94	Jun-94	Jul-94	Aug-94	Sep-94	Oct-94
9	0	0	0	0	0	0	10,176	4,257
10	0	0	0	0	0	0	2,129	4,257
11	0	0	0	0	0	0	2,129	4,257
12								
13								
14								
15								
16								
17								
18								
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20								
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40								
41								
42								
43								
44			**Includes: (as noted above)**					
45			**1) "Tech"-56 hrs ($1,707).**					
46			**2) "Test Tech"-208 hrs ($6,341).**					
47			**($1,707+$6,341=$8,048)**				9,644	3,832
48							532	
49								
50								426
51								
52								
53								
54								
55								
56								
57								
58								
59								

PROJECT 93-208-wl-01

GE-90 Blade Testing

Project 93-208-wl-01 GE-90 Blade Testing

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	**94-208-wl-01**			GE-90 Blade Testing					Personnel			Salary	Hourly					
2	Xfer type:	Facility		Office:	WL/POME				**GS-13**		**S&E**	**83,697**	**$40.24**					
3	Signature:	7-Aug-93			X5-4013				GS-13*		TFP	83,697	$40.24	>>>>>	$241	6 hrs: May-Aug 93,		
4	Expiration	7-Aug-95			WPAFB				Technical Support			79,341	$38.14			Sub-step E2.		
5	Location:				Contractor:		General Electric		GS-14*		Legal	110,688	$53.22	>>>>>	$798	15 hrs: Jun-Aug 93,		
6		Airfare:	N/A													Sub-step E4.		
7		Per Diem:	N/A							*No separate sheet attached.								
8	(Dollars)	$641,496	Apr-93	May-93	Jun-93	Jul-93	Aug-93	Sep-93	Oct-93	Nov-93	Dec-93	Jan-94	Feb-94	Mar-94	Apr-94	May-94	Jun-94	Jul-94
9	Total w/o Tech	50,332	0	60	729	326	1,775	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449
10	Total	641,496	0	60	729	326	19,689	19,363	19,363	19,363	19,363	19,363	19,363	19,363	19,363	19,363	19,363	19,363
11	Sum	49,293	0	0	402	0	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449
12	Human	49,293	0	0	402	0	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449
13	Travel & Equipment		N/A															
14	Strategy	0																
15	A1	0																
16	A2	0																
17	A3	0																
18	A4	0																
19	A5	0																
20	A6	0																
21	A7	0																
22	A8	0																
23	A9	0																
24	ID Tech	0																
25	B1	0																
26	B2	0																
27	B3	0																
28	B4	0																
29	B5	0																
30	Marktng	0																
31	C1	0																
32	C2	0																
33	C3	0																
34	C4	0																
35	ID Vehcle	0																
36	D1	0																
37	D2	0																
38	D3	0																
39	D4	0																
40	D5	0																
41	Transfer	50,051																
42	E1	0																
43	E2	241	*TFP (	60	60	60	60	)										
44	E3	402			402													
45	E4	798	*Legal (		266	266	266	)										
46	E5	0																
47	E6	0																
48	E7 - 50/50	47,804					1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449
49	E8	0																
50	E9	805																
51	Post-Tfr	282																
52	F1	0																
53	F2	0																
54	F3	0																
55	F4	0																
56	F5	0																
57	F6	0																
58	F7	282																
59	F8	0																

Project 93-208-wl-01 GE-90 Blade Testing

	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK
1																			
2																			
3																			
4																			
5																			
6																			
7																			
8	Aug-94	Sep-94	Oct-94	Nov-94	Dec-94	Jan-95	Feb-95	Mar-95	Apr-95	May-95	Jun-95	Jul-95	Aug-95	Sep-95	Oct-95	Nov-95	Dec-95	Jan-96	Feb-96
9	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,489	1,489
10	19,363	19,363	19,363	19,363	19,363	19,363	19,363	19,363	19,363	19,363	19,363	19,363	19,363	19,363	19,363	19,363	19,363	19,403	19,403
11	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,489	1,489
12	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,489	1,489
13																			
14																			
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39																			
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41																			
42																			
43																			
44																			
45																			
46																			
47																			
48	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449	1,449
49																			
50																			
51																			
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53																			
54																			
55																			
56																			
57																			
58																		40	40
59																			

Project 93-208-wl-01 GE-90 Blade Testing

	AL	AM	AN	AO	AP
1					
2					
3					
4					
5					
6					
7					
8	Mar-96	Apr-96	May-96	Jun-96	Jul-96
9	1,489	1,489	443	443	40
10	19,403	19,403	443	443	40
11	1,489	1,489	443	443	40
12	1,489	1,489	443	443	40
13					
14					
15					
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42					
43					
44					
45					
46					
47					
48	1,449	1,449			
49					
50			402	402	
51					
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53					
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57					
58	40	40	40	40	40
59					

Technician

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	94-208-wl-01			GE-90 Blade Testing					Personnel			Salary	Hourly			
2	Xfer type:	Facility		Office:	WL/POME				GS-13		S&E	83,697	$40.24			
3	Signature:	7-Aug-93			X5-4013				GS-13*		TFP	83,697	$40.24	>>>>>>	$241	6 hrs: Ma
4	Expiration	7-Aug-95			WPAFB				**Technical Support**			**79,341**	**$38.14**			Sub-step
5	Location:				Contractor:		General Electric		GS-14*		Legal	110,688	$53.22	>>>>>>	$798	15 hrs: Ju
6		Airfare:	N/A													Sub-step
7		Per Diem:	N/A							***No separate sheet attached.**						
8	(Dollars)	$591,163	Apr-93	May-93	Jun-93	Jul-93	Aug-93	Sep-93	Oct-93	Nov-93	Dec-93	Jan-94	Feb-94	Mar-94	Apr-94	May-94
9	Sum	$591,163	$0	$0	$0	$0	$17,914	$17,914	$17,914	$17,914	$17,914	$17,914	$17,914	$17,914	$17,914	$17,914
10	Human	$591,163	$0	$0	$0	$0	$17,914	$17,914	$17,914	$17,914	$17,914	$17,914	$17,914	$17,914	$17,914	$17,914
11	Equip	N/A														
12	Travel	N/A														
13	Strategy	0														
14	A1	0														
15	A2	0														
16	A3	0														
17	A4	0														
18	A5	0														
19	A6	0														
20	A7	0														
21	A8	0														
22	A9	0														
23	ID Tech	0														
24	B1	0														
25	B2	0														
26	B3	0														
27	B4	0														
28	B5	0														
29	Marktng	0														
30	C1	0														
31	C2	0														
32	C3	0														
33	C4	0														
34	ID Vehcle	0														
35	D1	0														
36	D2	0														
37	D3	0														
38	D4	0														
39	D5	0														
40	Transfer	591,163														
41	E1	0														
42	E2	0														
43	E3	0														
44	E4	0														
45	E5	0														
46	E6	591,163					17,914	17,914	17,914	17,914	17,914	17,914	17,914	17,914	17,914	17,914
47	E7	0														
48	E8	0														
49	E9	0														
50	Post-Tfr	0														
51	F1	0														
52	F2	0														
53	F3	0														
54	F4	0														
55	F5	0														
56	F6	0														
57	F7	0														
58	F8	0														

Technician

	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
1																
2																
3	-Aug 93,															
4	2.															
5	-Aug 93,															
6	4.															
7																
8	Jun-94	Jul-94	Aug-94	Sep-94	Oct-94	Nov-94	Dec-94	Jan-95	Feb-95	Mar-95	Apr-95	May-95	Jun-95	Jul-95	Aug-95	Sep-95
9	$17,914	$17,914	$17,914	$17,914	$17,914	$17,914	$17,914	$17,914	$17,914	$17,914	$17,914	$17,914	$17,914	$17,914	$17,914	$17,914
10	$17,914	$17,914	$17,914	$17,914	$17,914	$17,914	$17,914	$17,914	$17,914	$17,914	$17,914	$17,914	$17,914	$17,914	$17,914	$17,914
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43																
44																
45																
46	17,914	17,914	17,914	17,914	17,914	17,914	17,914	17,914	17,914	17,914	17,914	17,914	17,914	17,914	17,914	17,914
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Technician

	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP
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7										
8	Oct-95	Nov-95	Dec-95	Jan-96	Feb-96	Mar-96	Apr-96	May-96	Jun-96	Jul-96
9	$17,914	$17,914	$17,914	$17,914	$17,914	$17,914	$17,914	$0	$0	$0
10	$17,914	$17,914	$17,914	$17,914	$17,914	$17,914	$17,914	$0	$0	$0
11										
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46	17,914	17,914	17,914	17,914	17,914	17,914	17,914			
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PROJECT 93-207-wl-01

Interface Property Data test Stand

Project 93-207-wl-01 Interface Property Data Test Stand

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	93-207-wl-01			Interface Property Data Test Stand						Personnel			Salary	Hourly			
2	Xfer type:	Product		Office:	WL/MLLM-3					GS-13			83,697	$40.24		S&E	
3	Signature:	5-Aug-93			X5-9821					WTN			83,200	$40.00		Consult	
4	Expiration:	5-Aug-94			WPAFB					Legal*	AFMC Comp.		110,688	$53.22	$213	Consult	
5	Location:	Tipp City, OH			Contractor:		Process Equipment Co.						*4 hours, Jul 93, Sub-step E4				
6		Airfare:	N/A										No separate sheet attached.				
7		Per Diem	N/A														
8	(Dollars)	$15,998	Mar-93	Apr-93	May-93	Jun-93	Jul-93	Aug-93	Sep-93	Oct-93	Nov-93	Dec-93	Jan-94	Feb-94	Mar-94	Apr-94	May-94
9	Total	$15,998	$1,600	$1,320	$680	$680	$1,857	$1,024	$704	$704	$704	$704	$704	$704	$1,670	$704	$2,240
10	Sum	$7,565	$0	$40	$40	$40	$684	$644	$644	$644	$644	$644	$644	$644	$1,610	$644	$0
11	Human	$7,565	$0	$40	$40	$40	$684	$644	$644	$644	$644	$644	$644	$644	$1,610	$644	$0
12	Equip	N/A															
13	Travel	N/A															
14	Strategy	0															
15	A1	0															
16	A2	0															
17	A3	0															
18	A4	0															
19	A5	0															
20	A6	0															
21	A7	0															
22	A8	0															
23	A9	0															
24	ID Tech	0															
25	B1	0															
26	B2	0															
27	B3	0															
28	B4	0															
29	B5	0															
30	Marketing	0															
31	C1	0															
32	C2	0															
33	C3	0															
34	C4	0															
35	ID Vehicle	0															
36	D1	0															
37	D2	0															
38	D3	0															
39	D4	0															
40	D5	0															
41	Transfer	7778															
42	E1	0															
43	E2	0															
44	E3	161		40	40	40	40										
45	E4	213				Legal (	213	)									
46	E5	0															
47	E6	6277					644	644	644	644	644	644	644	644	644	483	
48	E7 - 100/0	0															
49	E8	0															
50	E9	1127													966	161	
51	Post-Tfr	0															
52	F1	0															
53	F2	0															
54	F3	0															
55	F4	0															
56	F5	0															
57	F6	0															
58	F7	0															
59	F8	0															

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	**93-207-wl-01**			Interface Property Data Test Stand						Personnel			Salary	Hourly			
2	Xfer type:	Product		Office:	WL/MLLM-3					GS-13			83,697	$40.24		S&E	
3	Signature:	5-Aug-93			X5-9821					**WTN**			**83,200**	**$40.00**		**Consult**	
4	Expiration:	5-Aug-94			WPAFB					Legal*	AFMC Comp.		110,688	$53.22	$213	Consult	
5	Location:	Tipp City, OH			Contractor:		Process Equipment Co.						*4 hours, Jul 93, Sub-step E4				
6		Airfare:	N/A										**No separate sheet attached.**				
7	$8,220	Per Diem	N/A														
8	(Dollars)	$8,220	Mar-93	Apr-93	May-93	Jun-93	Jul-93	Aug-93	Sep-93	Oct-93	Nov-93	Dec-93	Jan-94	Feb-94	Mar-94	Apr-94	May-94
9	Total	$8,220	$1,600	$1,280	$640	$640	$960	$380	$60	$60	$60	$60	$60	$60	$60	$60	$2,240
10	Sum	$8,220	$1,600	$1,280	$640	$640	$960	$380	$60	$60	$60	$60	$60	$60	$60	$60	$2,240
11	Human	$8,220	$1,600	$1,280	$640	$640	$960	$380	$60	$60	$60	$60	$60	$60	$60	$60	$2,240
12	Equip	N/A															
13	Travel	N/A															
14	Strategy	0															
15	A1	0															
16	A2	0															
17	A3	0															
18	A4	0															
19	A5	0															
20	A6	0															
21	A7	0															
22	A8	0															
23	A9	0															
24	ID Tech	1600															
25	B1	0															
26	B2	1600	1600														
27	B3	0															
28	B4	0															
29	B5	0															
30	Marketing	0															
31	C1	0															
32	C2	0															
33	C3	0															
34	C4	0															
35	ID Vehicle	0															
36	D1	0															
37	D2	0															
38	D3	0															
39	D4	0															
40	D5	0															
41	Transfer	3740															
42	E1	1280		640	320	320											
43	E2	1920		640	320	320	320	320									
44	E3	0															
45	E4	0															
46	E5	0															
47	E6	0															
48	E7	540						60	60	60	60	60	60	60	60	60	
49	E8	0															
50	E9	0															
51	Post-Tfr	2880															
52	F1	0															
53	F2	0															
54	F3	0															
55	F4	0															
56	F5	0															
57	F6	0															
58	F7	1280					640										640
59	F8	1600															1,600

Appendix E: Analysis Data

The following is a listing of the Microsoft Excel spreadsheets used during data analysis.

Project Summary - Composite

1 of 5

	AW	AX	AY	BA	BB	BC
1	Total			Excluding Proj 93-208 Technicians		
2	Summary by Transfer Role			Summary by Transfer Role (Figure 4-31)		
3	S&E	$229,307	23.04%	S&E	$229,307	56.77%
4	TFP	$26,203	2.63%	TFP	$26,203	6.49%
5	Legal	$10,964	1.10%	Legal	$10,964	2.71%
6	Technicians	$613,996	61.70%	Technicians	$22,833	5.65%
7	WTN	$29,160	2.93%	WTN	$29,160	7.22%
8	Supervision	$800	0.08%	Supervision	$800	0.20%
9	Equipment	$45,500	4.57%	Equipment	$45,500	11.27%
10	Travel	$34,132	3.43%	Travel	$34,132	8.45%
11	Training	$5,000	0.50%	Training	$5,000	1.24%
12	Total	$995,062	100%	Total	$403,899	100%
13						
14	Summary by Major Step			Summary by Major Step (Figure 4-28)		
15						
16	Strategy	0	0.00%	Strategy	0	0.00%
17	ID Tech	1,600	0.16%	ID Tech	1,600	0.40%
18	Marketing	0	0.00%	Marketing	0	0.00%
19	ID Vehicle	11,166	1.12%	ID Vehicle	11,166	2.76%
20	Tansfer	961,400	96.62%	Tansfer	370,237	91.67%
21	Post Transfe	20,896	2.10%	Post Transfe	20,896	5.17%
22	Total	995,062	100%	Total	403,899	100.00%
23						
24	Detail of Transfer Step			Detail of Transfer Step		
25	E1	28,455	2.96%	E1	28,455	7.69%
26	E2	13,759	1.43%	E2	13,759	3.72%
27	E3	2,266	0.24%	E3	2,266	0.61%
28	E4	2,361	0.25%	E4	2,361	0.64%
29	E5	2,780	0.29%	E5	2,780	0.75%
30	E6	885,009	92.05%	E6	293,846	79.37%
31	E7	7,399	0.77%	E7	7,399	2.00%
32	E8	0	0.00%	E8	0	0.00%
33	E9	19,371	2.01%	E9	19,371	5.23%
34	Total	961,400	100%	Total	370,237	100%
35						

			Sub-Step				Ratio
36							
37							
38	Project	Cost	E6	%	All Others	%	(E to All)
39	93-207	$15,998	6,277	39	$9,721	61	0.6
40	93-208	$50,332	47,804	95	$2,528	5	18.9
41	93-221	$17,604	13,476	77	$4,128	23	3.3
42	93-250	$24,914	15,474	62	$9,440	38	1.6
43	93-267	$33,660	23,315	69	$10,345	31	2.3
44	94-047	$189,100	$143,233	76	$45,867	24	3.1
45	94-173	$25,383	16,498	65	$8,885	35	1.9
46	94-241	$46,908	27,769	59	$19,139	41	1.5
47	Total	$403,899	293,846	73	$110,053	27	2.7
48	w/o 93-208	$353,567	$246,042	70	$107,525	30	2.3
49							

Project Summary - Composite

2 of 5

	A	B	C	D	E	F	G	H	I	J	K	L
1	Checks	$995,062	$995,062	93-207 (Product)				93-208 (Facility)				
2		Percent of Total	$995,062	S&E	WTN	Legal	Sum	S&E	Technician (Test)*	TFP	Legal	Sum
3	Total	100%	$995,062	$7,565	$8,220	$213	$15,998	$49,293	$591,163	$241	$798	$641,495
4	Strategy	0.00%	$0									
5	A1	0.00%	$0									
6	A2	0.00%	$0									
7	A3	0.00%	$0									
8	A4	0.00%	$0									
9	A5	0.00%	$0									
10	A6	0.00%	$0									
11	A7	0.00%	$0									
12	A8	0.00%	$0									
13	A9	0.00%	$0									
14	ID Tech	0.16%	$1,600	0	1,600	0	1,600					
15	B1	0.00%	$0				0					
16	B2	0.16%	$1,600		1,600		1,600					
17	B3	0.00%	$0				0					
18	B4	0.00%	$0				0					
19	B5	0.00%	$0				0					
20	Marketing	0.00%	$0									
21	C1	0.00%	$0									
22	C2	0.00%	$0									
23	C3	0.00%	$0									
24	C4	0.00%	$0									
25	ID Vehicle	1.12%	$11,166									
26	D1	0.25%	$2,496									
27	D2	0.38%	$3,811									
28	D3	0.41%	$4,061									
29	D4	0.05%	$532									
30	D5	0.03%	$266									
31	Transfer	96.62%	$961,400	7,565	3,740	213	11,518	49,011	591,163	241	798	641,213
32	E1	2.86%	$28,455		1,280		1,280					0
33	E2	1.38%	$13,759		1,920		1,920			241		241
34	E3	0.23%	$2,266	161			161	402				402
35	E4	0.24%	$2,361			213	213				798	798
36	E5	0.28%	$2,780				0					0
37	E6	88.94%	$885,009	6,277			6,277	47,804	591,163			638,967
38	E7	0.74%	$7,399		540		540					0
39	E8	0.00%	$0				0					0
40	E9	1.95%	$19,371	1,127			1,127	805				805
41	Post-Tfr	2.10%	$20,896	0	2,880	0	2,880	282	0	0	0	282
42	F1	0.00%	$0				0					0
43	F2	0.00%	$0				0					0
44	F3	0.00%	$0				0					0
45	F4	0.04%	$373				0					0
46	F5	0.00%	$0				0					0
47	F6	0.31%	$3,063				0					0
48	F7	0.65%	$6,438		1,280		1,280	282				282
49	F8	1.11%	$11,022		1,600		1,600					0
50	Equipment	4.57%	$45,500									
51	Total Trav	4.30%	$42,755									
52	Already included:		0.87%	$8,623								
53	Unspecified (not incl'd)		3.43%	$34,132								
54	Training	0.50%	$5,000									

Project Summary - Composite

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	M	N	O	P	Q	R	S	T	U	V	W	X	Y
1	93-221 (Product)						93-250 (Process)						
2	S&E	TFP	Legal	Technician	Technician (Test)	Sum	S&E	TFP	Technician	Supervision (Contractor)	WTN	Sum	
3	$8,515	$402	$639	$1,707	$6,341	$17,604	$11,451	$402	$5,541	$300	$7,220	$24,914	
4													
5													A1
6													A2
7													A3
8													A4
9													A5
10													A6
11													A7
12													A8
13													A9
14													
15													B1
16													B2
17													B3
18													B4
19													B5
20													
21													C1
22													C2
23													C3
24													C4
25													
26													D1
27													D2
28													D3
29													D3
30													D5
31	8,515	402	639	1,707	6,341	17,604	11,175	402	5,541	300	4,340	21,758	
32	2,129					2,129	552				1,280	1,832	E1
33		402				402	138	402			1,920	2,460	E2
34			639			639						0	E3
35						0	552					552	E4
36						0						0	E5
37	5,428			1,707	6,341	13,476	9,933		5541			15,474	E6
38	532					532				300	1,140	1,440	E7
39						0						0	E8
40	426					426						0	E9
41							276	0	0	0	2,880	3,156	
42												0	F1
43												0	F2
44												0	F3
45												0	F4
46												0	F5
47												0	F6
48											1,280	1,280	F7
49							276				1,600	1,876	F8

Project Summary - Composite

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	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ
1	93-267 (Process)						94-047 (Product)				
2	S&E	TFP	Technician	Supervision (Contractor)	WTN	Sum	S&E-Maj	S&E-Capt	Legal	Sum	
3	$16,414	$402	$9,244	$500	$7,100	$33,660	$16,235	$85,111	$8,622	**$189,100**	
4											
5											A1
6											A2
7											A3
8											A4
9											A5
10											A6
11											A7
12											A8
13											A9
14											
15											B1
16											B2
17											B3
18											B4
19											B5
20											
21											C1
22											C2
23											C3
24											C4
25							$191	$0	$0	$191	
26										$0	D1
27										$0	D2
28							$191			$191	D3
29										$0	D3
30										$0	D5
31	16,414	402	9,244	500	4,220	30,780	$11,450	$83,210	$8,622	**$182,414**	
32	2,343				1,280	3,623	$958	$16,295		$17,253	E1
33		402			1,920	2,322		$4,400		$4,400	E2
34						0				$0	E3
35						0				$0	E4
36						0	$1,531	$1,249		$2,780	E5
37	14,071		9,244			23,315	$2,835	$61,266		**$143,233**	E6
38				500	1,020	1,520				$0	E7
39						0				$0	E8
40						0	$6,126		$8,622	$14,748	E9
41	0	0	481	0	2,880	2,880	$4,594	$1,901	$0	$6,495	
42						0				$0	F1
43						0				$0	F2
44						0				$0	F3
45						0				$0	F4
46						0				$0	F5
47						0	$3,063			$3,063	F6
48					1,280	1,280				$0	F7
49					1,600	1,600	$1,531	$1,901		$3,432	F8
50	Travel (already incl'd):		$481				Equipment		**$40,000**		
51							Travel (Unspecified)		**$34,132**		
52							Training (Unspecified)		**$5,000**		

Project Summary - Composite

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	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU
1	94-173 (Product)					94-241 (Product)				$46,908	
2	S&E	S&E	WTN	Legal	Sum	S&E	S&E	"TFP"	Legal	Sum	
3	$11,181	$7,316	$6,620	$266	$25,383	$13,247	$2,979	$24,756	$426	**$46,908**	
4											
5											A1
6											A2
7											A3
8											A4
9											A5
10											A6
11											A7
12											A8
13											A9
14											
15											B1
16											B2
17											B3
18											B4
19											B5
20											
21											C1
22											C2
23											C3
24											C4
25	62	0	0	0	62	4,542	0	5,945	426	10,913	
26	62				62	305		2,129		2,434	D1
27					0	1,219		2,592		3,811	D2
28					0	3,018		426	426	3,870	D3
29					0			532		532	D4
30					0			266		266	D5
31	11,119	7,316	3,740	266	22,441	7,181	2,979	18,012	0	**33,672**	
32	906		1,280		2,186	152				152	E1
33	94		1,920		2,014					0	E2
34					0			1,064		1,064	E3
35				266	266			532		532	E4
36					0					0	E5
37	9,182	7,316			16,498	3,406	2979	15,884		**27,769**	E6
38	937		540		1,477	1,890				1,890	E7
39					0					0	E8
40					0	1,733		532		2,265	E9
41	0	0	2,880	0	2,880	1,524	0	799	0	2,323	
42					0					0	F1
43					0					0	F2
44					0					0	F3
45					0			373		373	F4
46					0					0	F5
47					0					0	F6
48			1,280		1,280	610		426		1,036	F7
49			1,600		1,600	914				914	F8
50						Equipment		**$5,500**			
51						Travel (already incl'd):		**$2,274**			

Product Summary

1 of 3

	AD	AE	AF
1	**Product Total**		
2	**Summary by Transfer Role**		
3	S&E	$152,149	51.58%
4	TFP	$25,158	8.53%
5	Legal	$10,166	3.45%
6	Technicians	$8,048	2.73%
7	WTN	$14,840	5.03%
8	Supervision	$0	0.00%
9	Equipment	$45,500	15.42%
10	Travel	$34,132	11.57%
11	Training	$5,000	1.69%
12	Total	$294,993	100%
13			
14	**Summary by Major Step**		
15	Strategy	$0	0.00%
16	ID Tech	$1,600	0.54%
17	Marketing	$0	0.00%
18	ID Vehicle	$11,166	3.79%
19	Tansfer	$267,649	90.73%
20	Post Transfer	$14,578	4.94%
21	Total	$294,993	100%
22			
23	**Detail of Transfer Step**		
24	E1	$23,000	8.44%
25	E2	$8,736	3.20%
26	E3	$1,864	0.68%
27	E4	$1,011	0.37%
28	E5	$2,780	1.02%
29	E6	$212,253	77.85%
30	E7	$4,439	1.63%
31	E8	$0	0.00%
32	E9	$18,566	6.81%
33	Total	$272,649	100%
34			

Product Summary

2 of 3

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Checks	$294,993	$294,993	93-207 (Product)				93-221 (Product)					
2		Percent of Total	$294,993	S&E	WTN	Legal	Sum	S&E	TFP	Legal	Technician	Technician (Test)	Sum
3	Total	100%	$294,993	$7,565	$8,220	$213	$15,998	$8,515	$402	$639	$1,707	$6,341	$17,604
4	Strategy	0.00%	$0										
5	A1	0.00%	$0										
6	A2	0.00%	$0										
7	A3	0.00%	$0										
8	A4	0.00%	$0										
9	A5	0.00%	$0										
10	A6	0.00%	$0										
11	A7	0.00%	$0										
12	A8	0.00%	$0										
13	A9	0.00%	$0										
14	ID Tech	0.54%	$1,600	0	1,600	0	1,600						
15	B1	0.00%	$0				0						
16	B2	0.54%	$1,600		1,600		1,600						
17	B3	0.00%	$0				0						
18	B4	0.00%	$0				0						
19	B5	0.00%	$0				0						
20	Marketing	0.00%	$0										
21	C1	0.00%	$0										
22	C2	0.00%	$0										
23	C3	0.00%	$0										
24	C4	0.00%	$0										
25	ID Vehicle	3.79%	$11,166										
26	D1	0.85%	$2,496										
27	D2	1.29%	$3,811										
28	D3	1.38%	$4,061										
29	D4	0.18%	$532										
30	D5	0.09%	$266										
31	Transfer	90.73%	$267,649	7,565	3,740	213	11,518	8,515	402	639	1,707	6,341	17,604
32	E1	7.80%	$23,000		1,280		1,280	2,129					2,129
33	E2	2.96%	$8,736		1,920		1,920		402				402
34	E3	0.63%	$1,864	161			161			639			639
35	E4	0.34%	$1,011			213	213						0
36	E5	0.94%	$2,780				0						0
37	E6	70.26%	$207,253	6,277			6,277	5,428			1,707	6,341	13,476
38	E7	1.50%	$4,439		540		540	532					532
39	E8	0.00%	$0				0						0
40	E9	6.29%	$18,566	1,127			1,127	426					426
41	Post-Tfr	4.94%	$14,578	0	2,880	0	2,880						
42	F1	0.00%	$0				0						
43	F2	0.00%	$0				0						
44	F3	0.00%	$0				0						
45	F4	0.13%	$373				0						
46	F5	0.00%	$0				0						
47	F6	1.04%	$3,063				0						
48	F7	1.22%	$3,596		1,280		1,280						
49	F8	2.56%	$7,546		1,600		1,600						

Product Summary

3 of 3

	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB
1	94-047 (Product)				94-173 (Product)					94-241 (Product)					
2	S&E-Maj	S&E-Capt	Legal	Sum	S&E	S&E	WTN	Legal	Sum	S&E	S&E	TFP	Legal	Sum	
3	$16,235	$85,111	$8,622	**$189,100**	$11,181	$7,316	$6,620	$266	$25,383	$13,247	$2,979	$24,756	$426	**$46,908**	
4									25,383						
5															A1
6															A2
7															A3
8															A4
9															A5
10															A6
11															A7
12															A8
13															A9
14															
15															B1
16															B2
17															B3
18															B4
19															B5
20															
21															C1
22															C2
23															C3
24															C4
25	191	0	0	191	62	0	0	0	62	4,542	0	5,945	426	10,913	
26				0	62				62	305		2,129		2,434	D1
27				0					0	1,219		2,592		3,811	D2
28	191			191					0	3,018		426	426	3,870	D3
29				0					0			532		532	D3
30									0			266		266	D5
31	11,450	83,210	8,622	**182,414**	11,119	7,316	3,740	266	22,441	7,181	2,979	18,012	0	**33,672**	
32	958	16,295		17,253	906		1,280		2,186	152				152	E1
33		4,400		4,400	94		1,920		2,014					0	E2
34				0					0			1,064		1,064	E3
35				0				266	266			532		532	E4
36	1,531	1,249		2,780					0					0	E5
37	2,835	61,266		**143,233**	9,182	7,316			16,498	3,406	2,979	15,884		**27,769**	E6
38				0	937		540		1,477	1,890				1,890	E7
39				0					0					0	E8
40	6,126		8,622	14,748					0	1,733		532		2,265	E9
41	4,594	1,901	0	6,495	0	0	2,880	0	2,880	1,524	0	799	0	2,323	
42				0					0					0	F1
43				0					0					0	F2
44				0					0					0	F3
45				0					0			373		373	F4
46				0					0					0	F5
47	3,063			3,063					0					0	F6
48				0			1,280		1,280	610		426		1,036	F7
49	1,531	1,901		3,432			1,600		1,600	914				914	F8
50	Equipment		**40,000**	Sub-step E6						Equipment		**5,500**			
51	Travel(Unspecified)		**34,132**	Sub-step E6						Travel(Already Incl'd)		**2,274**			
52	Training(Unspecified)		**5,000**	Sub-step E6											

Facility Summary

1 of 2

	K	L	M	O	P	Q
	Facility Total			**Excluding Proj 93-208 Technicians**		
	Summary by Transfer Role			**Summary by Transfer Role**		
	S&E	$49,293	7.68%	S&E	$49,293	97.94%
	TFP	$241	0.04%	TFP	$241	0.48%
	Legal	$798	0.12%	Legal	$798	1.59%
	Technicians	$591,163	92.15%	Technicians	$0	0.00%
	WTN	$0	0.00%	WTN	$0	0.00%
	Supervision	$0	0.00%	Supervision	$0	0.00%
	Equipment	$0	0.00%	Equipment	$0	0.00%
	Total	$641,495	100%	Total	$50,332	100%
	Summary by Major Step			**Summary by Major Step**		
	Strategy	$0	0.00%	Strategy	$0	0.00%
	ID Tech	$0	0.00%	ID Tech	$0	0.00%
	Marketing	$0	0.00%	Marketing	$0	0.00%
	ID Vehicle	$0	0.00%	ID Vehicle	$0	0.00%
	Tansfer	$641,213	99.96%	Tansfer	$50,050	99.44%
	Post Transfer	$282	0.04%	Post Transfer	$282	0.56%
	Total	$641,495	100%	Total	$50,332	100%
	Detail of Transfer Step			**Detail of Transfer Step**		
	E1	$0	0.00%	E1	$0	0.00%
	E2	$241	0.04%	E2	$241	0.48%
	E3	$402	0.06%	E3	$402	0.80%
	E4	$798	0.12%	E4	$798	1.59%
	E5	$0	0.00%	E5	$0	0.00%
	E6	$638,967	99.65%	E6	$47,804	95.51%
	E7	$0	0.00%	E7	$0	0.00%
	E8	$0	0.00%	E8	$0	0.00%
	E9	$805	0.13%	E9	$805	1.61%
	Total	$641,213	100%	Total	$50,050	100%

Facility Summary

2 of 2

	A	B	C	D	E	F	G	H	I
1				93-208 (Facility)					
2		Percent of Total	$641,495	S&E	Technician (Test)	TFP	Legal	Sum	
3	Total	100%	$641,495	$49,293	$591,163	$241	$798	$641,495	
4	Strategy	0.00%	$0						
5	A1	0.00%	$0						A1
6	A2	0.00%	$0						A2
7	A3	0.00%	$0						A3
8	A4	0.00%	$0						A4
9	A5	0.00%	$0						A5
10	A6	0.00%	$0						A6
11	A7	0.00%	$0						A7
12	A8	0.00%	$0						A8
13	A9	0.00%	$0						A9
14	ID Tech	0.00%	$0						
15	B1	0.00%	$0						B1
16	B2	0.00%	$0						B2
17	B3	0.00%	$0						B3
18	B4	0.00%	$0						B4
19	B5	0.00%	$0						B5
20	Marketing	0.00%	$0						
21	C1	0.00%	$0						C1
22	C2	0.00%	$0						C2
23	C3	0.00%	$0						C3
24	C4	0.00%	$0						C4
25	ID Vehicle	0.00%	$0						
26	D1	0.00%	$0						D1
27	D2	0.00%	$0						D2
28	D3	0.00%	$0						D3
29	D4	0.00%	$0						D3
30	D5	0.00%	$0						D5
31	Transfer	99.96%	$641,213	49,011	591,163	241	798	641,213	
32	E1	0.00%	$0					0	E1
33	E2	0.04%	$241			241		241	E2
34	E3	0.06%	$402	402				402	E3
35	E4	0.12%	$798				798	798	E4
36	E5	0.00%	$0					0	E5
37	E6	99.61%	$638,967	47,804	591,163			638,967	E6
38	E7	0.00%	$0					0	E7
39	E8	0.00%	$0					0	E8
40	E9	0.13%	$805	805				805	E9
41	Post-Tfr	0.04%	$282	282	0	0		282	
42	F1	0.00%	$0					0	F1
43	F2	0.00%	$0					0	F2
44	F3	0.00%	$0					0	F3
45	F4	0.00%	$0					0	F4
46	F5	0.00%	$0					0	F5
47	F6	0.00%	$0					0	F6
48	F7	0.04%	$282	282				282	F7
49	F8	0.00%	$0					0	F8

Process Summary

1 of 3

	Q	R	S	T	U
1		**Process Total**			
2		**Summary by Transfer Role**			
3		S&E	27,865	47.57%	
4		TFP	804	1.37%	
5		Legal	0	0.00%	
6		Technician	14,785	25.24%	
7		WTN	14,320	24.45%	
8		Supervisio	800	1.37%	
9		Equipment	0	0.00%	
10		Total	58,574	100%	
11					
12		**Summary by Major Step**			
13		Strategy	0	0.00%	
14		ID Tech	0	0.00%	
15		Marketing	0	0.00%	
16		ID Vehicle	0	0.00%	
17		Tansfer	52,538	89.70%	
18		Post Transf	6,036	10.30%	
19		Total	58,574	100%	
20					
21		**Detail of Transfer Step**			
22		E1	5,455	10.38%	
23		E2	4,782	9.10%	
24		E3	0	0.00%	
25		E4	552	1.05%	
26		E5	0	0.00%	
27		E6	38,789	73.83%	
28		E7	2,960	5.63%	
29		E8	0	0.00%	
30		E9	0	0.00%	
31		Total	52,538	100%	
32					

Process Summary

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	A	B	C	D	E	F	G	H	I
1	Checks	$58,574	$58,574	93-250 (Process)					
2		Percent of Total	$58,574	S&E	TFP	Technician	Supervision (Contractor)	WTN	Sum
3	Total	100%	$58,574	$11,451	$402	$5,541	$300	$7,220	$24,914
4	Strategy	0.00%	$0						
5	A1	0.00%	$0						
6	A2	0.00%	$0						
7	A3	0.00%	$0						
8	A4	0.00%	$0						
9	A5	0.00%	$0						
10	A6	0.00%	$0						
11	A7	0.00%	$0						
12	A8	0.00%	$0						
13	A9	0.00%	$0						
14	ID Tech	0.00%	$0						
15	B1	0.00%	$0						
16	B2	0.00%	$0						
17	B3	0.00%	$0						
18	B4	0.00%	$0						
19	B5	0.00%	$0						
20	Marketing	0.00%	$0						
21	C1	0.00%	$0						
22	C2	0.00%	$0						
23	C3	0.00%	$0						
24	C4	0.00%	$0						
25	ID Vehicle	0.00%	$0						
26	D1	0.00%	$0						
27	D2	0.00%	$0						
28	D3	0.00%	$0						
29	D4	0.00%	$0						
30	D5	0.00%	$0						
31	Transfer	89.70%	$52,538	11,175	402	5,541	300	4,340	21,758
32	E1	9.31%	$5,455	552				1,280	1,832
33	E2	8.16%	$4,782	138	402			1,920	2,460
34	E3	0.00%	$0						0
35	E4	0.94%	$552	552					552
36	E5	0.00%	$0						0
37	E6	66.22%	$38,789	9,933		5541			15,474
38	E7	5.05%	$2,960				300	1,140	1,440
39	E8	0.00%	$0						0
40	E9	0.00%	$0						0
41	Post-Tfr	10.30%	$6,036	276	0	0	0	2,880	3,156
42	F1	0.00%	$0						0
43	F2	0.00%	$0						0
44	F3	0.00%	$0						0
45	F4	0.00%	$0						0
46	F5	0.00%	$0						0
47	F6	0.00%	$0						0
48	F7	4.37%	$2,560					1,280	1,280
49	F8	5.93%	$3,476	276				1,600	1,876

Process Summary

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	J	K	L	M	N	O	P
1	93-267 (Process)						
2	S&E	TFP	Technician	Supervision (Contractor)	WTN	Sum	
3	$16,414	$402	$9,244	$500	$7,100	$33,660	
4							
5							A1
6							A2
7							A3
8							A4
9							A5
10							A6
11							A7
12							A8
13							A9
14							
15							B1
16							B2
17							B3
18							B4
19							B5
20							
21							C1
22							C2
23							C3
24							C4
25							
26							D1
27							D2
28							D3
29							D3
30							D5
31	16,414	402	9,244	500	4,220	30,780	
32	2,343				1,280	3,623	E1
33		402			1,920	2,322	E2
34						0	E3
35						0	E4
36						0	E5
37	14,071		9,244			23,315	E6
38				500	1,020	1,520	E7
39						0	E8
40						0	E9
41	0	0	0	0	2,880	2,880	
42						0	F1
43						0	F2
44						0	F3
45						0	F4
46						0	F5
47						0	F6
48					1,280	1,280	F7
49					1,600	1,600	F8

Sub-Step Analysis

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	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	**Summary by Sub-Step (Figure 4-29)**															
2		**Composite**			**Product**				**Facility**				**Process**			
3		Total Total	$403,899		Product Total =		$294,993		Facility Total =		$50,332		Process Total =		$58,574	
4		Raw	Percentage		W/I Type	Raw	Of Total		W/I Type	Raw	Of Total		W/I Type	Raw	Of Total	
5	A1	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%	A1
6	A2	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%	A2
7	A3	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%	A3
8	A4	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%	A4
9	A5	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%	A5
10	A6	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%	A6
11	A7	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%	A7
12	A8	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%	A8
13	A9	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%	A9
14	B1	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%	B1
15	B2	$1,600	0.40%		0.54%	$1,600	0.40%		0.00%	$0	0.00%		0.00%	$0	0.00%	B2
16	B3	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%	B3
17	B4	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%	B4
18	B5	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%	B5
19	C1	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%	C1
20	C2	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%	C2
21	C3	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%	C3
22	C4	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%	C4
23	D1	$2,496	0.62%		0.85%	$2,496	0.62%		0.00%	$0	0.00%		0.00%	$0	0.00%	D1
24	D2	$3,811	0.94%		1.29%	$3,811	0.94%		0.00%	$0	0.00%		0.00%	$0	0.00%	D2
25	D3	$4,061	1.01%		1.38%	$4,061	1.01%		0.00%	$0	0.00%		0.00%	$0	0.00%	D3
26	D4	$532	0.13%		0.18%	$532	0.13%		0.00%	$0	0.00%		0.00%	$0	0.00%	D4
27	D5	$266	0.07%		0.09%	$266	0.07%		0.00%	$0	0.00%		0.00%	$0	0.00%	D5
28	E1	$28,455	7.05%		7.80%	$23,000	5.69%		0.00%	$0	0.00%		9.31%	$5,455	1.35%	E1
29	E2	$13,759	3.41%		2.96%	$8,736	2.16%		0.48%	$241	0.06%		8.16%	$4,782	1.18%	E2
30	E3	$2,266	0.56%		0.63%	$1,864	0.46%		0.80%	$402	0.10%		0.00%	$0	0.00%	E3
31	E4	$2,361	0.58%		0.34%	$1,011	0.25%		1.59%	$798	0.20%		0.94%	$552	0.14%	E4
32	E5	$2,780	0.69%		0.94%	$2,780	0.69%		0.00%	$0	0.00%		0.00%	$0	0.00%	E5
33	E6	$293,846	72.75%		70.26%	$207,253	51.31%		94.98%	$47,804	11.84%		66.22%	$38,789	9.60%	E6
34	E7	$7,399	1.83%		1.50%	$4,439	1.10%		0.00%	$0	0.00%		5.05%	$2,960	0.73%	E7
35	E8	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%	E8
36	E9	$19,371	4.80%		6.29%	$18,566	4.60%		1.60%	$805	0.20%		0.00%	$0	0.00%	E9
37	F1	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%	F1
38	F2	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%	F2
39	F3	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%	F3
40	F4	$373	0.09%		0.13%	$373	0.09%		0.00%	$0	0.00%		0.00%	$0	0.00%	F4
41	F5	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%		0.00%	$0	0.00%	F5
42	F6	$3,063	0.76%		1.04%	$3,063	0.76%		0.00%	$0	0.00%		0.00%	$0	0.00%	F6
43	F7	$6,438	1.59%		1.22%	$3,596	0.89%		0.56%	$282	0.07%		4.37%	$2,560	0.63%	F7
44	F8	$11,022	2.73%		2.56%	$7,546	1.87%		0.00%	$0	0.00%		5.93%	$3,476	0.86%	F8
45	A-C		0%		1%		0%		0%		0%		0%		0%	
46	D-F		100%		99%		73%		100%		12%		100%		15%	
47	A-F		100%		100%				100%				100%			
48																

Sub-Step Analysis

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	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	A
1			Detail of Sub-Step - Identify Vehicle									Relative Percentage of Sub-Step - Identify Vehicle								
2																			
3			Composite	Product	Facility	Process				Composite		Product		Facility		Process			
4		D1	0.62%	0.85%	0.00%	0.00%	D1		D1	$2,496	22.35%	$2,496	22.35%	0	0.00%	0	0.00%	D1	
5		D2	0.94%	1.29%	0.00%	0.00%	D2		D2	$3,811	34.13%	$3,811	34.13%	0	0.00%	0	0.00%	D2	
6		D3	1.01%	1.38%	0.00%	0.00%	D3		D3	$4,061	36.37%	$4,061	36.37%	0	0.00%	0	0.00%	D3	
7		D4	0.13%	0.18%	0.00%	0.00%	D4		D4	$532	4.76%	$532	4.76%	0	0.00%	0	0.00%	D4	
8		D5	0.07%	0.09%	0.00%	0.00%	D5		D5	$266	2.38%	$266	2.38%	0	0.00%	0	0.00%	D5	
9			2.76%	3.79%	0.00%	0.00%				$11,166		$11,166	100%	0	100%	0	100%		
10										2.76%									
11																			
12			Detail of Sub-Step - Transfer						Figure 4-30	Relative Percentage of Sub-Step - Transfer									
13			Composite	Product	Facility	Process				Composite		Product		Facility		Process			
14		E1	7.05%	7.80%	0.00%	9.31%	E1		E1	$28,455	7.69%	$23,000	8.59%	$0	0.00%	$5,455	10.38%	E1	
15		E2	3.41%	2.96%	0.48%	8.16%	E2		E2	$13,759	3.72%	$8,736	3.26%	$241	0.48%	$4,782	9.10%	E2	
16		E3	0.56%	0.63%	0.80%	0.00%	E3		E3	$2,266	0.61%	$1,864	0.70%	$402	0.80%	$0	0.00%	E3	
17		E4	0.58%	0.34%	1.59%	0.94%	E4		E4	$2,361	0.64%	$1,011	0.38%	$798	1.59%	$552	1.05%	E4	
18		E5	0.69%	0.94%	0.00%	0.00%	E5		E5	$2,780	0.75%	$2,780	1.04%	$0	0.00%	$0	0.00%	E5	
19		E6	72.75%	70.26%	94.98%	66.22%	E6		E6	$293,846	79.37%	$207,253	77.43%	$47,804	95.51%	$38,789	73.83%	E6	
20		E7	1.83%	1.50%	0.00%	5.05%	E7		E7	$7,399	2.00%	$4,439	1.66%	$0	0.00%	$2,960	5.63%	E7	
21		E8	0.00%	0.00%	0.00%	0.00%	E8		E8	$0	0.00%	$0	0.00%	$0	0.00%	$0	0.00%	E8	
22		E9	4.80%	6.29%	1.60%	0.00%	E9		E9	$19,371	5.23%	$18,566	6.94%	$805	1.61%	$0	0.00%	E9	
23			91.67%	90.73%	99.44%	89.70%				$370,237		$267,649	100%	$50,050	100%	$52,538	100%		
24										91.67%									
25																			
26			Detail of Sub-Step - Post Transfer									Relative Percentage of Sub-Step - Post Transfer								
27			Composite	Product	Facility	Process				Composite		Product		Facility		Process			
28		F1	0.00%	0.00%	0.00%	0.00%	F1		F1	$0	0.00%	$0	0.00%	$0	0.00%	$0	0.00%	F1	
29		F2	0.00%	0.00%	0.00%	0.00%	F2		F2	$0	0.00%	$0	0.00%	$0	0.00%	$0	0.00%	F2	
30		F3	0.00%	0.00%	0.00%	0.00%	F3		F3	$0	0.00%	$0	0.00%	$0	0.00%	$0	0.00%	F3	
31		F4	0.09%	0.13%	0.00%	0.00%	F4		F4	$373	1.79%	$373	2.56%	$0	0.00%	$0	0.00%	F4	
32		F5	0.00%	0.00%	0.00%	0.00%	F5		F5	$0	0.00%	$0	0.00%	$0	0.00%	$0	0.00%	F5	
33		F6	0.76%	1.04%	0.00%	0.00%	F6		F6	$3,063	14.66%	$3,063	21.01%	$0	0.00%	$0	0.00%	F6	
34		F7	1.59%	1.22%	0.56%	4.37%	F7		F7	$6,438	30.81%	$3,596	24.67%	$282	100.00%	$2,560	42.41%	F7	
35		F8	2.73%	2.56%	0.00%	5.93%	F8		F8	$11,022	52.75%	$7,546	51.76%	$0	0.00%	$3,476	57.59%	F8	
36			5.17%	4.94%	0.56%	10.30%				$20,896		$14,578	100%	$282	100%	$6,036	100%		
37			99.60%	99.46%	100.00%	100.00%				5.17%		$293,393		$50,332		$58,574			
38														$402,299					
39														+ $1,600 (B2)					
40														$403,899					

Sub-Step Analysis

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	AK	AL	AM	AN	AP	AQ	AR	AS	AU	AV	AW	AX
1	**Composite**		Figure 4-31		Average:	$50,487		Chart 12				
2	**Summary by Transfer Role**				**Summary by Major Step**				**Detail of Transfer Step**			
3	Role	Raw	Total		Major Step	Raw	Total		Sub-Step	Raw	Total	
4	S&E	$229,307	56.77%		Strategy	$0	0.00%		E1	$28,455	7.69%	
5	TFP	$26,203	6.49%		ID Tech	$1,600	0.40%		E2	$13,759	3.72%	
6	Legal	$10,964	2.71%		Marketing	$0	0.00%		E3	$2,266	0.61%	
7	Technicians	$22,833	5.65%		ID Vehicle	$11,166	2.76%		E4	$2,361	0.64%	
8	WTN	$29,160	7.22%		Tansfer	$370,237	91.67%		E5	$2,780	0.75%	
9	Supervision	$800	0.20%		Post Transfer	$20,896	5.17%		E6	$293,846	79.37%	
10	Equipment	$45,500	11.27%		Total	$403,899	100%		E7	$7,399	2.00%	
11	Travel	$34,132	8.45%						E8	$0	0.00%	
12	Training	$5,000	1.24%						E9	$19,371	5.23%	
13	Total	$403,899	100%						Total	$370,237	100%	
14	**Product**			Chart 9	Average:	$58,999						
15	**Summary by Transfer Role**				**Summary by Major Step**				**Detail of Transfer Step**			
16	Role	Raw	ithin Typ	Of Total	Major Step	Raw	ithin Typ	Of Total	Sub-Step	Raw	ithin Typ	Of Total
17	S&E	$152,149	51.58%	37.67%	Strategy	$0	0.00%	0.00%	E1	$23,000	8.44%	5.69%
18	TFP	$25,158	8.53%	6.23%	ID Tech	$1,600	0.54%	0.40%	E2	$8,736	3.20%	2.16%
19	Legal	$10,166	3.45%	2.52%	Marketing	$0	0.00%	0.00%	E3	$1,864	0.68%	0.46%
20	Technicians	$8,048	2.73%	1.99%	ID Vehicle	$11,166	3.79%	2.76%	E4	$1,011	0.37%	0.25%
21	WTN	$14,840	5.03%	3.67%	Tansfer	$267,649	90.73%	66.27%	E5	$2,780	1.02%	0.69%
22	Supervision	$0	0.00%	0.00%	Post Transfer	$14,578	4.94%	3.61%	E6	$212,253	77.85%	52.55%
23	Equipment	$45,500	15.42%	11.27%	Total	$294,993	100%	73%	E7	$4,439	1.63%	1.10%
24	Travel	$34,132	11.57%	8.45%					E8	$0	0.00%	0.00%
25	Training	$5,000	1.69%	1.24%					E9	$18,566	6.81%	4.60%
26	Total	$294,993	100%	73%					Total	$272,649	100%	67.50%
27	**Process**			Chart 10	Average:	$29,257						
28	**Summary by Transfer Role**				**Summary by Major Step**				**Detail of Transfer Step**			
29	Role	Raw	Within Typ	Of Total	Major Step	Raw	ithin Typ	Of Total	Sub-Step	Raw	ithin Typ	Of Total
30	S&E	$27,865	47.57%	6.90%	Strategy	$0	0.00%	0.00%	E1	$5,455	10.38%	1.35%
31	TFP	$804	1.37%	0.20%	ID Tech	$0	0.00%	0.00%	E2	$4,782	9.10%	1.18%
32	Legal	$0	0.00%	0.00%	Marketing	$0	0.00%	0.00%	E3	$0	0.00%	0.00%
33	Technicians	$14,785	25.24%	3.66%	ID Vehicle	$0	0.00%	0.00%	E4	$552	1.05%	0.14%
34	WTN	$14,320	24.45%	3.55%	Tansfer	$52,538	89.70%	13.01%	E5	$0	0.00%	0.00%
35	Supervision	$800	1.37%	0.20%	Post Transfer	$6,036	10.30%	1.49%	E6	$38,789	73.83%	9.60%
36	Equipment	$0	0.00%	0.00%	Total	$58,574	100%	15%	E7	$2,960	5.63%	0.73%
37	Total	$58,574	100%	15%					E8	$0	0.00%	0.00%
38									E9	$0	0.00%	0.00%
39									Total	$52,538	100%	13%
40	**Facility**			Chart 11	Average:	$50,332						
41	**Summary by Transfer Role**				**Summary by Major Step**				**Detail of Transfer Step**			
42	Role	Raw	Within Typ	Of Total	Major Step	Raw	ithin Typ	Of Total	Sub-Step	Raw	ithin Typ	Of Total
43	S&E	$49,293	97.94%	12.20%	Strategy	$0	0.00%	0.00%	E1	$0	0.00%	0.00%
44	TFP	$241	0.48%	0.06%	ID Tech	$0	0.00%	0.00%	E2	$241	0.48%	0.06%
45	Legal	$798	1.59%	0.20%	Marketing	$0	0.00%	0.00%	E3	$402	0.80%	0.10%
46	Technicians	$0	0.00%	0.00%	ID Vehicle	$0	0.00%	0.00%	E4	$798	1.59%	0.20%
47	WTN	$0	0.00%	0.00%	Tansfer	$50,050	99.44%	12.39%	E5	$0	0.00%	0.00%
48	Supervision	$0	0.00%	0.00%	Post Transfer	$282	0.56%	0.07%	E6	$47,804	95.51%	11.84%
49	Equipment	$0	0.00%	0.00%	Total	$50,332	100%		E7	$0	0.00%	0.00%
50	Total	$50,332	100%	12%					E8	$0	0.00%	0.00%
51									E9	$805	1.61%	0.20%
52									Total	$50,050	100%	12%
53												

Spend Rates

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	A	B	C	D	E	F	G	H	I	J	K
1	**Total**	**Project**	1	2	3	4	5	6	7	8	9
2	$17,603	**221**	$425.72	$526.32	$526.32	$526.32	$1,164.91	$0.00	$0.00	$0.00	$0.00
3	# Months:	19	$425.72	$952.04	$1,478.36	$2,004.68	$3,169.59	$3,169.59	$3,169.59	$3,169.59	$3,169.59
4											
5	$15,998	**207**	$1,600.00	$1,320.24	$680.24	$680.24	$1,856.92	$1,023.82	$703.82	$703.82	$703.82
6	# Months:	15	$1,600.00	$2,920.24	$3,600.48	$4,280.72	$6,137.64	$7,161.46	$7,865.29	$8,569.11	$9,272.93
7											
8	$189,101	**047**	$3,901.97	$3,347.50	$3,347.50	$4,651.50	$3,347.50	$9,312.05	$5,781.85	$5,781.85	$5,781.85
9	# Months:	34	$3,901.97	$7,249.46	$10,596.96	$15,248.45	$18,595.95	$27,908.00	$33,689.85	$39,471.70	$45,253.55
10											
11	$25,382	**173**	$62.46	$1,028.92	$29.55	$29.55	$29.55	$29.55	$1,309.55	$989.55	$669.55
12	# Months:	18	$62.46	$1,091.38	$1,120.93	$1,150.48	$1,180.03	$1,209.58	$2,519.13	$3,508.68	$4,178.23
13											
14	$46,908	**241**	$4,560.94	$2,912.39	$1,422.35	$890.20	$890.20	$890.20	$1,591.31	$1,591.31	$2,017.04
15	# Months:	31	$4,560.94	$7,473.32	$8,895.68	$9,785.88	$10,676.08	$11,566.28	$13,157.60	$14,748.91	$16,765.95
16											
17	$24,912	**250**	$1,516.08	$876.08	$876.08	$624.60	$1,738.47	$905.37	$905.37	$905.37	$905.37
18	# Months:	24	$1,516.08	$2,392.16	$3,268.25	$3,892.85	$5,631.31	$6,536.69	$7,442.06	$8,347.43	$9,252.81
19											
20	$33,661	**267**	$2,688.72	$1,405.88	$1,085.88	$765.88	$1,527.72	$887.72	$887.72	$925.22	$2,796.65
21	# Months:	22	$2,688.72	$4,094.61	$5,180.49	$5,946.38	$7,474.10	$8,361.82	$9,249.55	$10,174.77	$12,971.42
22											
23	$50,332	**208**	$60.36	$728.82	$326.44	$1,775.04	$1,448.60	$1,448.60	$1,448.60	$1,448.60	$1,448.60
24	# Months:	39	$60.36	$789.18	$1,115.62	$2,890.66	$4,339.26	$5,787.86	$7,236.46	$8,685.06	$10,133.67
25											
26											
27	**Project**										
28	**221**	% "Complete"	5.26%	10.53%	15.79%	21.05%	26.32%	31.58%	36.84%	42.11%	47.37%
29		% Spent	2.42%	5.41%	8.40%	11.39%	18.01%	18.01%	18.01%	18.01%	18.01%
30											
31	**207**	% "Complete"	6.67%	13.33%	20.00%	26.67%	33.33%	40.00%	46.67%	53.33%	60.00%
32		% Spent	10.00%	18.25%	22.51%	26.76%	38.37%	44.77%	49.16%	53.56%	57.96%
33											
34	**047**	% "Complete"	2.94%	5.88%	8.82%	11.76%	14.71%	17.65%	20.59%	23.53%	26.47%
35		% Spent	2.06%	3.83%	5.60%	8.06%	9.83%	14.76%	17.82%	20.87%	23.93%
36											
37	**173**	% "Complete"	5.56%	11.11%	16.67%	22.22%	27.78%	33.33%	38.89%	44.44%	50.00%
38		% Spent	0.25%	4.30%	4.42%	4.53%	4.65%	4.77%	9.92%	13.82%	16.46%
39											
40	**241**	% "Complete"	3.23%	6.45%	9.68%	12.90%	16.13%	19.35%	22.58%	25.81%	29.03%
41		% Spent	9.72%	15.93%	18.96%	20.86%	22.76%	24.66%	28.05%	31.44%	35.74%
42											
43	**250**	% "Complete"	4.17%	8.33%	12.50%	16.67%	20.83%	25.00%	29.17%	33.33%	37.50%
44		% Spent	6.09%	9.60%	13.12%	15.63%	22.60%	26.24%	29.87%	33.51%	37.14%
45											
46	**267**	% "Complete"	4.55%	9.09%	13.64%	18.18%	22.73%	27.27%	31.82%	36.36%	40.91%
47		% Spent	7.99%	12.16%	15.39%	17.67%	22.20%	24.84%	27.48%	30.23%	38.53%
48											
49	**208**	% "Complete"	2.56%	5.13%	7.69%	10.26%	12.82%	15.38%	17.95%	20.51%	23.08%
50		% Spent	0.12%	1.57%	2.22%	5.74%	8.62%	11.50%	14.38%	17.26%	20.13%
51											

Spend Rates

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	L	M	N	O	P	Q	R	S	T	U	V
1	10	11	12	13	14	15	16	17	18	19	20
2	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$10,176.17	$4,257.23	
3	$3,169.59	$3,169.59	$3,169.59	$3,169.59	$3,169.59	$3,169.59	$3,169.59	$3,169.59	$13,345.76	$17,602.99	
4											
5	$703.82	$703.82	$703.82	$1,669.56	$703.82	$2,240.00					
6	$9,976.76	$10,680.58	$11,384.40	$13,053.96	$13,757.78	$15,997.78					
7											
8	$5,781.85	$5,781.85	$5,781.85	$5,781.85	$5,781.85	$5,781.85	$5,781.85	$5,781.85	$5,781.85	$5,781.85	$5,781.85
9	$51,035.41	$56,817.26	$62,599.11	$68,380.96	$74,162.81	$79,944.66	$85,726.52	$91,508.37	$97,290.22	$103,072.07	$108,853.92
10											
11	$1,049.55	$3,717.98	$3,717.98	$1,746.44	$1,746.44	$1,746.44	$1,746.44	$1,746.44	$3,986.44		
12	$5,227.78	$8,945.76	$12,663.74	$14,410.18	$16,156.61	$17,903.05	$19,649.48	$21,395.92	$25,382.35		
13											
14	$532.15	$562.64	$562.64	$623.60	$4,635.14	$654.09	$654.09	$654.09	$4,635.14	$654.09	$654.09
15	$17,298.10	$17,860.74	$18,423.37	$19,046.98	$23,682.12	$24,336.21	$24,990.30	$25,644.38	$30,279.53	$30,933.61	$31,587.70
16											
17	$905.37	$1,317.87	$1,186.62	$1,730.37	$1,092.87	$2,217.87	$1,599.12	$1,181.28	$60.00	$60.00	$60.00
18	$10,158.18	$11,476.05	$12,662.68	$14,393.05	$15,485.92	$17,703.80	$19,302.92	$20,484.20	$20,544.20	$20,604.20	$20,664.20
19											
20	$2,187.28	$2,084.15	$2,571.65	$1,371.65	$2,131.03	$2,777.90	$887.72	$887.72	$887.72	$887.72	$887.72
21	$15,158.70	$17,242.85	$19,814.51	$21,186.16	$23,317.19	$26,095.09	$26,982.81	$27,870.54	$28,758.26	$29,645.98	$30,533.71
22											
23	$1,448.60	$1,448.60	$1,448.60	$1,448.60	$1,448.60	$1,448.60	$1,448.60	$1,448.60	$1,448.60	$1,448.60	$1,448.60
24	$11,582.27	$13,030.87	$14,479.47	$15,928.07	$17,376.68	$18,825.28	$20,273.88	$21,722.48	$23,171.08	$24,619.68	$26,068.29
25											
26											
27											
28	52.63%	57.89%	63.16%	68.42%	73.68%	78.95%	84.21%	89.47%	94.74%	100.00%	
29	18.01%	18.01%	18.01%	18.01%	18.01%	18.01%	18.01%	18.01%	75.82%	100.00%	
30											
31	66.67%	73.33%	80.00%	86.67%	93.33%	100.00%					
32	62.36%	66.76%	71.16%	81.60%	86.00%	100.00%					
33											
34	29.41%	32.35%	35.29%	38.24%	41.18%	44.12%	47.06%	50.00%	52.94%	55.88%	58.82%
35	26.99%	30.05%	33.10%	36.16%	39.22%	42.28%	45.33%	48.39%	51.45%	54.51%	57.56%
36											
37	55.56%	61.11%	66.67%	72.22%	77.78%	83.33%	88.89%	94.44%	100.00%		
38	20.60%	35.24%	49.89%	56.77%	63.65%	70.53%	77.41%	84.29%	100.00%		
39											
40	32.26%	35.48%	38.71%	41.94%	45.16%	48.39%	51.61%	54.84%	58.06%	61.29%	64.52%
41	36.88%	38.08%	39.28%	40.60%	50.49%	51.88%	53.27%	54.67%	64.55%	65.94%	67.34%
42											
43	41.67%	45.83%	50.00%	54.17%	58.33%	62.50%	66.67%	70.83%	75.00%	79.17%	83.33%
44	40.78%	46.07%	50.83%	57.77%	62.16%	71.06%	77.48%	82.23%	82.47%	82.71%	82.95%
45											
46	45.45%	50.00%	54.55%	59.09%	63.64%	68.18%	72.73%	77.27%	81.82%	86.36%	90.91%
47	45.03%	51.22%	58.86%	62.94%	69.27%	77.52%	80.16%	82.80%	85.43%	88.07%	90.71%
48											
49	25.64%	28.21%	30.77%	33.33%	35.90%	38.46%	41.03%	43.59%	46.15%	48.72%	51.28%
50	23.01%	25.89%	28.77%	31.65%	34.52%	37.40%	40.28%	43.16%	46.04%	48.91%	51.79%
51											

Spend Rates

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	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG
1	21	22	23	24	25	26	27	28	29	30	31
2											
3											
4											
5											
6											
7											
8	$5,781.85	$5,781.85	$5,781.85	$5,781.85	$5,781.85	$5,781.85	$5,781.85	$5,781.85	$5,781.85	$7,592.29	$7,213.16
9	$114,635.77	$120,417.62	$126,199.48	$131,981.33	$137,763.18	$143,545.03	$149,326.88	$155,108.73	$160,890.59	$168,482.87	$175,696.03
10											
11											
12											
13											
14	$654.09	$654.09	$654.09	$654.09	$6,207.30	$707.30	$707.30	$2,972.92	$875.74	$1,180.57	$53.22
15	$32,241.79	$32,895.87	$33,549.96	$34,204.05	$40,411.35	$41,118.65	$41,825.95	$44,798.87	$45,674.61	$46,855.18	$46,908.40
16											
17	$60.00	$60.00	$1,475.63	$2,652.50							
18	$20,724.20	$20,784.20	$22,259.82	$24,912.32							
19											
20	$887.72	$2,240.00									
21	$31,421.43	$33,661.43									
22											
23	$1,448.60	$1,448.60	$1,448.60	$1,448.60	$1,448.60	$1,448.60	$1,448.60	$1,448.60	$1,448.60	$1,448.60	$1,448.60
24	$27,516.89	$28,965.49	$30,414.09	$31,862.69	$33,311.30	$34,759.90	$36,208.50	$37,657.10	$39,105.70	$40,554.31	$42,002.91
25											
26											
27											
28											
29											
30											
31											
32											
33											
34	61.76%	64.71%	67.65%	70.59%	73.53%	76.47%	79.41%	82.35%	85.29%	88.24%	91.18%
35	60.62%	63.68%	66.74%	69.79%	72.85%	75.91%	78.97%	82.02%	85.08%	89.10%	92.91%
36											
37											
38											
39											
40	67.74%	70.97%	74.19%	77.42%	80.65%	83.87%	87.10%	90.32%	93.55%	96.77%	100.00%
41	68.73%	70.13%	71.52%	72.92%	86.15%	87.66%	89.17%	95.50%	97.37%	99.89%	100.00%
42											
43	87.50%	91.67%	95.83%	100.00%							
44	83.19%	83.43%	89.35%	100.00%							
45											
46	95.45%	100.00%									
47	93.35%	100.00%									
48											
49	53.85%	56.41%	58.97%	61.54%	64.10%	66.67%	69.23%	71.79%	74.36%	76.92%	79.49%
50	54.67%	57.55%	60.43%	63.30%	66.18%	69.06%	71.94%	74.82%	77.69%	80.57%	83.45%
51											

Spend Rates

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	AH	AI	AJ	AK	AL	AM	AN	AO
1	32	33	34	35	36	37	38	39
2								
3								
4								
5								
6								
7								
8	$5,936.55	$5,170.82	$2,297.19					
9	$181,632.59	$186,803.41	$189,100.60					
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23	$1,448.60	$1,488.84	$1,488.84	$1,488.84	$1,488.84	$442.63	$442.63	$40.24
24	$43,451.51	$44,940.35	$46,429.19	$47,918.03	$49,406.87	$49,849.50	$50,292.13	$50,332.37
25								
26								
27								
28								
29								
30								
31								
32								
33								
34	94.12%	97.06%	100.00%					
35	96.05%	98.79%	100.00%					
36								
37								
38								
39								
40								
41								
42								
43								
44								
45								
46								
47								
48								
49	82.05%	84.62%	87.18%	89.74%	92.31%	94.87%	97.44%	100.00%
50	86.33%	89.29%	92.25%	95.20%	98.16%	99.04%	99.92%	100.00%
51								

Activity Cost

1 of 1

Sub-Step										
	Composite	Product					Process		Facility	
Activity\Project		93-207	93-221	94-047	94-173	94-241	93-250	93-267	93-208	
Total	$995,062	$15,998	$17,604	$189,100	$25,383	$46,908	$24,914	$33,660	$50,332	$403,899
A1	$0									$0
A2	$0									$0
A3	$0									$0
A4	$0									$0
A5	$0									$0
A6	$0									$0
A7	$0									$0
A8	$0									$0
A9	$0									$0
B1	$0	$0								$0
B2	$1,600	$1,600								$1,600
B3	$0	$0								$0
B4	$0	$0								$0
B5	$0	$0								$0
C1	$0									$0
C2	$0									$0
C3	$0									$0
C4	$0									$0
D1	$2,496			$0	$62	$2,434				$2,496
D2	$3,811			$0	$0	$3,811				$3,811
D3	$4,061			$191	$0	$3,870				$4,061
D4	$532			$0	$0	$532				$532
D5	$266			$0	$0	$266				$266
E1	$28,455	$1,280	$2,129	$17,253	$2,186	$152	$1,832	$3,623	$0	$28,455
E2	$13,759	$1,920	$402	$4,400	$2,014	$0	$2,460	$2,322	$241	$13,759
E3	$2,266	$161	$639	$0	$0	$1,064	$0	$0	$402	$2,266
E4	$2,361	$213	$0	$0	$266	$532	$552	$0	$798	$2,361
E5	$2,780	$0	$0	$2,780	$0	$0	$0	$0	$0	$2,780
E6	$293,846	$6,277	$13,476	$143,233	$16,498	$27,769	$15,474	$23,315	$47,804	$293,846
E7	$7,399	$540	$532	$0	$1,477	$1,890	$1,440	$1,520	$0	$7,399
E8	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
E9	$19,371	$1,127	$426	$14,748	$0	$2,265	$0	$0	$805	$19,371
F1	$0	$0		$0	$0	$0	$0	$0	$0	$0
F2	$0	$0		$0	$0	$0	$0	$0	$0	$0
F3	$0	$0		$0	$0	$0	$0	$0	$0	$0
F4	$373	$0		$0	$0	$373	$0	$0	$0	$373
F5	$0	$0		$0	$0	$0	$0	$0	$0	$0
F6	$3,063	$0		$3,063	$0	$0	$0	$0	$0	$3,063
F7	$6,438	$1,280		$0	$1,280	$1,036	$1,280	$1,280	$282	$6,438
F8	$11,022	$1,600		$3,432	$1,600	$914	$1,876	$1,600	$0	$11,022
	$403,899	$7,999	$8,802	$94,550	$12,692	$23,454	$12,457	$16,830	$25,166	$201,950

Major Step		Project								
(Figure 4-28)		Product					Process		Facility	
Activity	Composite	93-207	93-221	94-047	94-173	94-241	93-250	93-267	93-208	
A	$0									$0
B	$1,600	$1,600								$1,600
C	$0									$0
D	$11,166			$191	$62	$10,913				$11,166
E	$370,237	$11,518	$17,604	$182,414	$22,441	$33,672	$21,758	$30,780	$50,050	$370,237
F	$20,896	$2,880		$6,495	$2,880	$2,323	$3,156	$2,880	$282	$20,896
Total	$403,899	$15,998	$17,604	$189,100	$25,383	$46,908	$24,914	$33,660	$50,332	$403,899

Project Period Analysis

	Type:	Product	Facility	Product	Process	Process	Product	Product	Product
	Project:	**93-207**	**93-208**	**93-221**	**93-250**	**93-267**	**94-047**	**94-173**	**94-241**
	Actual Start	Mar-93	May-93	Apr-93	May-93	Jul-93	Oct-93	Sep-93	Jan-94
		5	3	5	5	4	5	9.5	9
	Signature	5-Aug-93	7-Aug-93	29-Aug-93	30-Sep-93	3-Nov-93	7-Mar-94	18-Jun-94	29-Sep-94
		12	24	8	12	16	24	12	12
	Expiration	5-Aug-94	7-Aug-95	26-Apr-94	30-Sep-94	4-Mar-95	7-Mar-96	18-Jun-95	29-Sep-95
		0	12	6	7	2	5	**0**	10
	Actual End	May-94	Jul-96	Oct-94	Apr-95	Apr-95	Jul-96	Feb-95	Jul-96
	Adjustment for early Completion	-2						-3.5	
	Actual Length	15	39	19	24	22	34	18	31
202									
	Total Cost	$15,998	$50,332	$17,604	$24,914	$33,660	$189,100	$25,383	$46,908
$403,899									
	Average Cost/Month	$1,067	$1,291	$927	$1,038	$1,530	$5,562	$1,410	$1,513
	Composite	$2,000							
	Product	$2,521							
	Process	$1,273							
	Facility	$1,291							
	Composite w/o 94-047		$1,279						

	Average Actual Length	Average Formal Length
Composite	25.3	15.0
Product	23.4	13.6
Process	23.0	14.0
Facility	39.0	24.0
Comp w/o 208	23.3	13.7

Average "Jump"	Percentage of Formal	Percentage of Actual
5.69	37.92%	22.52%
	Avg. Formal Length	**Avg. Actual Length**
	15	25
Average Overtime ("OT")	**OT Percent of Formal**	**OT Percent of Actual**
5.25	35.00%	20.79%

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Vita

Captain James C. Boyd III [redacted]

Graduating from Wheeling Park High School in 1982, he then entered the United States Air Force Academy where he graduated on 28 May 1986 and was subsequently assigned as a project officer to the Joint Tactical Communications System Program Office (SPO), Hanscom AFB, MA. In January 1988, Captain Boyd transferred to the Strategic Systems SPO where he worked as an engineer and project manager on multiple highly classified projects until May 1991. Being selected to career broaden in aircraft maintenance through the Broadening Experience Special Tour, he attended the Aircraft Maintenance/Munitions Course at Chanute AFB, IL from June through October 1991. Upon graduation, he was reassigned to 58th Fighter Wing, Luke Air Force Base, AZ performing duties as officer-in-charge in both the 58th Component Repair Squadron and 58th Equipment Maintenance Squadron until October 1992. Following graduation from Squadron Officer School, Maxwell AFB, Montgomery, AL, in December 1992, Captain Boyd was assigned as the Assistant Squadron Maintenance Officer (ASMO), in the 461st Fighter Squadron (FS). In anticipation of terminating F-15E operations at Luke AFB, the 461st FS and the 555th FS were consolidated forming the 550th FS in July 1994 where Captain Boyd again performed duties as the ASMO. Completing the BEST assignment in December 1994, Captain Boyd was selected as a Project Officer in the Special Operations Forces SPO on the AC-130U Gunship Program. In June 1995, he entered the Air Force Institute of Technology's Graduate Systems Management program. Upon graduation, Captain Boyd will be reassigned to the Human Systems Center, Brooks AFB, TX as an Acquisition Program Manager.

Permanent Address: [redacted]

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 074-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	September 1996	Master's Thesis

4. TITLE AND SUBTITLE
IDENTIFYING COST PATTERNS OF MANAGING TECHNOLOGY TRANSFER ACTIONS

5. FUNDING NUMBERS

6. AUTHOR(S)
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7. PERFORMING ORGANIZATION NAMES(S) AND ADDRESS(S)
Air Force Institute of Technology
2950 P Street
WPAFB OH 45433-7765

8. PERFORMING ORGANIZATION REPORT NUMBER
AFIT/GSM/LAS/96S-2

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Air Force Material Command
Technology Transfer Office, TTO
Wright-Patterson AFB OH 45433

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT (*Maximum 200 Words*)

Significant national resources are dedicated to research and development (R&D) at government laboratories. In an era of increasing deficits and resulting budget reductions, transfer of technology from these laboratories to the private sector is important in order to improve the return on this R&D investment, as well as to improve the US industrial technological base, thus enhancing our nation's economic security. However, no accurate measures to evaluate the efficiency of the technology transfer (TT) process exist. Likewise, accurate cost information, affording insight into the cost patterns and allowing more effective resource management, does not exist. This research draws on the principles of activity-based costing in order to develop a collection instrument, quantify the direct cost-over-time, and identify the cost patterns of eight TT projects managed at Wright Laboratory, all employing the cooperative research and development agreement vehicle. Results reveal 80 percent of a technology transfer's total resources were dedicated to the performance of the transfer activity. Additionally, human resources accounted for 80 percent of the total. Expenditures were linear and fairly consistent over the project's life, which begins nearly six months prior to signature and ends more than five months after expiration.

15. SUBJECT TERMS	15. NUMBER OF PAGES
Technology Transfer, Activity-Based Costing, Wright Laboratory, Cooperative Research and Development Agreement, Cost, Research and Development, Government Laboratory	228
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED

AFIT Control Number AFIT/GSM/LAS/96S-2

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