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RELATIONSHIPS BETWEEN CRDA ELEMENTS AND BENEFITS TO THE GOVERNMENT IN TECHNOLOGY TRANSFER

THESIS

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THESIS

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Mark J. Davis

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ABSTRACT

Technology transfer has become an increasingly important mission of federal laboratories over the past decade, with results that benefit the government, private companies, and the nation's economy. Cooperative Research and Development Agreements (CRDAs) are the most used mechanism to perform technology transfer from our nation's federal laboratories to the private sector.

The main objective of this research is to determine important CRDA elements that are associated with higher benefits to the government. Recommendations are provided for technology transfer managers to improve CRDAs by identifying the CRDA elements that are associated with higher or lower benefits to the government.

Key findings include that CRDAs, in general, provide many types of important benefits to the government. CRDA elements that are associated with significantly higher government benefits include quantified manpower requirements, the commercial partner's ability to commercialize CRDA technology, CRDA technology market information, quantified copyright royalty rates, and quantified sales royalty rates. CRDA elements associated with significantly lower government benefits include detailed facility requirements and the CRDA technology's stage of development.

RELATIONSHIPS BETWEEN CRDA ELEMENTS AND BENEFITS TO THE GOVERNMENT IN TECHNOLOGY TRANSFER

I. Introduction

Background

Recent history has brought about the information age and a global economy in which the United States competes. This global economy transforms economic strength into a major factor in military superiority (Bagur and Guissinger, 1987; Perry, 1991; and SIDAC, 1995). In other words, a strong economy produces more innovations and, therefore, better defense systems. Technology transfer is a mechanism available to leverage limited government and commercial resources for increased contribution to U.S. economic and military competitiveness (SIDAC, 1995).

For the purposes of this research, federal technology transfer is defined as "the process by which existing knowledge, facilities or capabilities developed under federal research and development (R&D) are utilized to fulfill public or private domestic needs" (Carr, 1992A:9). The military is no longer the only beneficiary of the many rich ideas, innovations, research capabilities, and technologies found in the government laboratories, product centers, and logistics centers (Bagur and Guissinger, 1987). The recent trend of increased technology transfer has opened much of government R&D to the commercial sector.

The role of federal technology transfer has become increasingly important in the United States political and economic arenas. The end of the Cold War has produced a reduction in military threats to the United States. Ergo, defense budgets have been steadily decreasing over the past few years, including the military's R&D budgets. The government can no longer afford to maintain a separate defense industrial base. Technology transfer is a step toward merging the commercial sector and defense industrial base into a single entity while maintaining national security.

A growing U.S. economy, with increased innovation aided by technology transfer, equates to a higher standard of living for the American people. Technology transfer is a means to both leverage limited government resources and provide commercial companies new opportunities for growth and competitiveness. Commercial companies obtain access to newly developed technologies and basic research facilities from the nation's federal R&D agencies through technology transfer. The goal is to give commercial companies technical information that will help in the development of new and better commercial technologies and products for the American public, eventually resulting in a reduction of the cost of defense systems.

Congress has passed many laws since the early 1980's that provide government agencies with the mandate to engage in technology transfer. The Stevenson-Wydler Act of 1980 (Public Law 96-480) makes technology transfer a part of government R&D agencies' missions and creates mechanisms to facilitate technology transfer (Bagur and Guissinger, 1987). The Bayh-Dole Act of 1980 (Public Law 96-517) and a 1983 Presidential Memorandum on Government Patent Policy give clear authorization to

government agencies to license government technology to commercial firms and clarify agency authorities for government patents (Bagur and Guissinger, 1987). The Trademark Clarification Act of 1984 (Public Law 98-620) and the Federal Technology Transfer Act of 1986 (Public Law 99-502) eliminate potential barriers to technology transfer and provide government agencies further incentives to enter into technology transfer agreements (Bagur and Guissinger, 1987). The Federal Technology Transfer Act of 1986 also provides for the use of Cooperative Research and Development Agreements (CRDAs) in the federal government (AFMC, 1995). It is clear that Congress recognizes the fact that technology transfer is a desirable process. In fact, technology transfer from the government to the commercial sector is now a fundamental goal of the United States government (Clinton and Gore, 1993).

DOD R&D agencies are expected to continue producing innovations in support of military system development with less money than they have had in the past. Technology transfer partnerships with the commercial sector provide a way of maintaining the desired level of innovation with these reduced budgets. Technology transfer agreements allow the government to receive direct monetary benefits such as licensing fees, royalty payments, work avoidance, cost avoidance, and other payments (Braun, 1996). Much of these monetary benefits are used to fund additional government R&D that would otherwise not be possible. Technology transfer agreements also generate qualitative benefits for the government such as increased productivity, improved management and business practices, and improved morale (Braun, 1996). These qualitative benefits are often just as important as the quantifiable benefits in the long run operation of the

government laboratory. Although not all technology transfer agreements produce large benefits, it is clear that there is a trend toward making each agreement produce as many benefits to the government as possible (Guilfoos, 1996). In the long run, technology transfer should allow government laboratories to do more R&D with their limited budgets, and carry out the R&D more effectively and efficiently.

Scope

Federal laboratories perform or contract out most of the basic research in the federal government, and employ a vast amount of impressive scientific talent (SIDAC, 1995). With the recent emphasis of technology transfer within the nation's federal laboratories, this talent is now available to commercial companies through cooperative agreements. This research will focus on technology transfer from the federal laboratories. Wright Laboratory, Wright-Patterson AFB OH, is the source of the data collected.

Cooperative Research and Development Agreements (CRDAs) are the most popular method of conducting a technology transfer from government laboratories to commercial companies (SIDAC, 1995). Air Force policy dictates the use of the number of CRDAs signed as a technology transfer metric (Department of the Air Force, 1994). However, the total number of CRDAs does not tell decision makers how successful each CRDA is or how the government benefits from the agreement. Instead of creating CRDAs for the sake of increasing this metric, laboratories should do everything possible to make sure that each CRDA has every opportunity to be successful. For the purposes of this research, a successful CRDA is defined as a CRDA that results in benefits to the

government. This research will focus on determining what elements of a CRDA (i.e., statements written into the signed CRDA) are associated with specific benefits for the government. Technology transfer policy makers are provided with specific suggestions as to what elements should be included in CRDAs in order to maximize the likelihood of government benefits as a result of the CRDAs.

Research Objectives

The fundamental question to be addressed in the following research is what helps determine a successful CRDA. One way to do this is to make sure that each CRDA has the elements that have proven successful in the past. To this end, the specific research objectives are:

1. Determine the important elements of CRDAs that have been signed in the past.

2. Ascertain categories of benefits to the government that result from successful technology transfer.

3. Determine statistically significant relationships between the CRDA elements and benefits received by the government.

Relevancy

With the recent trend toward increasing the number of CRDAs signed between government laboratories and the commercial sector, and the cost of managing such CRDAs, it is imperative that the CRDAs be beneficial to the government. Reduced budgets and manpower in federal laboratories further the requirement for beneficial CRDAs. Past research has focused on the potential benefits received by the laboratories as a result of CRDAs, but no research to date has concentrated on defining which CRDA

elements are associated with the laboratory benefits (Braun, 1996). This research will attempt to provide this important information to government laboratories so CRDAs may be written in a manner that has the maximum potential to produce government benefits.

Thesis Overview

Chapter II reviews existing literature to provide background information on the CRDA process, a definition of the CRDA elements, a review of potential benefits received by the government as a result of CRDAs, and a review of related research. Chapter III explains the methodologies to be employed in accomplishing this research. Empirical data on CRDA elements and government benefits are collected through historical CRDA reviews and a questionnaire administered to personnel with primary responsibility of each CRDA at Wright Laboratory. Analysis of variance techniques highlight the relationships between CRDA elements and specific government benefits. Chapter IV summarizes the data collected during the interview process and present the results of the data analysis. Chapter V presents the conclusions and managerial implications along with potential areas for future research.

II. Literature Review

Introduction

This chapter reviews past literature as related to the research objectives of this thesis. The technology transfer process and barriers to that process are outlined along with some possible solutions. Benefits of a successful technology transfer process are defined, and metrics to monitor the level of technology transfer success are proposed. Finally, an overview of a CRDA and a definition of specific government benefits that constitute a successful CRDAs for this thesis are provided.

Technology Transfer Process

For the purpose of this research, technology transfer is defined as the transfer of technology from government laboratories to the commercial sector as stated in Chapter I. Technology can be in the form of equipment, products, processes, and know-how. There are over 700 federal laboratories with 100,000 scientists and engineers and a combined budget of over $70 billion (Hughes, 1993; SIDAC, 1995). The Department of Defense (DOD) is a major player in this research and development (R&D), accounting for about 55% of this budget (SIDAC, 1995). Technology transfer within the United States Air Force is of increasing concern within this R&D budget. Air Force Material Command (AFMC) manages nearly all the Air Force research and development (R&D), including the Air Force laboratories. AFMC created a Technology Transfer Office (AFMC/TTO) in 1992 with the primary mission of facilitating and coordinating all AFMC technology transfer activities (Sharp, 1993). AFMC/TTO created the Technology Transfer Integrated

Planning Team (TTIPT) in 1993 with a charter to write a technology transfer handbook for AFMC, provide training to AFMC laboratories, and provide potential commercial partners with relevant information (Sharp, 1993). AFMC/TTO first published the AFMC Technology Transfer Handbook in November 1995 (updates continue) and continues to provide training and information for AFMC laboratories and potential commercial partners.

The AFMC Technology Transfer Handbook (1995) defines the technology transfer master process in six major steps: 1) develop a technology transfer strategy; 2) identify the technology to be transferred; 3) market the technology; 4) identify the technology transfer vehicle; 5) transfer the technology; and 6) close-out the transfer.

Carr (1992B) presents three models to manage the technology transfer process. The legal model focuses on the legal aspect of patenting inventions which leads to few technology transfers due to timeline and negotiation barriers. The administrative model uses a separate staff to conduct the technology transfer activities. This model usually increases the number of technology transfers, but may not focus on transfer quality and can lead to many ineffective transfers. The marketing model focuses on licensing technologies to commercial firms which often leads more effective transfers and commercial products. The AFMC Technology Transfer Handbook leaves the specific model to be implemented up to the organizations that will manage the transfers.

AFMC (1995) encourages tailoring the technology transfer process to fit the specific applications being performed, especially within the major steps defined above. Step 5, transfer the technology, is described in more detail in a later section as related to

the Cooperative Research and Development Agreement (CRDA) mechanism. The next section will outline barriers to successful technology transfer.

Barriers to Technology Transfer

Many barriers to successful technology transfer have been reported in recent literature and are usually accompanied by some suggestions for overcoming the barriers. General categories identified regularly include intellectual property rights, proprietary or classified information, equal opportunity, mission and cultural differences between partners, and lack of knowledge of the technology transfer process. This section focuses mainly on barriers that are affected by what is included in or not included in CRDAs.

Intellectual property is defined as "an intangible right that can be bought and sold, leased or rented, or otherwise transferred between parties in much the same way that rights to real property or other personal property can be transferred" (SIDAC, 1995:D-2). Intellectual property includes such things as inventions, technology, technical knowledge, and technical processes and is often protected by formal mechanisms such as patents, trade secrets and copyrights (SIDAC, 1995).

Intellectual property concerns are listed as barriers in many technology transfer studies (Hittle, 1991; Bodd, 1993; Sayles, 1994; Lesko and Irish, 1995). The main concerns with intellectual property rights include exclusive versus nonexclusive commercial rights (Radosevich and Kassicieh, 1993), responsibilities for defending rights (Chapman, 1989), and negotiation delays (SIDAC, 1995; Quan, 1995; Ham and Mowery, 1995). In the past, when a government technology was made available to private

companies, licensing of the technology was conducted in a way that gave all companies equal rights to the technology (Parker and Zilberman, 1993). This practice did not give companies enough incentive to offset their investment and risk, and few government technologies were transferred for use in commercial products. Most researchers now recommend that the commercial partner generally be given exclusive commercialization rights under the technology transfer agreement for three to five years (Radosevich and Kassicieh, 1993; Berman, 1994; SIDAC, 1995). This provides the company with greater incentive to make the significant investment usually required to bring the new technology to the market. AFMC (1995:A-8) adds that the government must also retain an "irrevocable, worldwide, royalty-free right to use the invention on behalf of the United States." Carr (1992B) recommends training on intellectual property for all involved in technology transfer and a simple, easy to understand, transfer agreement highlighting the intellectual property issues. Chapman (1989) agrees that most of the misunderstandings and delays can be avoided by stating intellectual property rights in a simple agreement that avoids extensive, legalistic wording. It is clear that a technology transfer agreement (e.g., CRDA) must outline the rights to intellectual property throughout the transfer.

Proprietary and classified data often inhibit or prevent technology transfer by making the transfer impossible or inhibiting the negotiation process (Hittle, 1991; Carr, 1992A; Sayes, 1994; SIDAC, 1995). Proprietary information must be protected under the CRDA, but most of this data should be protected through responsible labeling and handling of proprietary data by personnel on both sides. Classified data can only be

broken down as a barrier by declassifying the data or providing all participants including the commercial partner the relevant security clearance.

Equal opportunity to government research is another often cited barrier to the technology transfer process. A requirement of government research is that the results are public property because laboratories are supported with tax dollars. One argument says that all commercial companies should have equal rights to the laboratory research results at all times (SIDAC, 1995). This often prevents any technology transfer because the commercial firms do not have adequate incentive (i.e., sole rights to technology) to risk the large investments usually required to bring new technologies to the commercial market (Lee, 1990; SIDAC, 1995). The resolution that is preferred in the literature is equal opportunity to knowledge of transfer opportunities and the bidding process through publicizing laboratory resources and opportunities, but the best commercial bid should be given sole commercialization rights for three to five years (Carr, 1992A; Radosevich and Kassicieh, 1993; Berman, 1994). The 1989 National Competitiveness Technology Transfer Act allows CRDAs to protect intellectual property from the Freedom of Information Act for 5 years, which would otherwise make all government results public property (SIDAC, 1995).

The mission and culture of the technology transfer partners (i.e., government and commercial firm) are significantly different. The government is concerned with national defense and good use of taxpayer dollars, while the commercial firm is usually concerned with being competitive in its markets and making a profit. Often, the conflict between these two missions inhibits the technology transfer process (Lee, 1990; Carr, 1992A;

Bodd, 1993; Sayles, 1994; Chard, 1994; SIDAC, 1995). Laboratory culture is usually criticized for being too bureaucratic and not sensitive or responsive to commercial time pressures and profit motives (Hittle, 1991; SIDAC, 1995). Commercial culture is often criticized for focusing too much on short term success and its bottom line (Hittle, 1991; SIDAC, 1995). The most effective methods of overcoming these barriers seem to be proper commercial company selection, a clear statement of objectives and plan in the CRDA, good communication, and hard work by both sides (Sayles, 1994; Lesko and Irish, 1995; SIDAC, 1995).

The last major category of barriers to the technology transfer process is the lack of knowledge of the technology transfer process and opportunities by both the government and the commercial partner (Hittle, 1991; Berman, 1994; Sayles, 1994). The government should make sure that its personnel are trained on technology management and the technology transfer process, especially as related to the specific details of the negotiation process (Lee, 1990; Hittle, 1991; SIDAC, 1995). The government should also market its core competencies to the commercial sector (Lee, 1990). The commercial partner should learn as much as it can about the technology transfer process, the laboratory capabilities, and technology opportunities (Hittle, 1991). The management of both partners must make organizational learning of the technology transfer process a priority (Radosevich and Kassicieh, 1993). The CRDA can help overcome this barrier by containing a clear statement of objective and transfer plan. Once again, education, communication, and a clear plan in the CRDA are key elements in avoiding another barrier, that of ignorance.

A few other relevant barriers do not fit neatly into the above categories. Lee (1990), Berman (1994), and Lesko and Irish (1995) note barriers such as lack of management support and lack of funding for technology transfer activities, both of which are obviously necessary to conduct successful technology transfer. Preference should be given to commercial firms which produce mainly in the United States, but this should not block technology transfer as has occurred in the past (Carr, 1992A; Berman, 1994). Product liability is often a stumbling block in negotiations with the predominant solution being that the commercial partner accepts liability for products that it produces and the government accepts liability for any third party licenses that may be granted by the government (Berman, 1994). The CRDA should clearly outline all liability responsibilities related to the transfer. Radosevich and Kassicieh (1993) state that laboratories can avoid the appearance of conflict of interest of their personnel through training and the use of objective intermediaries to evaluate transfer agreements. Commercial firms must avoid the *not invented here syndrome* and accept the value of outside research and technology in order to maintain competitiveness (Lee, 1990). The above suggestions for success such as increased understanding and communication along with simple, standardized CRDAs should help alleviate the problem of extended negotiation processes which results from many of the barriers already mentioned (Knauth, 1991; Bernard, 1995; Lesko and Irish, 1995; SIDAC, 1995). Another barrier that can be solved through the same training, communication, and simple CRDAs is the use of adversarial tactics by lawyers on both sides of the technology transfer negotiations (SIDAC, 1995).

Hittle (1991) states that an important technology transfer barrier is the lack of effective transfer mechanisms, and SIDAC (1995) suggests that the very popular and flexible CRDA is one possible solution. Highlighted later in this chapter, a CRDA is one type of successful technology transfer agreement. A well written CRDA can encompass many of the suggestions noted above. With the process and partnership started off on the right path with a clear and complete CRDA, the process should have a greater chance of success. One of the goals of this research is to find empirical evidence supporting this claim. This research will help determine if specific elements included in a CRDA can help overcome the above barriers and are associated with successful CRDAs. The next section will highlight the benefits of avoiding these barriers to successful technology transfer.

Benefits of Technology Transfer

The literature abounds with perceived and real benefits of technology transfer. There are national benefits, commercial industry benefits, and government benefits. National benefits specifically improve the nation as a whole; economically, politically, socially, etc. Commercial industry benefits specifically improve commercial companies' position in the marketplace. Government benefits specifically improve the ability of the government to perform its mission. This section will review literature on all of the these categories of benefits to highlight some of the ways in which a transfer can be considered a success.

National Benefits

National benefits of technology transfer, which improve the nation as a whole, have been an objective of technology transfer since the beginning of the National Aeronautics and Space Administration (NASA) which has maintained a mission of technology transfer since its genesis (Chapman, 1994). NASA reported such national technology transfer benefits as increased value for tax payer investment, lives saved or improved, improved safety, improvements in the environment and quality of life, and productivity improvements (Chapman, 1994). In a 1991 study of 441 NASA technology transfers, it was determined that 259 (59%) provided either revenues or cost savings that totaled $21.6 billion, created or saved 352 jobs, and generated about $356 million in government tax revenue (Chapman, 1994). In a 1993 Agricultural Research Service study, 178 technology transfers generated $14.2 billion in revenues or savings (Chapman, 1994). And in a 1993 National Renewable Energy Laboratory study, 36 technology transfers generated $27 million in revenues and savings (Chapman, 1994).

Rood (1989) reports that technology transfer gives taxpayers a better value for their investment in this country's research and development activities by minimizing repetitive research and development and validating research findings. Technology transfer also results in new and improved products and processes being introduced into the national marketplace (Rood, 1989; AFMC TTO, 1994; West, 1994; SIDAC, 1995; Smith, 1995). More and better products and processes on the market result in a higher standard of living for the American population.

The Air Force Material Command Technology Transfer Office (1994) identifies possible technology transfer benefits of more jobs, a bigger tax base, improved education, and increased market competition. Spann et al. (1993) and West (1994) report national technology benefits of increased productivity, more jobs, new products and businesses, and increased technical knowledge through published papers and technical presentations. Smith (1995) adds the benefits of increased workforce training and technical competency. Guilfoos (1995) and AFMC (1995) generally agree with previous research and define the major national benefits as increases in jobs, knowledge, and standard of living. Geisler (1994) goes a level higher in defining national benefits as increases in energy independence, quality of life, and gross national product. While Geisler's benefits may be too high up the economic ladder to allow for clear causal relationship, it is clear that there are some very attractive national benefits of technology transfer.

Commercial Industry Benefits

Many of the benefits the commercial partner receives in the technology transfer arrangement, which improve the commercial company's position in the marketplace, are the root cause of the national benefits. If commercial companies improve, then often the economy as a whole improves. The bottom line for many companies is that there is a potential to increase long term profits through technology transfer (AFMC TTO, 1994; AFMC, 1995). Corporate growth through product diversification is one result from successful technology transfer (AFMC TTO, 1994). West (1994) provides a list of possible ways in which a company may benefit from technology transfer:

- increased productivity
- cost savings
- higher return on investment
- royalties
- competitive advantage
- market share
- new commercial sales
- new products
- new customers
- higher user satisfaction
- more jobs

Productivity increases as a result of technology transfer can be broken into categories such as improving an existing product or product line, improving effectiveness of a process, reducing production defects, enabling a new methodology, improving industrial/technical management, and improving technical awareness and skills of workforce (Smith, 1995). Some of the greatest returns from technology transfer are improved productivity through better manufacturing processes (Perry, 1991).

Brockhoff and Teichert (1995) categorize benefits into technical benefits (technology synergies, know-how, focus, and competitiveness), economic benefits (cost savings, time savings, uncertainty reduction, and diversity), and people-related benefits (information networking, procedural learning, trust creation, and cooperation learning). SIDAC (1995) summarizes three of the most important benefits that a commercial partner in technology may receive as access to unique facilities, access to unique perspectives and expertise of laboratory scientists and engineers, and the chance to be first to the market with a new technology. It is clear that the commercial partner has many incentives to pursue successful technology transfer agreements, but the focus of this research will be on the benefits received by the government.

Government/Air Force Benefits

The government must also benefit (i.e., improve the ability to accomplish its mission) in order to make a technology transfer agreement worth while. As with the commercial benefits, many of the government benefits of technology transfer lead to national benefits. National benefits such as increased national security and better use of taxpayer dollars are a result of such government benefits as:

- improved defense posture
- improved industrial base
- reduced costs for goods and services
- workload and cost avoidance
- reduced development costs
- reduced development timeline
- increased revenues (AFMC TTO, 1994)

Revenues can include direct payment for services provided, licensing fees for use of intellectual property including patents, and royalties from sales of products resulting from the technology transfer (Spann et al., 1993; SIDAC, 1995; AFMC, 1995).

Other research defines the government benefits slightly different and adds additional benefits. Rose (1995) highlights the government manpower benefits of increased training and technical knowledge of the laboratory scientists and engineers. Guilfoos (1995) and AFMC (1995) add the benefits of increased data supply and goodwill toward the laboratory and its staff. SIDAC (1995) identifies some unique government benefits including leverage of industrial capital in order to achieve the critical mass of resources, acceleration of research and development advances in laboratory projects, and ultimately a lower unit price to defense components by spreading the research and development costs over a larger market.

Bozeman and Coker (1992) stated that "there is a wealth of impressions, opinions, and anecdotes about technology transfer success and its causes. There is an impoverishment of empirical evidence." The next two sections will highlight the metrics that can be used to measure the degree to which these technology transfer benefits are achieved and research that has tried to provide empirical evidence for technology transfer successes.

Metrics for Technology Transfer

A technology transfer metric is defined as a set of "standardized data elements that form the basis for evaluating the transfer process" (SIDAC, 1995:70). Guilfoos (1994:173) cites *The Metrics Handbook* (AFSC/FMC, 1991) in detailing the attributes of a good metric:

- meaningful to the customer
- tells how well the goals are being met through processes and tasks
- simple, understandable, logical, and repeatable
- shows a trend
- unambiguously defined
- data is economical to collect
- timely
- it drives the appropriate action

Crutcher and Fieselman (1994) add that metrics should be quantifiable, measurable throughout the process, and have a direct relationship to the status of the process in question. The technology transfer process has proven relatively difficult to measure. Bodd (1993) notes that metrics, like most management issues, require continuous feedback and adjustment. In this section, recent attempts to define and refine technology transfer metrics are highlighted.

Crutcher and Fieselman (1994) and Ham and Mowery (1995) suggest three basic categories of cost, schedule, and performance metrics. These metrics stick to the basics of measuring cost overruns, schedule slippage, and benefits received. Souder et al. (1990) define successful technology transfer as creating a technology that is adopted by at least three fourths of the target users. They propose such metrics as number of units adopted by commercial users, number of new technologies resulting from technology transfer (called "gateway quality"), value added from adoption (perception of increased profits and cost savings), extent of adaptation in use, and timeframe of sustained use. Technology transfer measurement can also be grouped into input, output, and input-output related approaches with metrics such as economic benefits, productivity, number of patents, and subjective expert opinion (Geisler, 1992).

Bozeman and Fellows (1988) develop four models as a conceptual framework that groups technology transfer metrics. The out-the-door model defines technology transfer success as the transfer of technology (Bozeman and Fellows, 1988) with metrics including number of agreements signed and number of licenses granted (Carr, 1992A). In other words, this model does not look at the quality of the transfer, rather just the fact that it did occur. The market model defines technology transfer success as a transfer resulting in a new or improved commercially viable product or process (Bozeman and Fellows, 1988). Metrics for the market model include long term measures such as profits, royalty income, and cost savings (Carr, 1992A). The political model defines success as the appearance of a large and innovative technology transfer effort. Metrics for the political model include short term measures such as total technology transfer spending,

percent of budget dedicated to technology transfer, number of technical papers and reports, number of success stories published, number of technical problems solved, and percentage of project milestones reached (Carr, 1992A; West, 1994). Finally, the opportunity cost model defines technology transfer success as the transfer being a better investment than other options that the partners may have (Bozeman and Fellows, 1988). Metrics for the opportunity cost model include economic analysis of possible alternatives for investment.

The out-the-door model and political model metrics are criticized for not measuring the quality of the technology transfer (Carr, 1992A; Spann et al., 1995). The market and opportunity cost model metrics are often criticized for being too difficult to measure because they are long term in nature and the technology is difficult to link directly to commercial success (Guilfoos, 1994; Ham and Mowery, 1995; Spann et al., 1995). Market model emphasis is given credit for creating an organizational climate that seems to be best at creating commercially successful technology transfers that produce royalty income for the laboratories (Carr, 1992A).

Spann et al. (1993) provide some different possibilities for technology transfer metrics: percent of transfer objectives attained, number of products launched, degree of technology adoption, degree of emotional and financial commitment to the technology, return on investment, and market share changes. MacDonald (1993) adds that the metrics should depend on the context of the technology transfer such as environment, products, location, and leadership. West (1994) concludes that different metrics are required for short and long term effectiveness. Guilfoos (1994) adds that different metrics are

required at different levels of the government such as scientist level, laboratory level, command level, and Air Force level.

Autio and Laamanen (1995) report a study of criteria, indicators, and methods for metrics of the technology transfer process. They settled on three categories of metrics. The input metrics include, as in the political model, the amount of resources expended on the technology transfer process. Output metrics, as in the market model, measure technology transfer outputs such as number of new products, profits, and number of new jobs. Process metrics measure such things as the number of new development leads, the capacity of the technology transfer process, and number of new technology transfer partners.

West (1994) includes a different metric category, legislative metrics, which are mandated by Congress and fall mainly under the political model of technology transfer. These metrics include technology transfer expenditures, technology transfer budgets, time spent on technology transfer, number of requests for technology transfer help, and the number of site visits.

Roessner (1993) and MacDonald (1993) outline the need for government laboratories to use intermediate metrics of the technology transfer process such as number of technical papers or reports published, number of patents and invention disclosures, number of new development projects, the number of employee exchanges, number of start-up companies formed, and number of technical problems solved as a direct result of the technology transfer agreement. Relatively high numbers in these metrics predict a relatively higher probability of a successful technology transfer from the market model

perspective (Roessner, 1993). West (1994) points out that Wright Laboratory uses the technology transfer metrics including the amount of resources invested, number of agreements, attainment of agreement goals, and qualitative success stories.

The formal metric used in the recent past at Air Force Material Command (AFMC) is a graph of the value of technology transfer agreements (investment level by both partners in $) versus the number of formal agreements ("intensity") (Guilfoos, 1994). It is interesting to note that this metric fits neatly under the political model of technology transfer. AFMC currently uses a combination of the out-the-door, market, and political models of technology transfer when tracking their current prime technology transfer metric: number of agreements signed versus the benefits received by the government (AFMC, 1995). AFMC also asks the Air Force laboratories to track the number of technology transfer agreements completed, the number of questionnaires completed by both the laboratory and commercial partner personnel, the number of success stories published, the percent of laboratory personnel trained on technology transfer, and time required to complete technology transfer process steps (AFMC, 1995). The next section will highlight some of the studies that have attempted to fill the need for empirical evidence of the causes of technology transfer benefits.

The metrics that have been outlined give a good understanding of how to manage a technology transfer process and what a successful technology transfer process should output. A measurement, as opposed to a metric, is interested in the output numbers from the process. The above technology transfer benefits and metrics will serve as a

foundation for the definition of what measurements this research will use in defining a successful CRDA later in this chapter.

Related Research

In this section, past studies that have tried to determine causes of a successful technology transfer are summarized. It will become obvious that there is a gap in the research in the area of what constitutes a well written technology transfer agreement and what benefits can be expected from different agreements. The remainder of this thesis will try to fill this gap.

The causes of successful technology transfer have been the focus of many relatively recent studies. Bopp (1988) reports what he determined from a series of case studies to be critical factors in the success of technology transfer from the out-the-door and market model point of view. These critical factors include the existence of a *champion* to spur the transfer along, a laboratory with a multifaceted infrastructure, laboratory marketing, education on the technology transfer process, a receptive business climate and market, sufficient capital, and management support. Lee (1990) conducted a survey of 500 members of the Technology Transfer Society and reported a list of recommendations for technology transfer success that include government marketing to attract firms to technology transfer programs, government infrastructure to support increased technology transfer activities, active government management support of cooperative research, increased government R&D incentives for firms (e.g., tax credits), and government technology transfer training and development programs.

Souder and Nasser (1990) conducted a survey of consortia participants, and a list of consortia attributes are rated by survey participants as to effectiveness of the attribute in successful technology transfer. A relative importance is calculated for each attribute. The most important attributes are found to be strong organizational commitment, strong decision controls, strong charter, and systematic processes. Souder, Nashar, and Padmanabhan (1990) reported a similar study which uses expert ratings, statistical correlation, and path-analysis to give certain technology transfer conditions an importance rating. Pro-actions (e.g., passive outreach, cooperative agreements, joint transfer teams, consulting, and open interactions) were determined to be the most important conditions followed by technical quality (e.g., tangible value, divisibility, and incrementality), conditions (e.g., outside authority and research ties), and people-roles (e.g., gatekeepers, champions, and angels).

Gibson and Smilor (1991) also focus on R&D consortia, but perform a case study on one large R&D consortia, the Microelectronics and Computer Technology Corporation (MCC). The survey of MCC employees determined four variables are central to the MCC technology transfer process: communication interactivity, cultural and geographical distance, technical equivocality, and personal motivation. Winebrake (1992) analyzes 116 U.S. Department of Energy technology transfer case surveys and uses t-tests to statistically describe the differences in success ratings of different technology transfer mechanisms such as advisory groups, collaboration, personnel exchanges, licensing, and technology dissemination. Advisory groups and collaboration with cost-sharing both have a statistically significant ($p<.05$) positive relationship with

technology transfer success. Collaboration with cost-sharing is a major attribute of many CRDAs, and Winebrake (1992) shows that CRDAs may be associated with successful technology transfer.

Some studies use some kind of evaluation equation or model to determine the causes of successful technology transfer. Preston (1991), the director of the very successful Technology Licensing Office at Massachusetts Institute of Technology (MIT), reports his own equation for technology transfer success: $P_s = Q_t \times Q_m \times Q_v \times I$, where P_s is the probability of technology transfer success; Q_t is the quality of the technology to be transferred; Q_m is the quality of the management team supporting the technology transfer; Q_v is the quality of the capital investors supporting the technology transfer; and I is the quality of the image of the commercial company team supporting the technology transfer (all rated from 0 to 1). Deffeyes (1994) develops a similar technology transfer success equation: $T^2 = T \times E \times C \times B \times M$, where T^2 = probability of transfer success; T = technology quality; E = entrepreneurial spirit; C = capital; B = business knowledge; and M = mentoring (all rated from 0 to 1). Each element is necessary for successful technology transfer, and the higher each element is rated the higher the probability of technology transfer success. Fieselman and Crutcher (1994) use a software package called Transfer Opportunity Potential System (TOPS) to compare technology transfer candidates and rank the candidates in order of probable success. TOPS uses questions within three main categories to evaluate the technology transfer candidates: technology developing organization (e.g., culture, background, experience, and agreement specifics), technology to be transferred (e.g., complexity, maturity, documentation, general, and

estimates), and technology receiving organization (e.g., goals, culture, background, management tools, resources, schedule, market factors, and impact).

Many studies have also focused directly on Air Force technology transfer and the causes of success. Rose (1995) defines the necessary conditions for technology transfer success as:

- upper management support
- *champions*
- personnel sharing
- partner capability to develop technology
- partner business plan
- partner market research
- decentralized implementation
- minimized bureaucracy

Widmann (1995) focused on the relationships of the commercial partner's firm size and the agreement type with successful technology transfer. He found that technology transfer with smaller commercial partners and Small Business Innovative Research (SBIR) agreements usually contained a high amount of innovative commercialization, but CRDAs usually resulted in more complete commercial products.

Eddins (1996) conducted case studies of the CRDA signing process at Wright Laboratory. He found that the CRDA signing process has major problems such as *rework* requirements, lack of understanding of the process, and no clear criteria for approval. Recommendations for improvement include more up front training and planning (Eddins, 1996). One part of this planning could be improved CRDA work statements, and this thesis has an objective to recommend improvements for CRDAs including the work statements.

Smith (1995) provides a case study of the National Aerospace Plane (NASP) in which elements recurring in successful technology transfer are highlighted. These successful elements from the NASP program are positive technology transfer culture, technology push, clear goals, a single leader, and a clear link to potential users of the technology being transferred.

Bozeman (1991 and 1994) uses data from the master database of the National Comparative Research and Development Project (NCRDP) from over 300 government laboratories on the extent of and factors in their technology transfer successes. These studies use factors related to contingency organizational theory (strategy and motives) to evaluate as possible causes of successful technology transfer. Strategies of interest are on-site seminars, personnel contacts, membership in consortia, site visits, cooperative R&D, contracts, patents, and licenses. Motives of concern include economic development, cooperation, R&D center, budget, and wealth. Successful technology transfer is defined in five variable measures of effectiveness: number of licenses granted; laboratory directors rating of how well the laboratory transferred the technology; laboratory directors rating of how well the transfer lead to commercial success; tangible laboratory benefits; and tangible benefits of the laboratory scientists working on the transfer. Nonparametric (Kendall's tau) correlation coefficients are used to determine how much each factor was related to the success of each benefit variable. Conclusions of Bozeman's research were that no perfect model can be developed, but suggestions can be made with certain goals in mind. The best overall strategies seem to be participation in a research center and use of cooperative R&D. Cooperative R&D is the main reason why

CRDAs are written, and Bozeman (1994) shows that CRDAs of this type are often associated with successful technology transfer. The best motivation is described as economic development, but R&D center and wealth motivations also contain a weak, positive relationship to technology transfer success. Although Bozeman provides some substantial quantitative evidence of how strategy and motivation are related to technology transfer success, this study relies on subjective opinions of laboratory personnel and does not look directly at the elements of the transfer agreements.

Few researchers have looked specifically at CRDA content relationships with successful technology transfer. Braun (1996) conducted an analysis of Air Force benefits received as a result of 15 CRDAs from Wright Laboratory with the numbers of CRDAs containing each specific benefit listed in Table 1. Although Braun determines specific benefits of CRDAs, the research does not look at specific CRDA elements that may have caused the government benefits as will this research. Braun's data is used in the pilot study presented in Chapter III.

Table 1. Braun CRDA Benefits (Braun, 1996)

CRDA Benefit	# of CRDAs
license fees	0
royalty payments	4
cash reimbursements	2
work savings	4
resource savings	8
productivity increases	1
effective resource utilization	7
data exchange savings	3

Many recent studies have highlighted the need for more research to answer the question of what are the elements of a successful technology transfer agreement. West (1994) states that more research is needed to define input elements that predict successful technology transfer. Ham and Mowery (1995:73) state that "empirical research based on fieldwork is essential to improving the management of cooperative R&D" in federal laboratories. Smith (1995) addresses the need for determination of additional causes of technology transfer success. Rose (1995) highlights the need for ideas in increasing laboratory royalty income from successful technology transfers. This research will provide a piece of all these requirements. As research objective #3 states, this research will attempt to determine the relationships between CRDA elements and benefits received by the government and recommend the CRDA elements to include or avoid for successful technology transfer.

Past research has provided some studies that try to define technology transfer benefits and even link some agreement characteristics to success technology transfer. Many possible causes and correlations have been stated and some even studied, but none have looked at CRDA elements and none have tried to determine a link between CRDA elements and successful technology transfer. The main objective of this research is to attempt to fill this void in the research. Empirical evidence will be studied and analyzed to determine what CRDA benefits are associated with successful technology transfer. The next two sections will outline a *model CRDA* and highlight the elements of the CRDA that will be of interest in this research.

CRDA Overview

Few technologies in the federal laboratories are completely developed for commercial use, and therefore, most require further development before commercial products can be marketed, manufactured, and sold to commercial customers (SIDAC, 1995). The CRDA is one of the best mechanisms to allow for this further development through a partnership between the federal laboratory and the commercial firm wishing to exploit the new technology. CRDAs often give the commercial partner protected intellectual property rights allowing the firm to be first in the market with the new technology (Parker and Zilberman, 1993). Berman (1994:338) defines CRDAs as "comprehensive legal agreements for the sharing of personnel, equipment, funding, and intellectual property rights in joint government-industry research." The Air Force specifically defines a CRDA as:

> Any agreement between one or more Air Force RDT&E [Research, Development, Test & Evaluation] activities and one or more of the following parties: other Federal agencies, units of state or local government, for profit organizations (including corporations, partnerships, limited partnerships, and industrial development organizations), public and private foundations, nonprofit organizations (including universities), or other persons (including licensees of inventions owned by the Federal agency). Under these agreements, the Air Force, through its RDT&E activities, may provide personnel, services, facilities, equipment, intellectual property, or other resources (but not funds) with or without reimbursement. One or more of the non-Air Force partners may provide personnel, services, facilities, equipment, intellectual property, or other resources (including funds) towards the conduct of specified research or development efforts consistent with the missions of the laboratory. (Department of the Air Force, AFI 61-301, 1994:6)

The specific partners relevant to this research are the Air Force laboratories and for profit organizations or commercial companies.

One major benefit of the CRDA mechanism is that it is relatively flexible and easy to implement. The CRDA does not fall under the definition of a procurement contract or cooperative agreement as defined in section 6303 et seq. of Title 31 of the U.S. Code, and therefore, does not have to adhere to the Federal Acquisition Regulation (FAR) (AFMC, 1995). With the elimination of the large bureaucratic process of FAR compliance, CRDAs can be more simple and flexible than procurement contracts (Eddins, 1996; SIDAC, 1995). Commercial companies interact in many ways with federal laboratories. The main forms of interaction include:

- contract research (procurement contracts)
- cooperative research
- workshops/seminars
- licensing
- sponsored research
- technical consultation
- employee exchanges
- use of laboratory facilities
- laboratory visits
- information dissemination (Roessner and Bean, 1991:23-25)

The CRDA is flexible enough to encompass all of the above interactions except contract research which is handled through procurement contracts.

AFMC (1995) defines a similar set of endeavors allowed under a CRDA: transfer of resources, license grants, license waivers, determination of intellectual property rights, commercial rights permission, and license agreements. Ham and Mowery (1995) state that Department of Energy laboratories use CRDAs for transfer projects, codevelopment projects, and research and development services agreements. The Supportability

Investment Decision Analysis Center (SIDAC, 1995) provides a list of important CRDA characteristics:

- FAR does not apply; not a procurement contract
- no funds transfer from government to commercial partner
- government provides personnel, services, equipment, intellectual property, facilities, and other resources (except funds)
- commercial partner provides personnel, services, equipment, intellectual property, facilities, and other resources (including funds)
- rights to inventions and intellectual property negotiated and may be protected for up to five years
- special consideration is given to small businesses (less than 500 employees)
- government always retains license for inventions resulting from CRDA
- each agency tailors the CRDA as appropriate (SIDAC, 1995:E-2)

CRDAs are viewed in different ways by different organizations, but for the most part, CRDAs are believed to be positive mechanisms. Congress views the CRDA as an innovative technology transfer mechanism which will increase American technology competitiveness. The Air Force views CRDAs as potential supplemental sources of R&D funding and contract alternatives. Firms believe CRDAs are mechanisms to gain a competitive edge in their commercial market and in future government contracts. (Hittle, 1991)

In recent years, the CRDA has become a very popular mechanism for technology transfer. From the Technology Transfer Act of 1986 to early 1994, about 2200 CRDAs were signed throughout the federal government (Berman, 1994). DOD signed a significant portion, about 700, of these CRDAs (Lewis, 1994). This makes the CRDA the most used method for government and industry to work together in research and development. The Clinton administration's 1993 Defense Conversion Panel recommended further increase in the use of CRDAs (Morrocco, 1993). President

Clinton, in his 1993 technical policy statement, *Technology for America's Economic Growth, A New Direction to Build Economic Strength*, recommends a significant increase in the number of CRDAs and further suggests the elimination of CRDA obstacles (SIDAC, 1995). It is clear that the CRDA will be an important technology transfer mechanism for some time to come.

The fifth major step in the AFMC technology transfer master process, as outlined in an earlier section, is to transfer the technology. If it is assumed that in the fourth step the CRDA is selected as the vehicle of choice, then this fifth step becomes the CRDA process. This process is defined by AFMC as:

1. Define the desired results
2. Coordinate
3. Negotiate terms
4. Legal review
5. Authorization
6. Transfer technology
7. Monitor technology and administration
8. Collect revenues
9. Close out transfer (AFMC, 1995:D-6)

Hittle (1991) categorized the CRDA process into three phases: contact phase, coordination and negotiation phase, and review and approval phase.

Air Force Instruction 61-302 (1994) provides a model CRDA that can be tailored and guidelines for using the model CRDA. The model contains twelve sections or articles:

1. Preamble (names and addresses of collaborators)
2. Definitions (of relevant terms)
3. Work Statement (responsibilities, etc.)
4. Financial Obligations (payments, royalties, etc.)
5. Patents (disclosure, rights, filling, expenses)

6. Copyrights (disclosure, rights, payments, expenses)
7. Proprietary Information (protection, ownership)
8. Term, Modification, Extension, Termination, and Disputes (timelines, responsibilities, plans, etc.)
9. Representations and Warranties (responsibilities)
10. Liability (property, employees, etc.)
11. General Terms and Provisions (waste disposal, relationships, severability, etc.)
12. Notices (names, addresses, etc.) (AFI 61-302, 1994:6-7)

This model CRDA along with the instructions provides a good foundation for any Air Force organization to start with when preparing a CRDA. The model allows for a large amount of tailoring for specific organizational requirements. The relevance of each CRDA section to this research follows.

Article 1, Preamble, is of interest in the fact that the names of the principal investigators may be stated. Article 2, Definitions, is not important to this research. Definitions are consistent, for the most part, across CRDAs and are not considered as elements that will distinguish one CRDA from another. Article 3, Work Statement, will be the main focus of this research and is outlined in greater detail in the next section. Article 4, Financial Obligations, may contain such elements as some of the partner's responsibilities and royalty payments. Article 5, Patents, may include important intellectual property information such as patent ownership, type of license, commercialization rights, and patent royalty rates. Article 6, Copyrights, may include additional intellectual property information such as type of license and copyright royalty rates. Article 7, Proprietary Information, may include relevant information such as proprietary information protection. Article 8, Term, Modification, Extension, Termination, and Disputes, is of limited interest for this research but may include

timelines and milestones for the agreement. Article 9, Representations and Warranties, should include warranty responsibilities. Article 10, Liability, should include liability responsibilities. Article 11, General Terms and Provisions is not of interest in this research. All CRDAs should include Article 11 exactly as written in the Air Force's model CRDA and, therefore, Article 11 will not distinguish CRDAs from one another (AFI-61-302, 1994:7). Article 12, Notices, is of interest in that it may include the names of the principal investigators

All of the elements that are included in the CRDA Articles are often stated in the CRDA Work Statement, which is usually the first item written. The specific CRDA elements that are of interest to this research are outlined in the following section along with a detailed explanation of the work statement.

CRDA Work Statement

Work plans are an essential part of research and development. It is well known that a good work plan allows more potential for success than a poor work plan. Dakin and Lindsay (1991) provide a checklist of issues that should be addressed in any work plan for the cooperative commercialization of technology:

- Authority for agreement (e.g., the Technology Transfer Act of 1986)
- Subject matter of agreement (facilities, expertise, cooperative R&D, etc.)
- Statement of responsibilities (who, where, when)
- Funding requirements
- Intellectual property rights considerations
- Licensing rights and ownership
- Data rights and protection
- Other legal issues (resource limitations, warranties, property titles, liability, etc.)

Madu and Jacob (1989) use a dialectical inquiry system to provide suggestions for a successful strategic plan for international technology transfer:

- timetable and sequence
- education and training plan
- development of local management process
- implementation phases
- resources required
- research and development plan
- plant locations

The CRDA Work Statement is defined in Article 3 of the model CRDA (Department of the Air Force, AFI 61-302, 1994). The actual work statement is usually attached as Appendix A to the CRDA and referenced from Article 3 which is broken down into three subparagraphs:

3.1 Reference to Appendix A, Work Statement
3.2 Government property handling requirements
3.3 Proprietary information agreements (SIDAC, 1995:G-5)

Appendix A, Work Statement, is usually written by the technical representatives on both sides of the agreement rather than lawyers (SIDAC, 1995). SIDAC provides an outline of a work statement:

1. Title
2. Objective
3. Background
4. Technical Tasks
    4.1 Collaborator
    4.2 Air Force Activity
5. Deliverables or Desired Benefits
    5.1 Collaborator
    5.2 Air Force Activity
6. Other
7. Milestones
8. Reports (SIDAC, 1995:G-14)

As with most plans, the better the work statement is written, the better the agreement should proceed. With a good work statement, negotiation of the CRDA should proceed smoothly and the CRDA should have a better chance of success (SIDAC, 1995; Quan, 1995; Lesko and Irish, 1995).

Work statements serve the further purpose of garnering organizational understanding and commitment (Lesko and Irish, 1995). Writing a good work statement requires both organizations to do some homework on the subject of the agreement. This homework often fosters relationships and communication between the technical staffs of both parties. Technical level communication is often stated to be one of the major ingredients in a successful CRDA (Lesko and Irish, 1995; Roessner and Bean, 1994; SIDAC, 1995).

The work statement is a research plan that defines what is to be done and who is going to do it. The work statement should include the objectives and requirements of each party including the means (inputs) and ends (expected results) (SIDAC, 1995). Hittle (1991) provides some general recommendations for prenegotiation preparations, most of which can be written in the work statement. The government should build a team for the CRDA including personnel from the laboratory, the technology transfer staff, and the legal staff. The Laboratory should develop a positive relationship with the commercial partner. The objectives of the government and partner must be clearly understood. In general, the work statement should include:

- scope of the work in technical terms
- research and development responsibilities
- funding requirements

- personnel requirements
- service requirements
- property requirements
- facilities and equipment requirements
- reporting progress and results responsibilities
- principal investigators
- interaction procedures
- intellectual property rights
- environmental requirements
- health requirements
- safety requirements (SIDAC, 1995; AFMC, 1995)

Lesko and Irish (1995) outline a slightly different set of work statement elements which depend on the objectives of the CRDA:

- aspects of the operating environment
- means and ends
- product liability
- 3rd party licensing
- publication of results
- royalties from production
- company's potential profits
- ability to develop, manufacture, and distribute new products
- proprietary data protection
- resources required
- technology stage of development
- expertise required
- fields of use
- market size

Some further recommendations for a successful work statement include defining measures of success and realistic expectations. Continued investment should be tied to milestones and objectives, and exit criteria should be defined for each milestone. SIDAC (1995) also outlines what each party in a CRDA should ultimately look for in a work statement. The government should focus on relevance to the laboratory mission, potential government benefits, and government resources required. The commercial

partner should focus on firm resources required, potential firm profits, ability to evolve technology to a commercial product, protection of proprietary information, and competitive advantage. Both parties should also be aware of the technology's state of development, expertise required, potential fields of use, and the size of the new technology's market (SIDAC, 1995). Stephen Guilfoos, AFMC TTO/TTR (1996) stated the need for the work statement to cover, as appropriate, such areas as facility and manpower requirements, royalty plans, intellectual property rights (e.g., patent rights and *techknowledge* protection), and data requirements.

The CRDA elements that will be the focus of this thesis are derived from above lists and are outlined below. An explanation of how each will be defined and measured is outlined in Chapter III.

- responsibilities/tasks
    - government
    - partner
- facility/equipment requirements
    - government
    - partner
- manpower requirements
    - government
    - partner
- funding requirements for the partner
- services requirements
    - government
    - partner
- technology's stage of development
- partner's ability to commercialize product
- market information
- intellectual property rights
    - patent rights
        - no licenses granted
        - exclusive partner license
        - nonexclusive partner license

        - third party license
    - commercialization rights
- proprietary information protection
- data protection
- progress/results reporting requirements
    - government
    - partner
- desired results - expected benefits
    - government
    - partner
- milestone definition
- timeline
- exit criteria
- warranties
    - government
    - partner
- liability
    - government
    - partner
- principal investigator names
- environmental impacts
- safety issues

Braun (1996) found that in many cases the expected benefits outlined in the work statement were achieved or are expected to be achieved. Although there are many barriers to the CRDA process, a well written work statement has the possibility of breaking down some of these barriers. The next section will define benefits of a successful CRDA for the purposes of this research.

Benefits of a Successful CRDA

Overall benefits that may be a result of any technology transfer mechanism or timeframe were reviewed in an earlier section of this chapter. The government benefits that can result from CRDAs which will be the focus of this research will now be defined. Despite differences in mechanisms, CRDA benefits can be much the same as the general

technology transfer benefits. The CRDA benefits of choice for this research are government benefits only, and must be relatively easy to measure and collect.

Braun (1996) conducted a review of benefits received by the Air Force through CRDAs. He found that Air Force benefits can be divided into three categories: tangible (i.e., quantitative) revenues, tangible non-revenues, and intangible (i.e., qualitative) benefits. Tangible revenues are licensing fees and royalty payments. Tangible non-revenues include cash reimbursement for services, work avoidance, cost avoidance, productivity and efficiency increases, better utilization of laboratory resources, and savings from data exchange . Intangible benefits are such things as improved management and business practices and improved morale of laboratory personnel.

Although there are a multitude of CRDA benefits, this research focuses only on the quantitative and qualitative revenue and nonrevenue CRDA government benefits that can be readily collected from CRDA points of contact. The categories of benefits that are evaluated in this research are listed below.

- Quantitative Revenue Benefits
  - royalty payments
  - license fees
- Quantitative Nonrevenue Benefits
  - cash reimbursement for services
  - work and cost avoidance
  - productivity and efficiency increases
  - better utilization of laboratory resources
  - savings from receipt of data, hardware, or software
- Qualitative Nonrevenue Benefits
  - improved management practices
  - improved laboratory image or morale
  - improved technical capabilities

After discussion with WL technology transfer experts, some of the benefits listed under the quantitative nonrevenue benefits are determined to be better measured qualitatively. These benefits include productivity increases and better utilization of laboratory resources. This will be further discussed in Chapter III.

This chapter motivates why technology transfer is important and why this study is needed in the technology transfer research stream. The technology transfer process was outlined, and barriers to the technology transfer process which may be overcome through a well-written CRDA were presented. Benefits of successful technology transfer and metrics for determining the extent of the success were defined. Related research was summarized, and the gap in the research was identified which will be addressed by this research. The CRDA mechanism was outlined with specific emphasis on the CRDA Work Statement. Finally, the specific government benefits from CRDAs were defined. Chapter III will detail exactly how the CRDA elements and benefits will be analyzed and review the methodology that will be employed in the pursuit of a relationship between the CRDA elements and government benefits.

III. Methodology

Background

This chapter explains the methodology used in accomplishing this research. The methods presented in this chapter support the third research objective from Chapter I: Find the statistical relationships between the CRDA elements and benefits received by the government. Data collection techniques and statistical data analysis procedures are described along with the benefits and limitations of each. A pilot study of the procedures is reported along with the resulting refinements in procedures. Finally, expected results are presented.

Methods

This section contains the data collection techniques and statistical data analysis procedures along with the benefits and limitations of each.

Data Collection

Wright Laboratory (WL) is chosen as the only laboratory from which to draw data for this research. WL is in close proximity to the researcher and has signed over a hundred CRDAs since the early 1990s, which have many different purposes including cooperative research, testing, and manpower swapping. WL personnel have been cooperative with technology transfer researchers in the past, and have provided much useful technology transfer data. Nearly all of the WL CRDAs follow the AFMC *model CRDA* which makes them easier to compare, but other *model CRDAs* are in use in the DOD that are different. Although WL CRDAs may not represent all DOD CRDAs, the

number and diversity of WL CRDAs make WL a good data source with which to conduct research.

CRDA Elements. CRDA element data collection is conducted through a historical review of CRDAs. Copies of Wright Laboratory CRDAs are reviewed at the Wright Laboratory Technology Transfer Office for the specific elements of interest. Each CRDA is assigned a *yes* or a *no* for the inclusion of each potential element. The initial list of CRDA elements analyzed in the pilot study are defined in detail in Table 2 so there is no confusion over what constitutes a *yes* or a *no* for each element. This list was compiled after the extensive literature review reported in Chapter II, along with expert opinion from technology transfer professionals from Air Force Material Command, Wright Laboratory, and Air Force Institute of Technology. Table 2 constitutes a relatively exhaustive list of possible CRDA elements, and this list was refined during the pilot study analysis. The pilot study analysis was used to determine which elements were needed to be removed or modified.

The benefit of historical data collection is that the CRDAs, which are complete or in progress, have already been written and signed. This allows each CRDA to be objectively analyzed to determine which elements are present. The limitation of this technique is that some element definitions can not encompass every possible CRDA wording. Researcher judgment is required to determine if an element definition is satisfied in a specific CRDA. This risk is mitigated by using the element definitions in Table 2 as a systematic checklist. The resulting data are coded into ones (*yes's*) and zeros (*no's*) in order to be used in the statistical analysis procedures described below.

Table 2. Pilot Study CRDA Elements

CRDA Elements	**A *yes* in a particular category verifies that the following statements are true for that CRDA:**
1) responsibilities/tasks	Any responsibilities/tasks for either party are stated.
a) government	Government responsibilities and/or tasks for the CRDA are explained at any level of detail.
b) partner	Partner responsibilities and/or tasks for the CRDA are explained at any level of detail.
2) resources required	Any resources required for either party are stated.
a) facility/equipment requirements	Any of the below facility requirements are stated.
i) government	Government facilities or equipment that are required for the CRDA are specified directly by name or type.
ii) partner	Partner facilities or equipment that are required for the CRDA are specified directly by name or type.
b) manpower requirements	Any manpower requirements for either party are stated.
i) government	Government manpower requirements are specified directly.
ii) partner	Partner manpower requirements are specified directly.
c) funding requirements	Partner funding requirements are specified directly.
d) services requirements	Any services requirements for either party are stated.
i) government	Government services (e.g., communication, transportation, etc.) are specified directly.
ii) partner	Partner services (e.g., communication, transportation, etc.) are specified directly.
3) technology's stage of development	Technology development required in order to commercialize is specified directly.
4) partner's ability to commercialize product	Partner's expertise in the required technology commercialization area is specified directly.
5) direct market information	The market of technology commercialization is specified directly.
6) general market information	The market of technology commercialization is indirectly mentioned.
7) intellectual property rights	Any of the below intellectual property rights issues are stated.
a) no licenses granted	The statement is made that no licenses are granted as a result of the CRDA.
b) patent rights	Any of the below patent rights issues are stated.

Table 2 (Continued)

CRDA Elements	A yes for each category verifies that the following statements are true:
i) exclusive partner license	The CRDA gives the partner exclusive license to the technology.
ii) nonexclusive partner license	The CRDA gives the partner nonexclusive license to the technology.
iii) third party license	Rights for third party licensing are discussed directly.
iv) general	Patent rights are indirectly mentioned.
c) commercialization rights to partner	The partner is given commercialization rights to the technology.
d) proprietary information protection	Proprietary information protection is specified directly.
8) desired results - expected benefits	Any desired results or expected benefits for either party are stated.
a) government	Desired results or expected benefits for the government are stated directly.
b) partner	Desired results or expected benefits for the partner are stated directly.
9) progress/results reporting requirements	Any progress/results reporting requirements for either party are stated.
a) government	Government progress/results reporting requirements are stated directly.
b) partner	Partner progress/results reporting requirements are stated directly.
10) milestone definition	A timeline and/or exit criteria are stated directly.
a) timeline	A timeline of tasks and milestones is provided.
b) exit criteria	Exit criteria for each task are defined explicitly.
11) warranties	Any warranty issues for either party are stated.
a) government	Government warranties are specified directly.
b) partner	Partner warranties are specified directly.
12) liability	Any liability issues for either party are stated.
a) government	Government liabilities are specified directly
b) partner	Partner liabilities are specified directly.
13) principal investigator names	Any principal investigator names are stated including the patent holder names.
14) environmental impacts	Any environmental impacts are stated.
15) safety issues	Any safety issues are stated.

CRDA Benefits. CRDA government benefits are also collected for each CRDA of interest. Benefit data is collected through a questionnaire completed by CRDA points of contact at Wright Laboratory. The questionnaire is presented in Appendix A. For the pilot study, 12 questionnaires were sent out for the same CRDAs that Braun (1996) analyzed, and all 12 were completed and returned. These CRDAs were chosen as a starting point because benefit information is already available, and the points of contact are willing to participate in technology transfer research. For the main study, 83 questionnaires were sent out and 57 were completed and returned. The pilot study data was combined with the full study data for final analysis resulting in a larger sample size. This is acceptable because no changes were made to the questions contained in the pilot study, and only one question was added. This resulted in a total of 69 different CRDAs to be analyzed for this research, with the exception that the one added question has a sample size of 58 CRDAs.

The benefit categories are divided into quantitative and qualitative benefits. Quantitative (i.e., tangible) benefit categories in the questionnaire include royalty payments, cash reimbursement, license fees, work avoidance, data, software, hardware, and other financial benefits not directly payable as cash. Respondents are asked to provide dollar estimates, both collected and anticipated (i.e., estimated for the next 2 years), for the quantitative benefits categories that apply to their CRDA. Qualitative (i.e., intangible) benefit categories include improved productivity, better utilization of resources, improved management and business practices, improved image, improved morale, and improved technical capability in the laboratory. The improved technical

capability category was added after the pilot study for reasons described below. Respondents are asked to rate the importance of each qualitative category that applies to their CRDA on a five category Lickert scale, from no importance (1) to extremely important (5). The resulting data from the questionnaire is quantitative and can be used in the powerful statistical analysis techniques described later in this chapter.

Questionnaires answered by experts have some pros and cons. Each CRDA point of contact that fills out the questionnaire is the person that knows most about the given CRDA. This expert should be able to give the best data possible. Problems with the data could arise from a point of contact that has replaced an original point of contact. Some knowledge may be lost or degraded in this responsibility transfer which could translate to imperfect questionnaire responses. Also, some CRDA points of contact may not spend the time required to answer the questions to produce the best responses possible. Estimates are sometimes provided in the place of exact data.

Importance data from the questionnaire about qualitative benefits (i.e., questions nine through fourteen) are expert opinion only. This opinion could vary from person to person, and the data collected represents the CRDA point of contact's opinion. There are no exact numbers that can be referenced to respond to each of these questions, and there are no correct or incorrect answers. Experts are asked to provide the response that they feel is the best for the given CRDA. Although this introduces some subjectivity, the CRDA point of contact is the best person to provide opinions since he or she is the expert on the CRDA of interest. Results of the importance data are reported as expert opinion and nothing more.

Questionnaire reliability and validity are improved through expert review, detailed instructions, and pilot study analysis. The questionnaire was developed with review and input from technology transfer professionals from Air Force Material Command, Wright Laboratory, and Air Force Institute of Technology to ensure that each question is clear and represents a potential CRDA benefit. Detailed instructions provided at the beginning and throughout the questionnaire add to the likelihood that each question is well understood. A pilot study, reported later in this chapter, was conducted in which respondents were asked to suggest improvements to the questionnaire from a reliability and validity point of view.

Data Analysis

The purpose of the data analysis is to provide insight into the third objective of this thesis. The data analysis determines if there are any significant statistical relationships between any CRDA elements and CRDA benefits.

Data Summary. First, a summary of data collected is provided. The number of CRDAs containing each CRDA element and the number of CRDAs reported to benefit the government in each benefit category are reported, along with the average and range of each benefit category. Microsoft Excel for Windows is utilized to perform the top level summary, and Statistical Analysis System (SAS) for UNIX is used to produce lower level frequency counts.

Data Transformation. Second, the data is transformed for statistical analysis. The CRDA elements are the independent variables in the statistical analysis. Given that the CRDA element data is nominal level (i.e., *yes* or *no*) data, the data must be

coded into one's and zero's. Each high level element becomes a factor with two levels, and low level factors are accounted for in the higher level factors. For example, the higher level factor, manpower requirements, will include the effects of the two lower level manpower elements; government and partner. The benefit data represents the dependent variables in the statistical analysis. For each of the quantitative benefits, collected and anticipated benefits are summed to obtain one variable for analysis. These new variables measure the total amount that the CRDA is expected to realistically benefit the government in each benefit category.

Factor Analysis. Third, because the number of factors (i.e., independent variables) is relatively large, it is desirable to reduce this number in order to achieve a greater number of data points per factor combination. This adds confidence to the statistical conclusions. One method of reducing the number of elements without losing generalizability is to combine the CRDA elements that are highly correlated to one another into a single factor. The results of the new factor pertain to both of the correlated factors. Correlation magnitudes range from 0 (i.e., no correlation) to 1 (i.e., perfect correlation). Two elements are combined when their correlation is greater than .80.

Given that the CRDA element data is nominal level (i.e., categorical) data, nonparametric correlation techniques must be used. The phi coefficient has been developed to handle nominal data in both variables of concern (Conover 1971; Cooper and Emory, 1995). The phi coefficient (R) is defined by creating a two-by-two table of the nominal data as shown in Table 3 and is calculated using Equation (1). SAS is utilized to perform the correlation calculations.

Table 3. Phi Coefficient Table

		CRDA Element 1: yes	CRDA Element 1: no	
CRDA Element 2:	yes	a	b	r_1
	no	c	d	r_2
		c_1	c_2	N

$$R = \frac{ad - bc}{\sqrt{r_1 r_2 c_1 c_2}} \qquad (1)$$

where

a = number of CRDAs with a *yes* for both Element 1 and Element 2.
b = number of CRDAs with a *no* for Element 1 and a *yes* Element 2.
c = number of CRDAs with a *yes* for Element 1 and a *no* Element 2.
d = number of CRDAs with a *no* for both Element 1 and Element 2.
$r_1 = a + b$ $r_2 = c + d$
$c_1 = a + c$ $c_2 = b + d$
$N = r_1 + r_2 = c_1 + c_2$ = sample size

The results of the factor analysis provide the final list of CRDA elements to be analyzed using analysis of variance (ANOVA) as described below.

ANOVAs. Finally, ANOVAs are used to determine the main effects and interaction effects of CRDA elements for each CRDA benefit. Main effects show the significance level of each CRDA element with each benefit category. Interaction effects determine if CRDAs containing more than one (e.g., a certain pair) of the elements show a significant difference in mean benefit from the CRDAs without those elements. The results of ANOVA analysis reports the p-values (i.e., significance level) for differences in means between the factors being considered.

Parametric ANOVA analysis is the first choice in ANOVA techniques because this technique is the most statistically powerful (Devore, 1995). The assumptions of

parametric ANOVA analysis are that the population of CRDA benefits and the benefits of each factor are normally distributed and contain equal variance (Devore, 1995). To test for violation of these assumptions, a normality plot is constructed using Statistix 1.0 for Windows. A relatively straight line indicates strong support of the normality assumption. A Wilk-Shapiro value is reported along with the normality plot, which is closer to one with a more normally distributed sample distribution. For this research, if the Wilk-Shapiro value is greater than .90, then the normality assumption is close enough to run the parametric ANOVA analysis (Devore, 1995). As reported in Chapter IV, the normality assumption is grossly violated for all samples. No Wilk-Shapiro value is greater than .90, and the normality plots are not near a straight line. This eliminates the parametric ANOVA as a viable alternative for statistical analysis.

The second alternative of choice is the Kruskal-Wallis one-way nonparametric ANOVA. The assumption that must be verified for the Kruskal-Wallis ANOVA is that of a common continuous distribution of the error terms that results from the ANOVA procedure (Devore, 1995). Statistix is utilized to draw box plots of the error terms for all possible variable combinations. As reported in Chapter IV, all the distributions are similar enough to not grossly violate the assumption of similar continuous distributions of the sample errors. Also, because the Kruskal-Wallis ANOVA is a one-way ANOVA, the assumption of independent factors (i.e., CRDA elements) would ensure that no relevant information is lost by dropping interaction effects. This assumption is tested by performing parametric ANOVAs with all possible interaction effects up to three variable combinations. If none of the interactions are significant to the .10 level, then the

independent factor assumption can be utilized. As reported in Chapter IV, none of the interactions are significant. Because both assumptions are supported, the Kruskal-Wallis one-way nonparametric ANOVA is utilized for this research.

The inputs to the Kruskal-Wallis ANOVA analysis are the CRDA elements as factors (i.e., independent variables) and CRDA benefits data as the dependent variables. The Kruskal-Wallis test statistic (K) is denoted in equation (2), and is a measure of the extent to which the average rank of the i^{th} factor's observations deviate from their expected value (Devore, 1995). The test statistic is computed, then compared against a critical value determined from the χ^2 distribution. The χ^2 critical value is computed by looking up or computing the value for $\chi^2_{\alpha,I-1}$, that is value of χ^2 with a critical value of α and I-1 degrees of freedom. A test is considered significant at the α level if the Kruskal-Wallis test statistic (K) is greater than or equal to $\chi^2_{\alpha,I-1}$.

$$K = \frac{12}{N(N+1)} \sum_{j=1}^{I} J_i (\bar{R}_i - \frac{N+1}{2})^2 \qquad (2)$$

where

K = Kruskal-Wallis test statistic.
N = Total sample size.
I = Number of factors.
J_i = Sample size for the i^{th} factor.
$\bar{R}_i$ = Average rank for the i^{th} factor's observations.

The main output of the Kruskal-Wallis ANOVA analysis is the p-value. The p-value (p) states the level of significance of a particular independent variable in describing a particular dependent variable. For example, a p-value of .05 represents a model or variable that is statistically significant at the .05 level, and the test statistic is equal to the

critical value with α=.05. This provides the researcher with 95% confidence in the result, given that the CRDA element is significant. Statistical significance is the maximum probability of type 1 error present. Type 1 error is defined as rejecting the null hypothesis when the null hypothesis is actually true. In this research, p-values are the probability that a significant CRDA element is found when the CRDA element is actually not significant.

A summary of all the Kruskal-Wallis ANOVAs provides a list of significant CRDA elements. Consequently, results state that CRDAs containing certain elements are significantly different in mean benefits than CRDAs that do not contain the certain elements. A comparison of the means for each significant element and benefit combination yields the direction of the significance, which indicates if including the element combination is associated with significantly higher or lower benefits. From this analysis, suggestions as to which CRDA elements should be included or not included to achieve significantly higher CRDA government benefits are provided.

Analysis Limitations. Due to the relatively small number of sample data points available (69), it was not possible to get exactly equal sample proportions of each factor (i.e., CRDA element). Although most are close enough to be not statistically different, some factors contain significantly different sample proportions. This may cause some skewing of results, but ANOVAs have been shown to be robust with respect to unequal sample proportions. The few unequal sample proportions are not considered to cause significant changes in the results.

The error term population distributions for each ANOVA may not be exactly the same continuous distribution. The box plots reported in Chapter IV give an estimate of the distributions, and the Kruskal-Wallis ANOVA analysis is accomplished unless the assumptions are grossly violated. Although some skewing of results could occur if the true error term distributions are not the same continuous distribution, the Kruskal-Wallis ANOVA analysis has been shown to be robust with respect to violation of the assumptions (Devore, 1995). As reported in Chapter IV, none of the estimated error term distributions are significantly different from one another, and the Kruskal-Wallis ANOVA is utilized for this research.

The basic methodology and SAS programs are validated and verified through peer review, by computing the numbers through alternative computer software packages, and by hand computations. Furthermore, a pilot study was conducted to provide additional confidence in the collection and analytical methods.

Pilot Study

A pilot study was conducted in order to verify and validate the data collection and analysis methods. Twelve CRDAs were reviewed and analyzed. Frequency counts are provided in Appendix B, summary data is provided in Appendix C, and normality plots are provided in Appendix D.

CRDA Elements

In reviewing the CRDAs for specific elements, it was apparent that many of the CRDA elements are not of interest for this research. Nearly all of the Wright Laboratory

CRDAs follow a similar model and contain much of the same language. The elements that are contained in all CRDAs are removed from consideration because these elements will most likely not show any meaningful statistical relationship. These elements include responsibilities/tasks of government and partner, funding requirements for the partner, proprietary information protection, desired results or expected benefits of government and partner, milestone definition, timeline, liability of government and partner, and principal investigator names. For the same reason, the elements that are not found in any of the CRDAs analyzed are also removed from consideration. These elements include warranties of government and partner, environmental impacts, and safety issues. Progress reporting requirements of the government and partner are removed from consideration because these elements are in nearly all the CRDAs and will most likely not produce a large enough sample to show statistically significant results. Services required and exit criteria elements were only in one CRDA and will also most likely not produce a large enough sample to show statistically significant results.

The pilot study CRDA review also allowed some changes to the definition and scope of some elements under consideration. The intellectual property rights elements were reduced to two different elements to include copyright royalty rates and sales royalty rates. The two marketing elements have been combined into one element with a more detailed definition. These redefinitions were the result of the CRDA review process (e.g., learning what was actually contained in the CRDAs) and talking with technology transfer experts. New definitions are expected to better differentiate between CRDAs. The remaining CRDA element definitions of interest to this research are listed in Table 4.

CRDA Benefits

The CRDA benefits questionnaire was given to the Wright Laboratory point of contact for each of the twelve CRDAs for the pilot study. Participants were asked to make comments that would improve the questionnaire. One recommendation was to add an additional qualitative benefit to the questionnaire. After discussion with technology transfer experts, question number 14, improved technical capability, was added to the questionnaire as a result of this recommendation. The five noncash benefits were combined in order to achieve enough data points in this benefit category for analysis. The analysis in Chapter IV does not combine the noncash benefits.

Table 4. Research CRDA Elements

CRDA Elements	**A yes for each category verifies that the following statements are true:**
1) facility/equipment requirements	Any of the below facility requirements are stated.
a) government	Government facilities or equipment that are required for the CRDA are specified directly by name or type.
b) partner	Partner facilities or equipment that are required for the CRDA are specified directly by name or type.
2) manpower requirements	Any of the below manpower requirements are stated.
a) government	Government manpower requirements are quantified.
b) partner	Partner manpower requirements are quantified.
3) technology's stage of development	Already completed technology development or required technology development before commercialization is specified directly.
4) partner's ability to commercialize product	Partner's expertise or experience in the required technology commercialization area is specified directly.
5) market information	Specific commercial application for the technology is specified directly.
6) copyright royalty rates	Any copyright royalty rates are quantified.
7) sales royalty rates	Any sales royalty rates are quantified.

Pilot Study Results. Kruskal-Wallis one-way nonparametric ANOVAs were computed for the pilot data using SAS. Detailed results are reported in Appendix E. Significant factors at the .10 level were found for five of the nine CRDA benefit categories. For reimbursements, proprietary information was a significant factor, but, as discussed above, the proprietary information factor was only in one CRDA and is dropped from consideration. For license fees and improved productivity, the technology's stage of development was a significant factor (p=.001 and .03, respectively). For improved resource utilization, no license rights (p=.08), patent rights (p=.06), and commercialization rights (p=.08) were significant factors. For improved management practices, facility requirements (p=.08) and technology's stage of development (p=.08) were significant factors.

A significant factor represents that, for a given CRDA benefit and element, the mean benefit for all CRDAs containing the CRDA element is significantly different from the mean benefit for all CRDAs not containing the CRDA element. The significant relationships above represent these differences in means. In order to determine if including a specific CRDA element is associated with a significantly higher or lower mean CRDA benefit, the mean benefits in each significant relationship must be compared. If the mean benefit is significantly higher when the CRDA element is included, then the CRDA element would be recommended to be included in a model CRDA. If the mean benefit is significantly lower when the CRDA element is included, then the CRDA element would not be recommended for CRDAs.

The means of each significant factor level were compared. From the pilot study, the technology's stage of development would be recommended to achieve higher levels of license fees and productivity. In order to achieve better resource utilization, no license rights, patent rights, and commercialization rights should not be included when writing a CRDA. Both facility requirements and the technology's stage of development would be recommended to be included in a CRDA to achieve improved management practices. Limited confidence can be placed on the generalizability of the results of the pilot study because of the small number of data points. The larger sample size, as reported in the next chapter, will produce much more statistically powerful in the results.

Expected Results

The pilot study gives some initial clues as to what may be expected to result from this research. The technology's stage of development may be associated with significantly higher license fees and noncash financial benefits, and significantly better perceived productivity and management practices. Facility requirements included in CRDAs may also be associated with better perceived management practices.

Although some significant negative relationships were found with the patent, license, and commercialization rights factor, these factors have been redefined as described above, and the relationships are expected to change. The new factors, copyright royalty rates and sales royalty rates, are expected to be associated with significantly higher royalties and license fees along with better laboratory image and morale.

Many other significant relationships are expected to result from the research. The partner's ability to commercialize, market information, and the technology's stage of development included in the CRDAs could be associated with significantly higher royalties received and license fees received. Facility and manpower requirements in the CRDAs could be associated with significantly higher reimbursements for services and non-cash financial benefits.

High qualitative benefits such as increased productivity and better utilization of resources could be associated with CRDAs that include facility and manpower requirements. The partner's ability to commercialize the CRDA technology could be associated with significantly better management practices in the laboratory. Better laboratory image and morale could be associated with CRDAs that include the technologies stage of development and market influences.

Summary

This chapter has detailed the methodologies to be utilized in this research. Data collection techniques consist of historical CRDA review and questionnaires administered to CRDA points of contact at Wright Laboratory. Statistical data analysis procedures include data summary and ANOVA analysis to determine which CRDA elements are associated with significantly higher or lower CRDA government benefits. A pilot study of the procedures is reported along with the resulting refinements in procedures. Expected results including initial hypotheses are also presented.

Chapter IV summarizes the data collected during the CRDA review and questionnaire process, reports factor analysis results, and presents the results of the ANOVA analysis.

IV. Analysis and Results

This chapter summarizes the data collected during the CRDA review and questionnaire process, reports model aptness and factor reduction results, and presents the results of the ANOVA analysis.

Data Summary

The results for this research are based on an overall sample size of 69. The only exception is the improved technical capability benefit which was not collected on 11 of the 12 pilot study CRDAs, and therefore, has a sample size of 58.

Table 5 reports the number and percent of CRDAs that contain each CRDA element. Nearly all of the CRDA elements have a relatively equal proportion of zero's and one's, which add statistical power to the results. Appendix F lists the frequencies of all two variable CRDA element interactions. They range from a sample size of 0 to 25, and only some of the sample sizes are sufficient to perform statistical analysis. It is clear that analysis at levels of four or more interactions will not be supported due to the limited sample size. Therefore, no four level or higher interactions are modeled in this research.

Table 5. CRDA Element Frequencies

CRDA Element	# CRDAs Containing	% CRDAs Containing
Facilities/ Equipment Required	40	58%
Manpower Required	36	52%
Tech Stage of Development	38	55%
Partner Ability to Commercialize	38	55%
Market Information	33	48%
Copyright Royalty Rates	44	64%
Sales Royalty Rates	18	26%

Tables 6 and 7 provide a definition of the variables utilized in the computer programs.

Table 6. CRDA Element Variable Definitions

CRDA Element Variable	CRDA Element Definition
FACIL	facility/equipment requirements
MANP	manpower requirements
TECHSTG	technology's stage of development
PARTABIL	partner's ability to commercialize product
MARKET	market information
COPYROY	copyright royalty rates
SALESROY	sales royalty rates

Table 7. CRDA Benefit Variable Definitions

CRDA Benefit Variable	CRDA Benefit Definition
ROYAL	Royalties Received
REIMB	Reimbursements Received
LICEN	License Fees Received
WRKAV	Work Avoidance for Government
DATA	Data Received
SW	Software Received
HW	Hardware Received
OTHER	Other Noncash Received
PRODUCT	Improved Laboratory Productivity
RESUTIL	Improved Laboratory Resource Utilization
MGT	Improved Laboratory Management
IMAGE	Improved Laboratory Image
MORALE	Improved Laboratory Morale
TECHCAP	Improved Laboratory Technical Capability

Table 8 summarizes relevant statistics for each CRDA benefit variable including sample size (N), mean benefit, standard deviation, and the minimum and maximum benefit values. For example, royalty benefits (i.e., ROYAL) has a sample size of 69, a

mean benefit of $5,332, a standard deviation of $16,180, a minimum benefit of $0, and a maximum benefit of $80,000.

Table 8. CRDA Benefits Averages

Variable	N	Mean	Std Dev	Minimum	Maximum
ROYAL	69	$5332	$16,180	$0	$80,000
REIMB	69	$46,631	$253,671	$0	$2,000,000
LICEN	69	$730	$3458	$0	$25,000
WRKAV	69	$64,667	$201,311	$0	$1,200,000
DATA	69	$3,052,536	$25,279,937	$0	$210,000,000
SW	69	$2478	$14,724	$0	$120,000
HW	69	$8696	$61,211	$0	$500,000
OTHER	69	$29,330	$240,742	$0	$2,000,000
PRODUCT	69	0.77	1.5	0	4.0
RESUTIL	69	1.6	1.8	0	5.0
MGT	69	1.3	1.7	0	5.0
IMAGE	69	2.5	1.8	0	5.0
MORALE	69	1.5	1.8	0	5.0
TECHCAP	58	2.0	1.8	0	5.0

Table 9 summarizes the number of CRDAs containing each benefit and the means of each CRDA benefit variable for the CRDAs that contain the benefit. For example, the mean royalty benefits for the 14 CRDAs that produced some royalties is $26,279.

Table 9. CRDA Inclusive Benefits Averages

CRDA Benefit	number CRDAs containing	Average for CRDAs Containing Benefit
Royalties Received	14	$26,279
Reimbursements Received	11	$292,505
License Fees Received	5	$10,080
Work Avoidance for Government	20	$223,100
Data Received	12	$17,552,083
Software Received	5	$34,200
Hardware Received	2	$300,000
Other Noncash Received	4	$505,950
Improved Laboratory Productivity	16	3.31
Improved Laboratory Resource Utilization	34	3.29
Improved Laboratory Management	28	3.25
Improved Laboratory Image	49	3.53
Improved Laboratory Morale	31	3.39
Improved Laboratory Technical Capability	35	3.29

The averages for quantitative government benefits range from $2500 to $3.1M per CRDA, but the standard deviations are large. The averages increase to $10,000 to $17.5M for the CRDAs that contain each benefit, with the standard deviations remaining large. This indicates that a small minority of the CRDAs produces very large benefits

while the majority produce relatively small benefits. For example, data benefits received by the government average $3.1M, but a single CRDA produced $210M. The remaining CRDAs were more modest in the benefits received with the next highest CRDA producing $130,000. While the majority of CRDAs receive some benefits, it is clear that there are some outstanding CRDAs that far exceed others in government benefits.

Of the 69 CRDAs analyzed, the total average quantitative benefit to the government is $3.2M per CRDA. This number alone indicates that technology transfer through CRDAs is an extremely beneficial endeavor for government laboratories. The CRDA points of contact were also asked to rate the importance of six different qualitative benefits to the government that could result from the CRDA. For the CRDAs that contained the specific benefits, the average importance rating for all six qualitative categories was between moderately important and very important.

Factor Reduction

Appendix F reports the phi correlation coefficient for each pair of CRDA elements. None of the CRDA elements are correlated above an absolute value of .80. In fact, the highest correlation value between any two CRDA elements is .281. Therefore, no elements are combined for analysis purposes.

Parametric ANOVAs were run with interaction effects for all combinations of the independent variables up to three variable combinations. Although the assumptions are violated for running parametric ANOVAs (i.e., non-normality), as explained below, this supports the assumption of independent variables. None of the interactions in the

parametric ANOVAs were significant at the .10 significance level. Therefore, the assumption of independent CRDA element variables is supported by the parametric ANOVA results. The independence between CRDA elements assumption allows the use of one-way ANOVA analysis without losing any information.

Aptness Assessment

In order to use parametric ANOVA techniques, the assumption of normal populations and equal variances must be supported. To test the normality assumption, SAS was used to perform normality plots and calculate the Wilk-Shapiro value for each CRDA benefit variable. A straight line in the normality plot and a Wilk-Shapiro value of 1.0 would indicate a perfectly normal sample population (Freud and Littell, 1981). Appendix G contains each plot and the Wilk-Shapiro values. Because none of the Wilk-Shapiro values were above .90, and most were under .50, the normality assumption is grossly violated for the sample taken. This eliminates the parametric ANOVA as a viable alternative.

As stated in Chapter III, the next alternative is to use the nonparametric Kruskal-Wallis one-way ANOVA technique. The assumption that must be verified for the Kruskal-Wallis ANOVA is that of a common continuous distribution of the error terms that result from the ANOVA procedure. Statistix was utilized to draw box plots of the error terms for all possible variable combinations. Appendix I shows some of the box plots. Only a few of the box plots are shown in order to save space. All the distributions are similar enough to not grossly violate the assumption of similar continuous

distributions of the sample errors. Therefore, the Kruskal-Wallis ANOVA has been utilized for this research, and the results are reported below.

Results of ANOVAs

Appendix H reports the statistical relationships between the CRDA elements and CRDA benefits as determined by computing Kruskal-Wallis one-way nonparametric ANOVAs. Table 10 summarizes the significant ($p<.20$) relationships along with the respective p-values. Some CRDA elements are associated with significantly higher benefits in some cases and lower benefits in other cases. The column labeled *Mean of CRDAs Containing Element* describes the direction of the significance. Some of the relationships are expected, but many are also unexpected or even opposite of the expected results. Most of the relationships have reasonable explanations, and possible explanations follow.

Including detailed facility requirements in the CRDA is associated with significantly lower productivity ($p<.10$), management practices ($p<.05$), and morale ($p<.05$). Other benefits (royalties, other noncash financial benefits, and image) were also lower with less significance ($p<.20$) when including facility requirements. These results are opposite of some of the expected results, and may indicate that including too much detail in terms of facility requirements hinders a CRDA's ability to produce government benefits.

Table 10. Kruskal-Wallis ANOVA Results

CRDA Element	CRDA Benefit	P-Value	Mean of CRDAs Containing Element
FACIL	ROYAL	.19	Lower
FACIL	OTHER	.17	Lower
FACIL	PRODUCT	.06*	Lower
FACIL	MGT	.03**	Lower
FACIL	IMAGE	.15	Lower
FACIL	MORALE	.02**	Lower
MANP	SW	.03**	Higher
MANP	HW	.17	Higher
MANP	MORALE	.04**	Lower
TECHSTG	WRKAV	.18	Lower
TECHSTG	RESUTIL	.01**	Lower
TECHSTG	MGT	.08*	Lower
TECHSTG	IMAGE	.0002***	Lower
PARTABIL	ROYAL	.17	Higher
PARTABIL	HW	.11	Lower
PARTABIL	OTHER	.06*	Higher
MARKET	SW	.02**	Higher
MARKET	OTHER	.05*	Lower
COPYROY	PRODUCT	.11	Higher
COPYROY	IMAGE	.18	Lower
SALESROY	ROYAL	.03**	Higher
SALESROY	DATA	.11	Lower
SALESROY	SW	.08*	Higher

* significant at the .10 level
** significant at the .05 level
*** significant at the .01 level

Quantified manpower requirements in the CRDA is associated with significantly higher software benefits ($p<.05$) and hardware benefits ($p<.20$), but lower morale ($p<.05$). Manpower requirements in CRDAs may be easily estimated and used more often when specific products (i.e., software and hardware) are to be produced as a result of the CRDA. Lower morale seems to indicate that detailed manpower requirements in CRDAs may hinder the laboratory's morale. This could be due to a perception of micromanagement of the laboratory workers by the CRDA writers.

Detailing the technology's stage of development in the CRDA is associated with significantly lower perceived resource utilization ($p<.05$), management practices ($p<.10$), and image ($p<.001$). Work avoidance was also lower ($p<.20$) when including the technology's stage of development. These results are opposite of some of the expected results, and may indicate that including too much detail about the technology's stage of development hinders a CRDA's ability to produce government benefits. It is thought that including the technology's stage of development would only help to clarify the CRDAs technology, and therefore, produce some significantly higher government benefits. This result is particularly surprising in terms of the direction of the significant relationships with this CRDA element, and no further explanation is attempted.

The partner's ability to commercialize the CRDA technology in the CRDA is associated with significantly higher other noncash financial benefits ($p<.10$) and royalties ($p<.20$), but lower hardware benefits ($p<.20$). The higher royalties and financial benefits are as expected. This may be due to the fact that the partner's ability to commercialize the technology is often positively related to the amount of profits that the company makes

on the technology, which would translate directly to royalties paid to the government. Lower hardware benefits may be because the partner's ability to commercialize is related to commercial products, which the government does not receive for free. So, although hardware may be produced as a result of the CRDA technology, the government often does not get that hardware for free from of the CRDA.

Market information for the CRDA technology included in the CRDA is associated with significantly higher software benefits ($p<.05$), but lower other noncash financial benefits ($p<.10$). The higher software benefits are as expected and may be realized because the market information indicates that a product (i.e., software) has a higher likelihood of being produced. When software is produced as a result of CRDAs, the government is usually provided at least one free copy. The lower noncash financial benefits that are contrary to the expected results cannot be explained.

Quantifying copyright royalty rates in the CRDA is associated with significantly higher perceived productivity ($p<.20$), but lower perceived image ($p<.20$). Both of these results are unanticipated, but higher productivity could be attributed to CRDA personnel working harder to achieve quantified goals. Lower perceived image is more difficult to explain but could occur because technologies in which partners will agree to quantified royalty rates are not as risky, and therefore, have less potential for big payoffs and prestige.

Quantifying sales royalty rates in the CRDA is associated with significantly higher royalties ($p<.05$) and software ($p<.10$), but lower data ($p<.20$). It is clear that quantifying the royalty rate could produce a better chance for the government to receive

substantial royalties as a result of the CRDA. There is a much better chance of collecting possible royalties when royalty rates are in writing up front. It is less clear why quantified royalty rates are associated with higher software benefits, but software products may be inherently associated with CRDAs that expect sales royalties. The data benefits could be lower because royalty payments take the place of data. For example, the government will probably not receive as much royalties on a product if the government is receiving data on the product, and vice versa.

This chapter has presented the results of this research quantitatively and has discussed possible explanations for each significant result. Chapter V highlights the significant conclusions and managerial implications that can be implied from the results of this research. Chapter V also presents potential areas for future research that could add to the knowledge base of this research stream.

V. Conclusions and Recommendations

This chapter presents the conclusions and managerial implications of this research and potential areas for future research. Conclusions are based on the research objectives defined in Chapter I:

1. Determine the important elements of CRDAs that have been signed in the past.

2. Ascertain categories of benefits to the government that result from successful technology transfer.

3. Determine statistically significant relationships between the CRDA elements and benefits received by the government.

Objective 1 is completed in Chapter II and III through a comprehensive literature review, technology transfer expert interviews, and historical CRDA reviews. Objective 2 is completed in Chapter II through comprehensive literature review and technology transfer expert interviews. Objective 3 is completed in Chapter IV through statistical analysis procedures outlined in Chapter III. The conclusions and managerial implications below are based on the results in the previous chapters.

Conclusions

CRDA Elements

In defining important CRDA elements for this research, it is apparent that many CRDAs have very unique purposes. This fact makes it more difficult to define a CRDA element that can be evaluated across all CRDAs. Although many CRDAs are unique, the recent definition of a model CRDA included in the AFMC Technology Transfer

Handbook standardized much of the wording of the CRDAs. This increased standardization makes comparing CRDAs easier because the organization is now very similar across CRDAs.

Many CRDA elements that are identified as important are either in nearly all or very few of the WL CRDAs analyzed. The elements that are contained in nearly all WL CRDAs include responsibilities/tasks of government and partner, funding requirements for the partner, proprietary information protection, desired results or expected benefits of government and partner, milestone definition, timeline, liability of government and partner, principal investigator names, and progress reporting requirements of the government and partner. The CRDA elements that are found in very few of the CRDAs analyzed include warranties of government and partner, environmental impacts, services required, exit criteria, and safety issues. Each of these elements may be interesting to investigate in future research if a the set of CRDAs have a relatively equal mix of including and not including the CRDA element. This could be the case if a different model CRDA (e.g., in organizations outside of AFMC) is used as a guide for CRDAs of interest.

CRDA Benefits

In reviewing the benefits received by the government as a result of CRDAs, it is clear that the government receives a wide variety and large amounts of benefits through technology transfer. Although most CRDAs do not realize all the possible benefits, most CRDAs do achieve at least some of the government benefits. A total of only 8 of the 69 CRDAs analyzed produced none of the government benefits studied. A clear majority,

42, of the CRDAs produced quantitative government benefits, and 58 produced qualitative government benefits. Technology transfer through CRDAs continues to provide laboratories with revenue and other financial benefits in order to do more research and development. Many intangible benefits to the government are also realized such as increased productivity, better resource utilization and management practices, improved image and morale, and improved technical capabilities.

Relationships of CRDA Elements and Benefits

Statistical relationships between the CRDA elements and benefits are reported quantitatively in Chapter IV. Some of the relationships are as expected, but others are unexpected or even opposite of the expected results. These significant results are highlighted below.

Significant results that were expected are summarized in Table 11. The partner's ability to commercialize the CRDA technology is associated with significantly higher royalties. The partner's ability to commercialize the CRDA technology probably indicates the extent to which the technology will sell, which will result directly in government royalties. Quantifying sales royalty rates in the CRDA is also associated with significantly higher royalties. Stating the royalty rates up front may give the government a better chance to receive royalties, as opposed to negotiating the rates when the sales are made and the CRDA is many years old.

Table 11. Expected Positive CRDA Element and Benefit Relationships

CRDA Element	CRDA Benefit
Partner's Ability to Commercialize Product	Royalties
Quantified Sales Royalty Rate	Royalties

Significant positive results that were unexpected are summarized in Table 12. Quantified manpower requirements in the CRDA is associated with significantly higher software and hardware benefits. Manpower requirements may just be easier to quantify in CRDAs that result in hardware and software products. The partner's ability to commercialize the CRDA technology is associated with significantly higher other noncash financial benefits. The partner's ability in the CRDA may lead the government to get more financial benefits simply because the partner may be relatively of high quality. Market information for the CRDA technology included in the CRDA is associated with significantly higher software benefits. Market information may be associated with higher software benefits because the market information indicates that the software in the CRDA has a higher likelihood of being sold. Quantifying sales royalty rates in the CRDA is associated with significantly higher software, and quantifying copyright royalty rates in the CRDA is associated with significantly higher perceived productivity in the laboratory. These two results are difficult to explain.

Table 12. Unexpected Positive CRDA Element and Benefit Relationships

CRDA Element	CRDA Benefit
Quantified Manpower Requirements	Hardware
Quantified Manpower Requirements	Software
Partner's Ability to Commercialize Product	Other Financial Benefits
Market Information	Software
Quantified Sales Royalty Rate	Software
Quantified Copyright Royalty Rate	Laboratory Productivity

Significant results that were opposite of the expected results are summarized in Table 13. Including detailed facility requirements in the CRDA is associated with significantly lower management practices and other noncash financial benefits. Detailing the technology's stage of development produces significantly lower perceived resource utilization, management practices, and image. Quantifying copyright royalty rates in the CRDA is associated with significantly lower perceived laboratory image. In each of these cases, CRDA partners may spend too much time worrying about detailed CRDA requirements (i.e., facility, technology's stage of development, and copyright royalties) and not enough time doing actual R&D work.

Table 13. Negative CRDA Element and Benefit Relationships

CRDA Element	CRDA Benefit
Quantified Facility Requirements	Improved Management Practices
Quantified Facility Requirements	Other Financial Benefits
CRDA Technology's Stage of Development	Improved Resource Utilization
CRDA Technology's Stage of Development	Improved Management Practices
CRDA Technology's Stage of Development	Improved Laboratory Image
Quantified Copyright Royalty Rate	Improved Laboratory Image

Overall, a few of the results are as expected, but many are unexpected. Furthermore, many expected results failed to produce significant relationships. Based on these results, some tentative recommendations for CRDA content can be made from the above results. The managerial recommendations and implications are provided below.

Managerial Implications

Results provided in this research are a first step in quantifying relationships between what is included in a CRDA and the benefits received by the government. Technology transfer managers can use the results provided above as a tentative reference for possible elements to include or not include when writing a CRDA. As is the case with model CRDAs, the elements suggested here are generic elements that must be tailored for each CRDA. The elements suggested here are in no way all inclusive, but represent CRDA elements that can be included to possibly increase that chances of receiving quantitative and qualitative government benefits as a result of the CRDA.

Some CRDA elements are associated with certain higher government benefits in this research, and can possibly increase the chances for CRDAs to result in significant government benefits. Quantifying manpower requirements in the CRDA may increase the chances of receiving software and hardware benefits to the government. This could be achieved by writing the estimated or *not-to-exceed* man-hour requirements for each partner into the CRDA. Detailing the partner's ability to commercialize the CRDA technology may increase the chance for the government to receive royalties and some noncash financial benefits. The partner's past experience and applications in the CRDA technology is some of the information that could help detail the partner's ability to commercialize the CRDA technology. Including market information for the CRDA technology may increase the likelihood of the government receiving software benefits. Market information can consist of applications and customers for the CRDA technology. Quantifying copyright royalty rates in the CRDA may result in higher productivity in the laboratory. Copyright royalty rates are usually quantified as a percent of royalties received from copyrights from the CRDA technology, and a percent of royalties received from the third party licensing of copyrights associated with the CRDA. Quantifying sales royalty rates in the CRDA may produce higher royalties and software benefits received by the government. Sales royalty rates are usually identified as a percent of royalties received from sales of the CRDA technology, and a percent of royalties received from the third party sales of licensed CRDA technology. Each of these CRDA elements warrant consideration for inclusion in new CRDAs in order to increase the government's quantitative and qualitative benefits.

Other CRDA elements are associated with lower government benefits and should be avoided if possible. Detailed facility requirements in the CRDA may decrease the likelihood of government benefits such as increased productivity, better management practices, increased morale and image, royalties, and noncash financial benefits. General responsibilities of each partner could be included in the CRDA without detailing which facilities are required to fulfill the responsibilities. Although including the CRDA technology's stage of development may decrease the likelihood of government benefits (increased resource utilization, better management practices, increased image, and less cost from work avoidance), the results were unexpected and further research is recommended for this CRDA element before action is taken to remove the element from CRDAs.

Recommendations provided here should in no way replace common sense when writing a CRDA. Many CRDAs are very unique and may not fit with the majority of CRDAs. These recommendations are suggestions and guidelines, not known facts or laws. Generalizability of the results is suspect due to the relatively small sample size and the fact that all CRDAs reviewed are from Wright Laboratory. It is not known if CRDAs from other laboratories or agencies will follow the same relationships. Further research will add more credibility to the above results and recommendations, and suggestions for future research in the area of CRDA elements and benefits to the government are provided below.

Recommendations for Future Research

While the results can offer some insights into the relationship between CRDA elements and CRDA benefits to the government, it is clear that further study is required to achieve a complete understanding of the many complex relationships.

The results and recommendations reported here are from a sample of only 69 Wright Laboratory CRDAs. Research that can provide a larger sample size would add confidence to the results in this research. CRDAs from other government laboratories and agencies should also be a part of future research in order to add credence to the results.

There are also many other possibilities for the study of different CRDA elements or benefits. A wide variety of options exist when defining how a CRDA element is defined. In addition, CRDA benefits, especially qualitative benefits, could be defined in a variety of manners or others could be studied.

Another possible research topic could be to compare the government benefits of CRDAs written before the model CRDA was adopted to the CRDAs written using the model CRDA as a guide. This could provide some insights as to the effectiveness of the CRDA elements that are suggested in the model CRDAs.

Case studies of the few very successful CRDAs might also provide further insight into what makes a CRDA beneficial to the government. CRDA elements could be reported along with other areas that are factors in determining government benefits. For example, level of management support, purpose of the CRDA, and time to approve the

CRDA could all be factors that are associated in some way to higher government CRDA benefits.

Appendix A. Cooperative Research and Development Agreement (CRDA)

Benefits Questionnaire

Background Information (Print responses):

1. Name/Office Symbol: _____

2. Position Title: _____

3. CRDA Number: _____

4. CRDA Title: _____

Quantitative Benefits (Place x in box for yes or no, Print dollar amounts as appropriate, Include estimates of future benefits that are likely to occur within 2 years or less):

5. **a.** Did the government receive any kind of royalty payments as a direct result of this CRDA?

❑ **Yes** ❑ **No**

b. If yes, estimate the total amount of royalty payments?

To date: $_____ Future: $_____

6. **a.** Did the government receive any kind of cash reimbursement for services performed by the laboratory as a direct result of this CRDA (e.g., facilities payments or salary payments)?

❑ **Yes** ❑ **No**

b. If yes, estimate the total amount of all cash reimbursements?

To date: $_____ Future: $_____

7. **a.** Did the government receive any kind of license fees as a direct result of this CRDA?

❑ **Yes** ❑ **No**

b. If yes, estimate the total amount of license fees?

To date: $_____ Future: $_____

8. **a.** Did the government realize any financial benefits that are not directly payable as cash as a direct result of this CRDA?

❑ **Yes** ❑ **No**

b. If yes, estimate the total amount of cost savings for each category?

Work Avoidance:	To date: $_____	Future: $_____
Data Received:	To date: $_____	Future: $_____
Software Received:	To date: $_____	Future: $_____
Hardware Received:	To date: $_____	Future: $_____
Other _____:	To date: $_____	Future: $_____

Qualitative Benefits (Place x in box for yes or no, If yes then Circle the most appropriate response for each part b):

9. **a.** Did this CRDA result in productivity increases in the laboratory (e.g., increased automation)?

❑ **Yes** ❑ **No**

b. If yes, then rate the importance of these productivity increases to the laboratory.

1	**2**	**3**	**4**	**5**
not important	slightly important	moderately important	very important	extremely important

10. **a.** Did this CRDA result in better utilization of laboratory resources (e.g., more use of a laboratory test facility)?

❑ **Yes** ❑ **No**

b. If yes, then rate the importance of this better utilization of resources to the laboratory.

1	**2**	**3**	**4**	**5**
not important	slightly important	moderately important	very important	extremely important

11. **a.** Did this CRDA result in improved management and business practices in the laboratory (e.g., improved skills and techniques through interaction with the partner)?

❑ **Yes** ❑ **No**

b. If yes, then rate the importance of these improved management and business practices to the laboratory.

1	**2**	**3**	**4**	**5**
not important	slightly important	moderately important	very important	extremely important

12. **a.** Did this CRDA result in improved laboratory image?

❑ **Yes** ❑ **No**

b. If yes, then rate the importance of this improved laboratory image to the laboratory.

1	**2**	**3**	**4**	**5**
not important	slightly important	moderately important	very important	extremely important

13. **a.** Did this CRDA result in improved morale in the laboratory?

❑ **Yes** ❑ **No**

b. If yes, then rate the importance of this improved morale to the laboratory.

1	**2**	**3**	**4**	**5**
not important	slightly important	moderately important	very important	extremely important

14. **a.** Did this CRDA result in improved technical capability in the laboratory?

❑ **Yes** ❑ **No**

b. If yes, then rate the importance of this improved technical capability to the laboratory.

1	**2**	**3**	**4**	**5**
not important	slightly important	moderately important	very important	extremely important

Appendix B. Pilot Study CRDA Element Frequencies

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CRDA Element	# of CRDAs Containing
RESP 1	12
RESPG	12
RESPP	12
FACIL	7
FACILG	6
FACILP	2
MANP	8
MANPG	7
MANPP	3
SERV	12
SERVG	2
SERVP	1
TECHSTG	1
PARTABIL	7
MARKDIR	6
MARKGEN	5
INTELPRP	4
NOLIC	11
PATRITE	6
EXCLU	11
NONEXCLU	2
THRDPART	0
PATGEN	1
COMMRTS	11
PROPRTRY	1
RESULTS	12
RESG	12
RESP	12
PROGRS	12
PROGRSG	10
PROGRSP	10
MILESTN	10
TIMELN	12
EXITCRT	12
WARR	1
WARRG	0
WARRP	0
LIAB	0
LIABG	12
LIABP	12
PRINCINV	12
ENVIRON	12
SAFETY	0

Appendix C. Pilot Study Summary Data

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Variable	N	Mean	Std Dev	Minimum	Maximum
ROYAL	12	2125.00	7361.22	0	25500.00
REIMB	12	2171.67	7522.87	0	26060.00
LICEN	12	33.3333333	115.47005	0	400.00000
NONCASH	12	185333.33	572831.62	0	2000000.0
PRODUCT	12	0.5000000	1.1677484	0	3.0000000
RESUTIL	12	0.7500000	1.3568011	0	3.0000000
MGT	12	1.7500000	1.9128750	0	5.0000000
IMAGE	12	2.9166667	1.9752253	0	5.0000000
MORALE	12	2.3333333	2.1881222	0	5.0000000
RESP	12	1.0000000	0	1.0000000	1.0000000
RESPG	12	1.0000000	0	1.0000000	1.0000000
RESPP	12	1.0000000	0	1.0000000	1.0000000
FACIL	12	0.5833333	0.5149287	0	1.0000000
FACILG	12	0.5000000	0.5222330	0	1.0000000
FACILP	12	0.1666667	0.3892495	0	1.0000000
MANP	12	0.6666667	0.4923660	0	1.0000000
MANPG	12	0.5833333	0.5149287	0	1.0000000
MANPP	12	0.2500000	0.4522670	0	1.0000000
SERV	12	1.0000000	0	1.0000000	1.0000000
SERVG	12	0.1666667	0.3892495	0	1.0000000
SERVP	12	0.0833333	0.2886751	0	1.0000000
TECHSTG	12	0.0833333	0.2886751	0	1.0000000
PARTABIL	12	0.5833333	0.5149287	0	1.0000000
MARKDIR	12	0.5000000	0.5222330	0	1.0000000
MARKGEN	12	0.4166667	0.5149287	0	1.0000000
INTELPRP	12	0.3333333	0.4923660	0	1.0000000
NOLIC	12	0.9166667	0.2886751	0	1.0000000
PATRITE	12	0.5000000	0.5222330	0	1.0000000
EXCLU	12	0.9166667	0.2886751	0	1.0000000
NONEXCLU	12	0.1666667	0.3892495	0	1.0000000
THRDPART	12	0	0	0	0
PATGEN	12	0.0833333	0.2886751	0	1.0000000
COMMRTS	12	0.9166667	0.2886751	0	1.0000000
PROPRTRY	12	0.0833333	0.2886751	0	1.0000000
RESULTS	12	1.0000000	0	1.0000000	1.0000000
RESG	12	1.0000000	0	1.0000000	1.0000000
PROGRS	12	1.0000000	0	1.0000000	1.0000000
PROGRSG	12	0.8333333	0.3892495	0	1.0000000
PROGRSP	12	0.8333333	0.3892495	0	1.0000000
MILESTN	12	0.8333333	0.3892495	0	1.0000000
TIMELN	12	1.0000000	0	1.0000000	1.0000000
EXITCRT	12	1.0000000	0	1.0000000	1.0000000
WARR	12	0.0833333	0.2886751	0	1.0000000
WARRG	12	0	0	0	0
WARRP	12	0	0	0	0
LIAB	12	0	0	0	0
LIABG	12	1.0000000	0	1.0000000	1.0000000
LIABP	12	1.0000000	0	1.0000000	1.0000000
PRINCINV	12	1.0000000	0	1.0000000	1.0000000
ENVIRON	12	1.0000000	0	1.0000000	1.0000000
SAFETY	12	0	0	0	0

Appendix D. Pilot Study Normality Plots

```
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         Univariate Procedure

Variable=ROYAL

W:Normal     0.32154   Pr<W     0.0001

       Normal Probability Plot
  27500+            *
       |           +
       |         +++++++
       |       +++++++
       |          +++++++
   2500+     *     *  *  * *+*+*+* *  *  *
   +----+----+----+----+----+----+----+----+----+----+
       -2   -1    0   +1   +2


Variable=REIMB

W:Normal     0.32154   Pr<W     0.0001

       Normal Probability Plot
  27500+            *
       |          ++
       |         ++++++
       |       +++++++
       |          +++++++
   2500+     *     *  *  * *+*+*+* *  *  *
   +----+----+----+----+----+----+----+----+----+----+
       -2   -1    0   +1   +2


Variable=LICEN

W:Normal     0.32154   Pr<W     0.0001

       Normal Probability Plot
    425+            *
       |
       |          ++
       |          +++++
    225+           ++++
       |       ++++
       |       +++++
       |        ++++
     25+     *     *  *  * *+*+* * *.  *  *
   +----+----+----+----+----+----+----+----+----+----+
       -2   -1    0   +1   +2
```
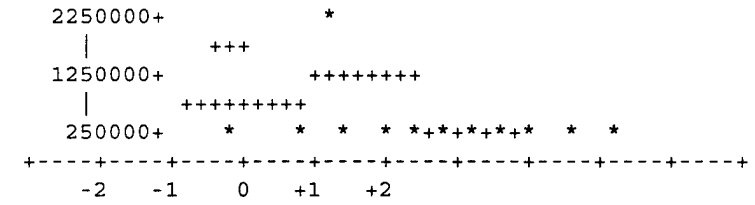
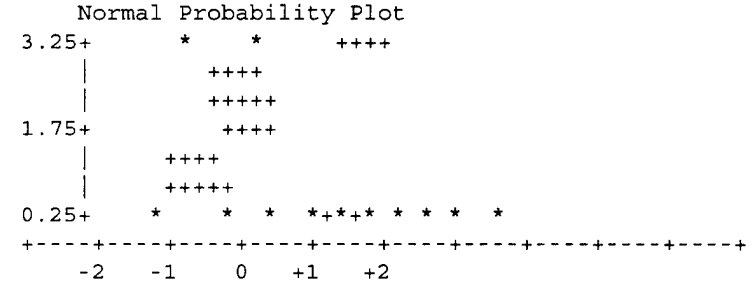

Variable=NONCASH

W:Normal 0.365225 Pr<W 0.0001



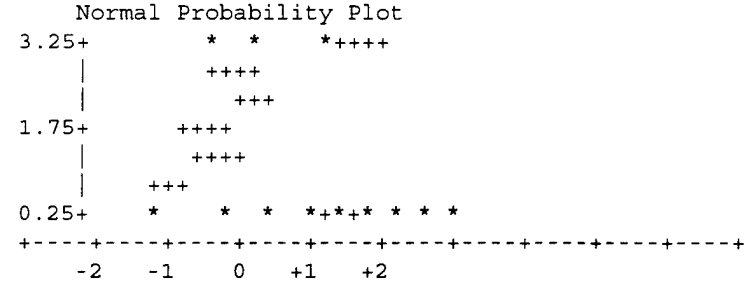
Variable=PRODUCT

W:Normal 0.462985 Pr<W 0.0001



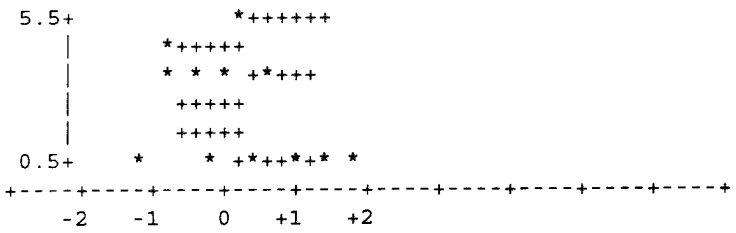
Variable=RESUTIL

W:Normal 0.554392 Pr<W 0.0001



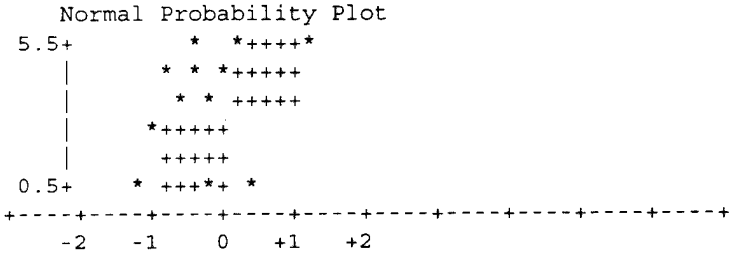
Variable=MGT

W:Normal 0.787613 Pr<W 0.0055



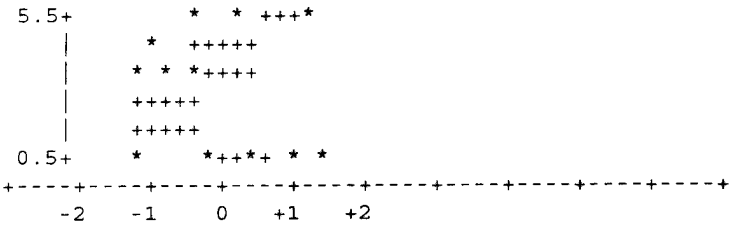
Variable=IMAGE

W:Normal 0.847779 Pr<W 0.0320



Variable=MORALE

W:Normal 0.805111 Pr<W 0.0091



Appendix E. Pilot Study ANOVA Results

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N P A R 1 W A Y P R O C E D U R E

Average Scores Were Used for Ties

Wilcoxon Scores (Rank Sums) for Variable **ROYAL** Classified by Variable **FACIL**

FACIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	5	30.0	32.5000000	2.95803989	6.00000000
1	7	48.0	45.5000000	2.95803989	6.85714286

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.71429 DF = 1 Prob > CHISQ = 0.3980

Wilcoxon Scores (Rank Sums) for Variable **REIMB** Classified by Variable **FACIL**

FACIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	5	30.0	32.5000000	2.95803989	6.00000000
1	7	48.0	45.5000000	2.95803989	6.85714286

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.71429 DF = 1 Prob > CHISQ = 0.3980

Wilcoxon Scores (Rank Sums) for Variable **LICEN** Classified by Variable **FACIL**

FACIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	5	30.0	32.5000000	2.95803989	6.00000000
1	7	48.0	45.5000000	2.95803989	6.85714286

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.71429 DF = 1 Prob > CHISQ = 0.3980

Wilcoxon Scores (Rank Sums) for Variable **NONCASH** Classified by Variable **FACIL**

FACIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	5	26.0	32.5000000	5.52199459	5.20000000
1	7	52.0	45.5000000	5.52199459	7.42857143

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 1.3856 DF = 1 Prob > CHISQ = 0.2392

Wilcoxon Scores (Rank Sums) for Variable **PRODUCT** Classified by Variable **FACIL**

FACIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	5	33.5000000	32.5000000	3.98862018	6.70000000
1	7	44.5000000	45.5000000	3.98862018	6.35714286

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.06286 DF = 1 Prob > CHISQ = 0.8020

Wilcoxon Scores (Rank Sums) for Variable **RESUTIL** Classified by Variable **FACIL**

FACIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	5	31.0	32.5000000	4.63435785	6.20000000
1	7	47.0	45.5000000	4.63435785	6.71428571

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.10476 DF = 1 Prob > CHISQ = 0.7462

Wilcoxon Scores (Rank Sums) for Variable **MGT** Classified by Variable **FACIL**

FACIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	5	22.5000000	32.5000000	5.65250012	4.50000000
1	7	55.5000000	45.5000000	5.65250012	7.92857143

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 3.1298 DF = 1 Prob > CHISQ = 0.0769

Wilcoxon Scores (Rank Sums) for Variable **IMAGE** Classified by Variable **FACIL**

FACIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	5	28.0	32.5000000	6.01607695	5.60000000
1	7	50.0	45.5000000	6.01607695	7.14285714

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.55950 DF = 1 Prob > CHISQ = 0.4545

Wilcoxon Scores (Rank Sums) for Variable **MORALE** Classified by Variable **FACIL**

FACIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	5	27.0	32.5000000	5.84846522	5.40000000
1	7	51.0	45.5000000	5.84846522	7.28571429

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.88439 DF = 1 Prob > CHISQ = 0.3470

Wilcoxon Scores (Rank Sums) for Variable **ROYAL** Classified by Variable **MANP**

MANP	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	4	30.0	26.0	2.82842712	7.50000000
1	8	48.0	52.0	2.82842712	6.00000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 2.0000 DF = 1 Prob > CHISQ = 0.1573

Wilcoxon Scores (Rank Sums) for Variable **REIMB** Classified by Variable **MANP**

MANP	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	4	24.0	26.0	2.82842712	6.00000000
1	8	54.0	52.0	2.82842712	6.75000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.50000 DF = 1 Prob > CHISQ = 0.4795

Wilcoxon Scores (Rank Sums) for Variable **LICEN** Classified by Variable **MANP**

MANP	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	4	24.0	26.0	2.82842712	6.00000000
1	8	54.0	52.0	2.82842712	6.75000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.50000 DF = 1 Prob > CHISQ = 0.4795

Wilcoxon Scores (Rank Sums) for Variable **NONCASH** Classified by Variable **MANP**

MANP	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	4	30.0	26.0	5.28003673	7.50000000
1	8	48.0	52.0	5.28003673	6.00000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.57391 DF = 1 Prob > CHISQ = 0.4487

Wilcoxon Scores (Rank Sums) for Variable **PRODUCT** Classified by Variable **MANP**

MANP	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	4	28.0	26.0	3.81385036	7.00000000
1	8	50.0	52.0	3.81385036	6.25000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.27500 DF = 1 Prob > CHISQ = 0.6000

Wilcoxon Scores (Rank Sums) for Variable **RESUTIL** Classified by Variable **MANP**

MANP	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	4	20.0	26.0	4.43129368	5.00000000
1	8	58.0	52.0	4.43129368	7.25000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 1.8333 DF = 1 Prob > CHISQ = 0.1757

Wilcoxon Scores (Rank Sums) for Variable **MGT** Classified by Variable **MANP**

MANP	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	4	26.5000000	26.0	5.40482388	6.62500000
1	8	51.5000000	52.0	5.40482388	6.43750000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.00856 DF = 1 Prob > CHISQ = 0.9263

Wilcoxon Scores (Rank Sums) for Variable **IMAGE** Classified by Variable **MANP**

MANP	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	4	23.0	26.0	5.75246983	5.75000000
1	8	55.0	52.0	5.75246983	6.87500000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.27198 DF = 1 Prob > CHISQ = 0.6020

Wilcoxon Scores (Rank Sums) for Variable **MORALE** Classified by Variable **MANP**

MANP	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	4	32.0	26.0	5.59220236	8.00000000
1	8	46.0	52.0	5.59220236	5.75000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 1.1512 DF = 1 Prob > CHISQ = 0.2833

Wilcoxon Scores (Rank Sums) for Variable **ROYAL** Classified by Variable **TECHSTG**

TECHSTG	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	11	72.0	71.5000000	1.65831240	6.54545455
1	1	6.0	6.5000000	1.65831240	6.00000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.09091 DF = 1 Prob > CHISQ = 0.7630

Wilcoxon Scores (Rank Sums) for Variable **REIMB** Classified by Variable **TECHSTG**

TECHSTG	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	11	72.0	71.5000000	1.65831240	6.54545455
1	1	6.0	6.5000000	1.65831240	6.00000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.09091 DF = 1 Prob > CHISQ = 0.7630

Wilcoxon Scores (Rank Sums) for Variable **LICEN** Classified by Variable **TECHSTG**

TECHSTG	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	11	66.0	71.5000000	1.65831240	6.0
1	1	12.0	6.5000000	1.65831240	12.0

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 11.000 DF = 1 Prob > CHISQ = 0.0009

Wilcoxon Scores (Rank Sums) for Variable **NONCASH** Classified by Variable **TECHSTG**

TECHSTG	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	11	67.0	71.5000000	3.09569594	6.0909091
1	1	11.0	6.5000000	3.09569594	11.0000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 2.1130 DF = 1 Prob > CHISQ = 0.1460

Wilcoxon Scores (Rank Sums) for Variable **PRODUCT** Classified by Variable **TECHSTG**

TECHSTG	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	11	66.5000000	71.5000000	2.23606798	6.0454545
1	1	11.5000000	6.5000000	2.23606798	11.5000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 5.0000 DF = 1 Prob > CHISQ = 0.0253

Wilcoxon Scores (Rank Sums) for Variable **RESUTIL** Classified by Variable **TECHSTG**

TECHSTG	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	11	73.0	71.5000000	2.59807621	6.63636364
1	1	5.0	6.5000000	2.59807621	5.00000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.33333 DF = 1 Prob > CHISQ = 0.5637

Wilcoxon Scores (Rank Sums) for Variable **MGT** Classified by Variable **TECHSTG**

TECHSTG	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	11	66.0	71.5000000	3.16885889	6.0
1	1	12.0	6.5000000	3.16885889	12.0

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 3.0124 DF = 1 Prob > CHISQ = 0.0826

Wilcoxon Scores (Rank Sums) for Variable **IMAGE** Classified by Variable **TECHSTG**

TECHSTG	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	11	72.5000000	71.5000000	3.37268439	6.59090909
1	1	5.5000000	6.5000000	3.37268439	5.50000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.08791 DF = 1 Prob > CHISQ = 0.7668

Wilcoxon Scores (Rank Sums) for Variable **MORALE** Classified by Variable **TECHSTG**

TECHSTG	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	11	67.0	71.5000000	3.27871926	6.0909091
1	1	11.0	6.5000000	3.27871926	11.0000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 1.8837 DF = 1 Prob > CHISQ = 0.1699

Wilcoxon Scores (Rank Sums) for Variable **ROYAL** Classified by Variable **PARTABIL**

PARTABIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	5	36.0	32.5000000	2.95803989	7.20000000
1	7	42.0	45.5000000	2.95803989	6.00000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 1.4000 DF = 1 Prob > CHISQ = 0.2367

Wilcoxon Scores (Rank Sums) for Variable **REIMB** Classified by Variable **PARTABIL**

PARTABIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	5	30.0	32.5000000	2.95803989	6.00000000
1	7	48.0	45.5000000	2.95803989	6.85714286

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.71429 DF = 1 Prob > CHISQ = 0.3980

Wilcoxon Scores (Rank Sums) for Variable **LICEN** Classified by Variable **PARTABIL**

PARTABIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	5	30.0	32.5000000	2.95803989	6.00000000
1	7	48.0	45.5000000	2.95803989	6.85714286

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.71429 DF = 1 Prob > CHISQ = 0.3980

Wilcoxon Scores (Rank Sums) for Variable **NONCASH** Classified by Variable **PARTABIL**

PARTABIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	5	34.0	32.5000000	5.52199459	6.80000000
1	7	44.0	45.5000000	5.52199459	6.28571429

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.07379 DF = 1 Prob > CHISQ = 0.7859

Wilcoxon Scores (Rank Sums) for Variable **PRODUCT** Classified by Variable **PARTABIL**

PARTABIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	5	33.5000000	32.5000000	3.98862018	6.70000000
1	7	44.5000000	45.5000000	3.98862018	6.35714286

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.06286 DF = 1 Prob > CHISQ = 0.8020

Wilcoxon Scores (Rank Sums) for Variable **RESUTIL** Classified by Variable **PARTABIL**

PARTABIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	5	37.0	32.5000000	4.63435785	7.40000000
1	7	41.0	45.5000000	4.63435785	5.85714286

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.94286 DF = 1 Prob > CHISQ = 0.3315

Wilcoxon Scores (Rank Sums) for Variable **MGT** Classified by Variable **PARTABIL**

PARTABIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	5	35.0	32.5000000	5.65250012	7.00000000
1	7	43.0	45.5000000	5.65250012	6.14285714

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.19561 DF = 1 Prob > CHISQ = 0.6583

Wilcoxon Scores (Rank Sums) for Variable **IMAGE** Classified by Variable **PARTABIL**

PARTABIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	5	40.0	32.5000000	6.01607695	8.00000000
1	7	38.0	45.5000000	6.01607695	5.42857143

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 1.5542 DF = 1 Prob > CHISQ = 0.2125

Wilcoxon Scores (Rank Sums) for Variable **MORALE** Classified by Variable **PARTABIL**

PARTABIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	5	33.0	32.5000000	5.84846522	6.60000000
1	7	45.0	45.5000000	5.84846522	6.42857143

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.00731 DF = 1 Prob > CHISQ = 0.9319

Wilcoxon Scores (Rank Sums) for Variable **ROYAL** Classified by Variable **MARKDIR**

MARKDIR	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	6	42.0	39.0	3.00000000	7.0
1	6	36.0	39.0	3.00000000	6.0

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 1.0000 DF = 1 Prob > CHISQ = 0.3173

Wilcoxon Scores (Rank Sums) for Variable **REIMB** Classified by Variable **MARKDIR**

MARKDIR	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	6	36.0	39.0	3.00000000	6.0
1	6	42.0	39.0	3.00000000	7.0

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 1.0000 DF = 1 Prob > CHISQ = 0.3173

Wilcoxon Scores (Rank Sums) for Variable **LICEN** Classified by Variable **MARKDIR**

MARKDIR	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	6	36.0	39.0	3.00000000	6.0
1	6	42.0	39.0	3.00000000	7.0

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 1.0000 DF = 1 Prob > CHISQ = 0.3173

Wilcoxon Scores (Rank Sums) for Variable **NONCASH** Classified by Variable **MARKDIR**

MARKDIR	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	6	42.0	39.0	5.60032467	7.0
1	6	36.0	39.0	5.60032467	6.0

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.28696 DF = 1 Prob > CHISQ = 0.5922

Wilcoxon Scores (Rank Sums) for Variable **PRODUCT** Classified by Variable **MARKDIR**

MARKDIR	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	6	39.0	39.0	4.04519917	6.50000000
1	6	39.0	39.0	4.04519917	6.50000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0 DF = 1 Prob > CHISQ = 1.0000

Wilcoxon Scores (Rank Sums) for Variable **RESUTIL** Classified by Variable **MARKDIR**

MARKDIR	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	6	42.0	39.0	4.70009671	7.0
1	6	36.0	39.0	4.70009671	6.0

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.40741 DF = 1 Prob > CHISQ = 0.5233

Wilcoxon Scores (Rank Sums) for Variable **MGT** Classified by Variable **MARKDIR**

MARKDIR	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	6	38.5000000	39.0	5.73268143	6.41666667
1	6	39.5000000	39.0	5.73268143	6.58333333

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.00761 DF = 1 Prob > CHISQ = 0.9305

Wilcoxon Scores (Rank Sums) for Variable **IMAGE** Classified by Variable **MARKDIR**

MARKDIR	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	6	44.0	39.0	6.10141563	7.33333333
1	6	34.0	39.0	6.10141563	5.66666667

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.67155 DF = 1 Prob > CHISQ = 0.4125

Wilcoxon Scores (Rank Sums) for Variable **MORALE** Classified by Variable **MARKDIR**

MARKDIR	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	6	36.0	39.0	5.93142632	6.0
1	6	42.0	39.0	5.93142632	7.0

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.25581 DF = 1 Prob > CHISQ = 0.6130

Wilcoxon Scores (Rank Sums) for Variable **ROYAL** Classified by Variable **INTELPRP**

INTELPRP	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	8	48.0	52.0	2.82842712	6.00000000
1	4	30.0	26.0	2.82842712	7.50000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 2.0000 DF = 1 Prob > CHISQ = 0.1573

Wilcoxon Scores (Rank Sums) for Variable **REIMB** Classified by Variable **INTELPRP**

INTELPRP	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	8	54.0	52.0	2.82842712	6.75000000
1	4	24.0	26.0	2.82842712	6.00000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.50000 DF = 1 Prob > CHISQ = 0.4795

Wilcoxon Scores (Rank Sums) for Variable **LICEN** Classified by Variable **INTELPRP**

INTELPRP	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	8	54.0	52.0	2.82842712	6.75000000
1	4	24.0	26.0	2.82842712	6.00000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.50000 DF = 1 Prob > CHISQ = 0.4795

Wilcoxon Scores (Rank Sums) for Variable **NONCASH** Classified by Variable **INTELPRP**

INTELPRP	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	8	54.0	52.0	5.28003673	6.75000000
1	4	24.0	26.0	5.28003673	6.00000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.14348 DF = 1 Prob > CHISQ = 0.7048

Wilcoxon Scores (Rank Sums) for Variable **PRODUCT** Classified by Variable **INTELPRP**

INTELPRP	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	8	56.0	52.0	3.81385036	7.00000000
1	4	22.0	26.0	3.81385036	5.50000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 1.1000 DF = 1 Prob > CHISQ = 0.2943

Wilcoxon Scores (Rank Sums) for Variable **RESUTIL** Classified by Variable **INTELPRP**

INTELPRP	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	8	52.0	52.0	4.43129368	6.50000000
1	4	26.0	26.0	4.43129368	6.50000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0 DF = 1 Prob > CHISQ = 1.0000

Wilcoxon Scores (Rank Sums) for Variable **MGT** Classified by Variable **INTELPRP**

INTELPRP	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	8	56.5000000	52.0	5.40482388	7.06250000
1	4	21.5000000	26.0	5.40482388	5.37500000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.69321 DF = 1 Prob > CHISQ = 0.4051

Wilcoxon Scores (Rank Sums) for Variable **IMAGE** Classified by Variable **INTELPRP**

INTELPRP	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	8	55.0	52.0	5.75246983	6.87500000
1	4	23.0	26.0	5.75246983	5.75000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.27198 DF = 1 Prob > CHISQ = 0.6020

Wilcoxon Scores (Rank Sums) for Variable **MORALE** Classified by Variable **INTELPRP**

INTELPRP	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	8	50.0	52.0	5.59220236	6.25000000
1	4	28.0	26.0	5.59220236	7.00000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.12791 DF = 1 Prob > CHISQ = 0.7206

Wilcoxon Scores (Rank Sums) for Variable **ROYAL** Classified by Variable **NOLIC**

NOLIC	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	11	72.0	71.5000000	1.65831240	6.54545455
0	1	6.0	6.5000000	1.65831240	6.00000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.09091 DF = 1 Prob > CHISQ = 0.7630

Wilcoxon Scores (Rank Sums) for Variable **REIMB** Classified by Variable **NOLIC**

NOLIC	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	11	72.0	71.5000000	1.65831240	6.54545455
0	1	6.0	6.5000000	1.65831240	6.00000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.09091 DF = 1 Prob > CHISQ = 0.7630

Wilcoxon Scores (Rank Sums) for Variable **LICEN** Classified by Variable **NOLIC**

NOLIC	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	11	72.0	71.5000000	1.65831240	6.54545455
0	1	6.0	6.5000000	1.65831240	6.00000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.09091 DF = 1 Prob > CHISQ = 0.7630

Wilcoxon Scores (Rank Sums) for Variable **NONCASH** Classified by Variable **NOLIC**

NOLIC	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	11	74.0	71.5000000	3.09569594	6.72727273
0	1	4.0	6.5000000	3.09569594	4.00000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.65217 DF = 1 Prob > CHISQ = 0.4193

Wilcoxon Scores (Rank Sums) for Variable **PRODUCT** Classified by Variable **NOLIC**

NOLIC	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	11	72.5000000	71.5000000	2.23606798	6.59090909
0	1	5.5000000	6.5000000	2.23606798	5.50000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.20000 DF = 1 Prob > CHISQ = 0.6547

Wilcoxon Scores (Rank Sums) for Variable **RESUTIL** Classified by Variable **NOLIC**

NOLIC	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	11	67.0	71.5000000	2.59807621	6.0909091
0	1	11.0	6.5000000	2.59807621	11.0000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 3.0000 DF = 1 Prob > CHISQ = 0.0833

Wilcoxon Scores (Rank Sums) for Variable **MGT** Classified by Variable **NOLIC**

NOLIC	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	11	69.5000000	71.5000000	3.16885889	6.31818182
0	1	8.5000000	6.5000000	3.16885889	8.50000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.39834 DF = 1 Prob > CHISQ = 0.5279

Wilcoxon Scores (Rank Sums) for Variable **IMAGE** Classified by Variable **NOLIC**

NOLIC	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	11	70.0	71.5000000	3.37268439	6.36363636
0	1	8.0	6.5000000	3.37268439	8.00000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.19780 DF = 1 Prob > CHISQ = 0.6565

Wilcoxon Scores (Rank Sums) for Variable **MORALE** Classified by Variable **NOLIC**

NOLIC	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	11	69.0	71.5000000	3.27871926	6.27272727
0	1	9.0	6.5000000	3.27871926	9.00000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.58140 DF = 1 Prob > CHISQ = 0.4458

Wilcoxon Scores (Rank Sums) for Variable **ROYAL** Classified by Variable **PATRITE**

PATRITE	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	6	42.0	39.0	3.00000000	7.0
0	6	36.0	39.0	3.00000000	6.0

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 1.0000 DF = 1 Prob > CHISQ = 0.3173

Wilcoxon Scores (Rank Sums) for Variable **REIMB** Classified by Variable **PATRITE**

PATRITE	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	6	36.0	39.0	3.00000000	6.0
0	6	42.0	39.0	3.00000000	7.0

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 1.0000 DF = 1 Prob > CHISQ = 0.3173

Wilcoxon Scores (Rank Sums) for Variable **LICEN** Classified by Variable **PATRITE**

PATRITE	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	6	36.0	39.0	3.00000000	6.0
0	6	42.0	39.0	3.00000000	7.0

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 1.0000 DF = 1 Prob > CHISQ = 0.3173

Wilcoxon Scores (Rank Sums) for Variable **NONCASH** Classified by Variable **PATRITE**

PATRITE	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	6	42.0	39.0	5.60032467	7.0
0	6	36.0	39.0	5.60032467	6.0

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.28696 DF = 1 Prob > CHISQ = 0.5922

Wilcoxon Scores (Rank Sums) for Variable **PRODUCT** Classified by Variable **PATRITE**

PATRITE	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	6	39.0	39.0	4.04519917	6.50000000
0	6	39.0	39.0	4.04519917	6.50000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0 DF = 1 Prob > CHISQ = 1.0000

Wilcoxon Scores (Rank Sums) for Variable **RESUTIL** Classified by Variable **PATRITE**

PATRITE	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	6	30.0	39.0	4.70009671	5.0
0	6	48.0	39.0	4.70009671	8.0

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 3.6667 DF = 1 Prob > CHISQ = 0.0555

Wilcoxon Scores (Rank Sums) for Variable **MGT** Classified by Variable **PATRITE**

PATRITE	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	6	33.5000000	39.0	5.73268143	5.58333333
0	6	44.5000000	39.0	5.73268143	7.41666667

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.92047 DF = 1 Prob > CHISQ = 0.3374

Wilcoxon Scores (Rank Sums) for Variable **IMAGE** Classified by Variable **PATRITE**

PATRITE	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	6	29.0	39.0	6.10141563	4.83333333
0	6	49.0	39.0	6.10141563	8.16666667

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 2.6862 DF = 1 Prob > CHISQ = 0.1012

Wilcoxon Scores (Rank Sums) for Variable **MORALE** Classified by Variable **PATRITE**

PATRITE	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	6	38.0	39.0	5.93142632	6.33333333
0	6	40.0	39.0	5.93142632	6.66666667

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.02842 DF = 1 Prob > CHISQ = 0.8661

Wilcoxon Scores (Rank Sums) for Variable **ROYAL** Classified by Variable **COMMRTS**

COMMRTS	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	11	72.0	71.5000000	1.65831240	6.54545455
0	1	6.0	6.5000000	1.65831240	6.00000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.09091 DF = 1 Prob > CHISQ = 0.7630

Wilcoxon Scores (Rank Sums) for Variable **REIMB** Classified by Variable **COMMRTS**

COMMRTS	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	11	72.0	71.5000000	1.65831240	6.54545455
0	1	6.0	6.5000000	1.65831240	6.00000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.09091 DF = 1 Prob > CHISQ = 0.7630

Wilcoxon Scores (Rank Sums) for Variable **LICEN** Classified by Variable **COMMRTS**

COMMRTS	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	11	72.0	71.5000000	1.65831240	6.54545455
0	1	6.0	6.5000000	1.65831240	6.00000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.09091 DF = 1 Prob > CHISQ = 0.7630

Wilcoxon Scores (Rank Sums) for Variable **NONCASH** Classified by Variable **COMMRTS**

COMMRTS	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	11	74.0	71.5000000	3.09569594	6.72727273
0	1	4.0	6.5000000	3.09569594	4.00000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.65217 DF = 1 Prob > CHISQ = 0.4193

Wilcoxon Scores (Rank Sums) for Variable **PRODUCT** Classified by Variable **COMMRTS**

COMMRTS	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	11	72.5000000	71.5000000	2.23606798	6.59090909
0	1	5.5000000	6.5000000	2.23606798	5.50000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.20000 DF = 1 Prob > CHISQ = 0.6547

Wilcoxon Scores (Rank Sums) for Variable **RESUTIL** Classified by Variable **COMMRTS**

COMMRTS	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	11	67.0	71.5000000	2.59807621	6.0909091
0	1	11.0	6.5000000	2.59807621	11.0000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 3.0000 DF = 1 Prob > CHISQ = 0.0833

Wilcoxon Scores (Rank Sums) for Variable **MGT** Classified by Variable **COMMRTS**

COMMRTS	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	11	69.5000000	71.5000000	3.16885889	6.31818182
0	1	8.5000000	6.5000000	3.16885889	8.50000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.39834 DF = 1 Prob > CHISQ = 0.5279

Wilcoxon Scores (Rank Sums) for Variable **IMAGE** Classified by Variable **COMMRTS**

COMMRTS	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	11	70.0	71.5000000	3.37268439	6.36363636
0	1	8.0	6.5000000	3.37268439	8.00000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.19780 DF = 1 Prob > CHISQ = 0.6565

Wilcoxon Scores (Rank Sums) for Variable **MORALE** Classified by Variable **COMMRTS**

COMMRTS	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	11	69.0	71.5000000	3.27871926	6.27272727
0	1	9.0	6.5000000	3.27871926	9.00000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.58140 DF = 1 Prob > CHISQ = 0.4458

Wilcoxon Scores (Rank Sums) for Variable **ROYAL** Classified by Variable **PROPRTRY**

PROPRTRY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	11	72.0	71.5000000	1.65831240	6.54545455
1	1	6.0	6.5000000	1.65831240	6.00000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.09091 DF = 1 Prob > CHISQ = 0.7630

Wilcoxon Scores (Rank Sums) for Variable **REIMB** Classified by Variable **PROPRTRY**

PROPRTRY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	11	66.0	71.5000000	1.65831240	6.0
1	1	12.0	6.5000000	1.65831240	12.0

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 11.000 DF = 1 Prob > CHISQ = 0.0009

Wilcoxon Scores (Rank Sums) for Variable **LICEN** Classified by Variable **PROPRTRY**

PROPRTRY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	11	72.0	71.5000000	1.65831240	6.54545455
1	1	6.0	6.5000000	1.65831240	6.00000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.09091 DF = 1 Prob > CHISQ = 0.7630

Wilcoxon Scores (Rank Sums) for Variable **NONCASH** Classified by Variable **PROPRTRY**

PROPRTRY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	11	69.0	71.5000000	3.09569594	6.27272727
1	1	9.0	6.5000000	3.09569594	9.00000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.65217 DF = 1 Prob > CHISQ = 0.4193

Wilcoxon Scores (Rank Sums) for Variable **PRODUCT** Classified by Variable **PROPRTRY**

PROPRTRY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	11	72.5000000	71.5000000	2.23606798	6.59090909
1	1	5.5000000	6.5000000	2.23606798	5.50000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.20000 DF = 1 Prob > CHISQ = 0.6547

Wilcoxon Scores (Rank Sums) for Variable **RESUTIL** Classified by Variable **PROPRTRY**

PROPRTRY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	11	73.0	71.5000000	2.59807621	6.63636364
1	1	5.0	6.5000000	2.59807621	5.00000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.33333 DF = 1 Prob > CHISQ = 0.5637

Wilcoxon Scores (Rank Sums) for Variable **MGT** Classified by Variable **PROPRTRY**

PROPRTRY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	11	74.5000000	71.5000000	3.16885889	6.77272727
1	1	3.5000000	6.5000000	3.16885889	3.50000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.89627 DF = 1 Prob > CHISQ = 0.3438

Wilcoxon Scores (Rank Sums) for Variable **IMAGE** Classified by Variable **PROPRTRY**

PROPRTRY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	11	72.5000000	71.5000000	3.37268439	6.59090909
1	1	5.5000000	6.5000000	3.37268439	5.50000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.08791 DF = 1 Prob > CHISQ = 0.7668

Wilcoxon Scores (Rank Sums) for Variable **MORALE** Classified by Variable **PROPRTRY**

PROPRTRY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	11	71.0	71.5000000	3.27871926	6.45454545
1	1	7.0	6.5000000	3.27871926	7.00000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.02326 DF = 1 Prob > CHISQ = 0.8788

Appendix F. CRDA Element Frequency Counts

The SAS System 11:16 Friday, May 30, 1997

TABLE OF **FACIL BY MANP**

FACIL	MANP		
Frequency / Percent / Row Pct / Col Pct	0	1	Total
0	13 18.84 44.83 39.39	16 23.19 55.17 44.44	29 42.03
1	20 28.99 50.00 60.61	20 28.99 50.00 55.56	40 57.97
Total	33 47.83	36 52.17	69 100.00

Phi Coefficient -0.051

TABLE OF **FACIL BY TECHSTG**

FACIL	TECHSTG		
Frequency / Percent / Row Pct / Col Pct	0	1	Total
0	15 21.74 51.72 48.39	14 20.29 48.28 36.84	29 42.03
1	16 23.19 40.00 51.61	24 34.78 60.00 63.16	40 57.97
Total	31 44.93	38 55.07	69 100.00

Phi Coefficient 0.116

TABLE OF **FACIL BY PARTABIL**

FACIL	PARTABIL		
Frequency Percent Row Pct Col Pct	0	1	Total
0	11 15.94 37.93 35.48	18 26.09 62.07 47.37	29 42.03
1	20 28.99 50.00 64.52	20 28.99 50.00 52.63	40 57.97
Total	31 44.93	38 55.07	69 100.00

Phi Coefficient -0.120

TABLE OF **FACIL BY MARKET**

FACIL	MARKET		
Frequency Percent Row Pct Col Pct	0	1	Total
0	15 21.74 51.72 41.67	14 20.29 48.28 42.42	29 42.03
1	21 30.43 52.50 58.33	19 27.54 47.50 57.58	40 57.97
Total	36 52.17	33 47.83	69 100.00

Phi Coefficient -0.008

TABLE OF **FACIL BY COPYROY**

FACIL	COPYROY		
Frequency Percent Row Pct Col Pct	0	1	Total
0	13 18.84 44.83 52.00	16 23.19 55.17 36.36	29 42.03
1	12 17.39 30.00 48.00	28 40.58 70.00 63.64	40 57.97
Total	25 36.23	44 63.77	69 100.00

Phi Coefficient 0.152

TABLE OF **FACIL BY SALESROY**

FACIL	SALESROY		
Frequency Percent Row Pct Col Pct	0	1	Total
0	20 28.99 68.97 39.22	9 13.04 31.03 50.00	29 42.03
1	31 44.93 77.50 60.78	9 13.04 22.50 50.00	40 57.97
Total	51 73.91	18 26.09	69 100.00

Phi Coefficient -0.096

TABLE OF **MANP BY TECHSTG**

MANP	TECHSTG		
Frequency Percent Row Pct Col Pct	0	1	Total
0	14 20.29 42.42 45.16	19 27.54 57.58 50.00	33 47.83
1	17 24.64 47.22 54.84	19 27.54 52.78 50.00	36 52.17
Total	31 44.93	38 55.07	69 100.00

Phi Coefficient -0.048

TABLE OF **MANP BY PARTABIL**

MANP	PARTABIL		
Frequency Percent Row Pct Col Pct	0	1	Total
0	16 23.19 48.48 51.61	17 24.64 51.52 44.74	33 47.83
1	15 21.74 41.67 48.39	21 30.43 58.33 55.26	36 52.17
Total	31 44.93	38 55.07	69 100.00

Phi Coefficient 0.068

TABLE OF **MANP BY MARKET**

MANP	MARKET		
Frequency / Percent / Row Pct / Col Pct	0	1	Total
0	19	14	33
	27.54	20.29	47.83
	57.58	42.42	
	52.78	42.42	
1	17	19	36
	24.64	27.54	52.17
	47.22	52.78	
	47.22	57.58	
Total	36	33	69
	52.17	47.83	100.00

Phi Coefficient 0.104

TABLE OF **MANP BY COPYROY**

MANP	COPYROY		
Frequency / Percent / Row Pct / Col Pct	0	1	Total
0	10	23	33
	14.49	33.33	47.83
	30.30	69.70	
	40.00	52.27	
1	15	21	36
	21.74	30.43	52.17
	41.67	58.33	
	60.00	47.73	
Total	25	44	69
	36.23	63.77	100.00

Phi Coefficient -0.118

TABLE OF **MANP BY SALESROY**

MANP SALESROY

Frequency / Percent / Row Pct / Col Pct	0	1	Total
0	27	6	33
	39.13	8.70	47.83
	81.82	18.18	
	52.94	33.33	
1	24	12	36
	34.78	17.39	52.17
	66.67	33.33	
	47.06	66.67	
Total	51	18	69
	73.91	26.09	100.00

Phi Coefficient 0.172

TABLE OF **TECHSTG BY PARTABIL**

TECHSTG PARTABIL

Frequency / Percent / Row Pct / Col Pct	0	1	Total
0	15	16	31
	21.74	23.19	44.93
	48.39	51.61	
	48.39	42.11	
1	16	22	38
	23.19	31.88	55.07
	42.11	57.89	
	51.61	57.89	
Total	31	38	69
	44.93	55.07	100.00

Phi Coefficient 0.063

TABLE OF **TECHSTG BY MARKET**

TECHSTG	MARKET		
Frequency / Percent / Row Pct / Col Pct	0	1	Total
0	21	10	31
	30.43	14.49	44.93
	67.74	32.26	
	58.33	30.30	
1	15	23	38
	21.74	33.33	55.07
	39.47	60.53	
	41.67	69.70	
Total	36	33	69
	52.17	47.83	100.00

Phi Coefficient 0.281

TABLE OF **TECHSTG BY COPYROY**

TECHSTG	COPYROY		
Frequency / Percent / Row Pct / Col Pct	0	1	Total
0	15	16	31
	21.74	23.19	44.93
	48.39	51.61	
	60.00	36.36	
1	10	28	38
	14.49	40.58	55.07
	26.32	73.68	
	40.00	63.64	
Total	25	44	69
	36.23	63.77	100.00

Phi Coefficient 0.228

TABLE OF **TECHSTG BY SALESROY**

TECHSTG	SALESROY		
Frequency Percent Row Pct Col Pct	0	1	Total
0	22 31.88 70.97 43.14	9 13.04 29.03 50.00	31 44.93
1	29 42.03 76.32 56.86	9 13.04 23.68 50.00	38 55.07
Total	51 73.91	18 26.09	69 100.00

Phi Coefficient -0.061

TABLE OF **PARTABIL BY MARKET**

PARTABIL	MARKET		
Frequency Percent Row Pct Col Pct	0	1	Total
0	18 26.09 58.06 50.00	13 18.84 41.94 39.39	31 44.93
1	18 26.09 47.37 50.00	20 28.99 52.63 60.61	38 55.07
Total	36 52.17	33 47.83	69 100.00

Phi Coefficient 0.107

TABLE OF **PARTABIL BY COPYROY**

PARTABIL COPYROY

Frequency / Percent / Row Pct / Col Pct	0	1	Total
0	13	18	31
	18.84	26.09	44.93
	41.94	58.06	
	52.00	40.91	
1	12	26	38
	17.39	37.68	55.07
	31.58	68.42	
	48.00	59.09	
Total	25	44	69
	36.23	63.77	100.00

Phi Coefficient 0.107

TABLE OF **PARTABIL BY SALESROY**

PARTABIL SALESROY

Frequency / Percent / Row Pct / Col Pct	0	1	Total
0	26	5	31
	37.68	7.25	44.93
	83.87	16.13	
	50.98	27.78	
1	25	13	38
	36.23	18.84	55.07
	65.79	34.21	
	49.02	72.22	
Total	51	18	69
	73.91	26.09	100.00

Phi Coefficient 0.205

TABLE OF **MARKET BY COPYROY**

MARKET	COPYROY		
Frequency / Percent / Row Pct / Col Pct	0	1	Total
0	15	21	36
	21.74	30.43	52.17
	41.67	58.33	
	60.00	47.73	
1	10	23	33
	14.49	33.33	47.83
	30.30	69.70	
	40.00	52.27	
Total	25	44	69
	36.23	63.77	100.00

Phi Coefficient 0.118

TABLE OF **MARKET BY SALESROY**

MARKET	SALESROY		
Frequency / Percent / Row Pct / Col Pct	0	1	Total
0	29	7	36
	42.03	10.14	52.17
	80.56	19.44	
	56.86	38.89	
1	22	11	33
	31.88	15.94	47.83
	66.67	33.33	
	43.14	61.11	
Total	51	18	69
	73.91	26.09	100.00

Phi Coefficient 0.158

TABLE OF **COPYROY BY SALESROY**

COPYROY	SALESROY		
Frequency Percent Row Pct Col Pct	0	1	Total
0	21 30.43 84.00 41.18	4 5.80 16.00 22.22	25 36.23
1	30 43.48 68.18 58.82	14 20.29 31.82 77.78	44 63.77
Total	51 73.91	18 26.09	69 100.00

Phi Coefficient 0.173

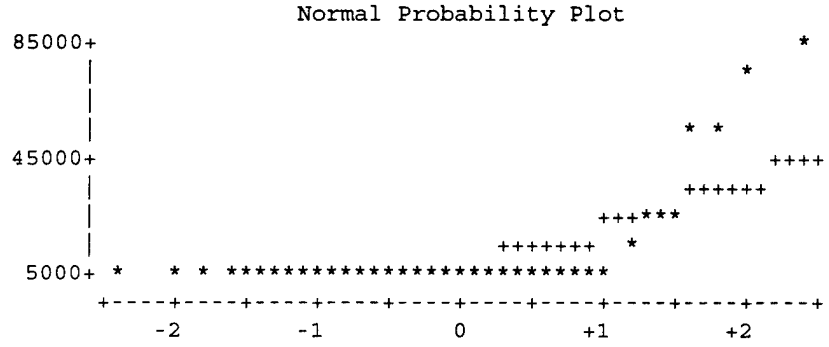
Appendix G. CRDA Benefit Normality Plots

The SAS System 20:24 Wednesday, April 23, 1997

Univariate Procedure

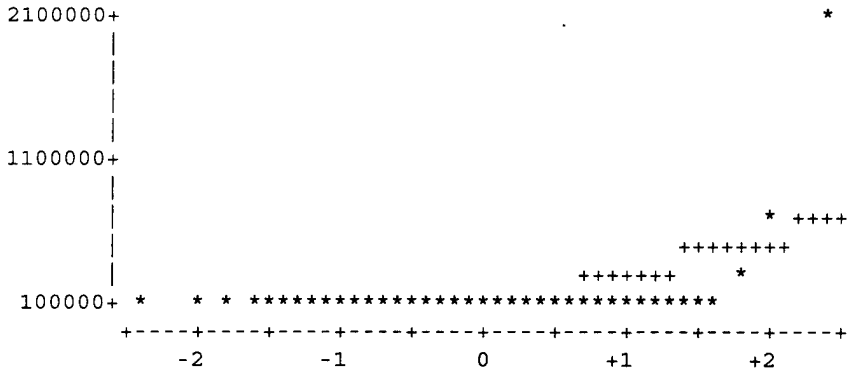
Variable=**ROYAL**

W:Normal 0.388331 Pr<W 0.0001

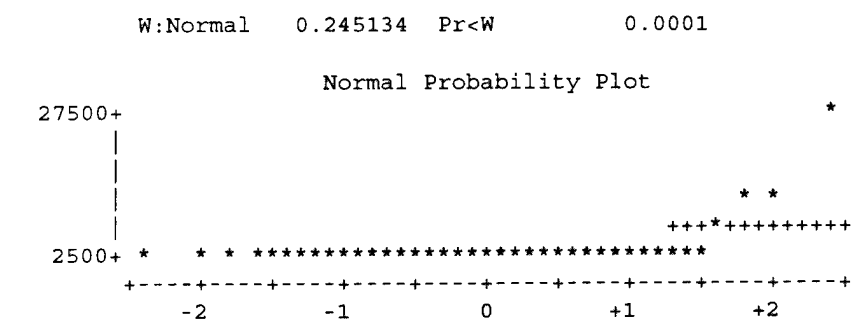


Variable=**REIMB**

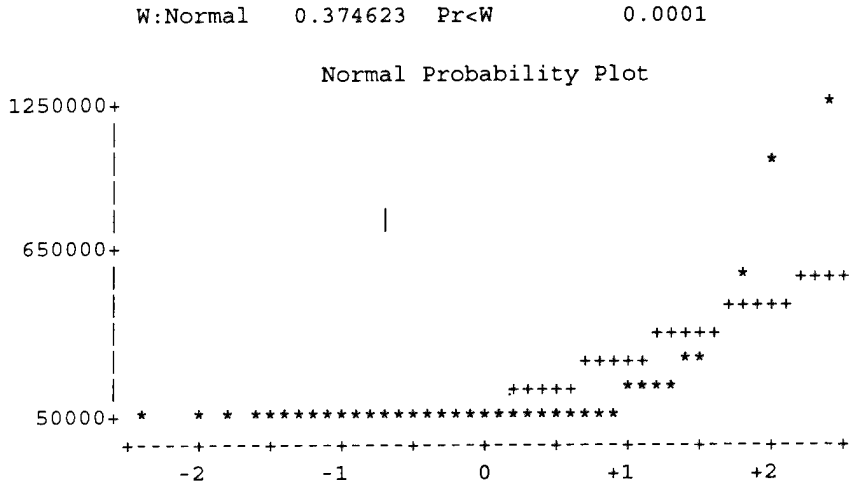
W:Normal 0.207935 Pr<W 0.0001



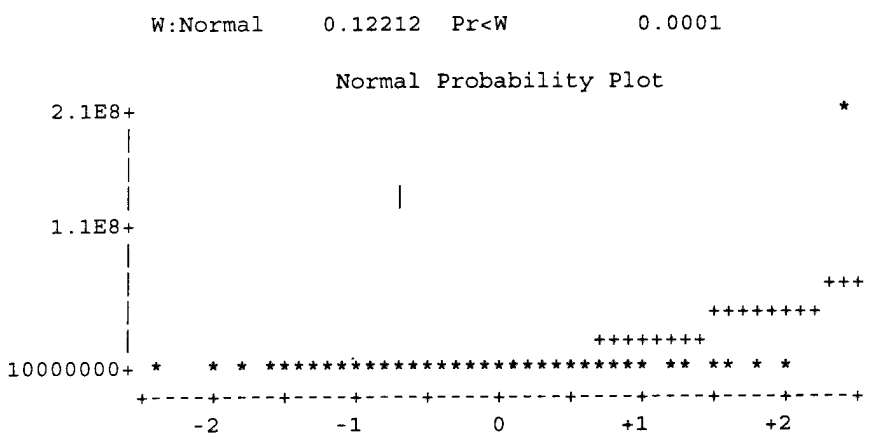
Variable=**LICEN**



Variable=**WRKAV**

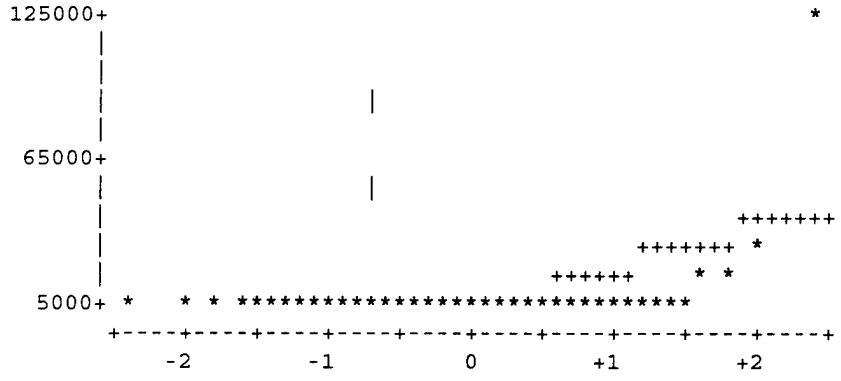


Variable=**DATA**



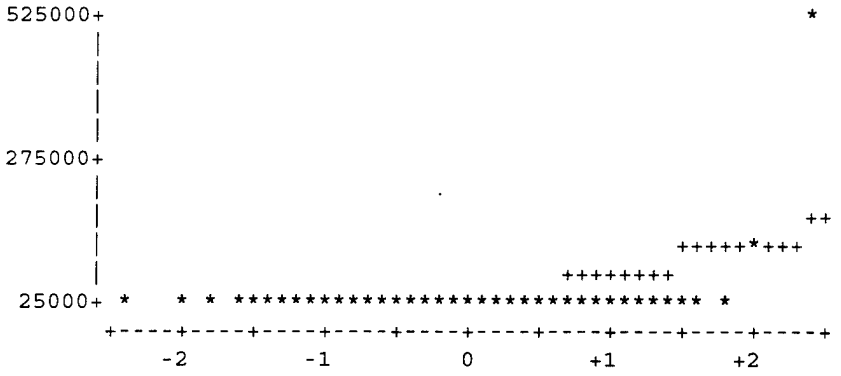
Variable=**SW**

W:Normal 0.185927 Pr<W 0.0001



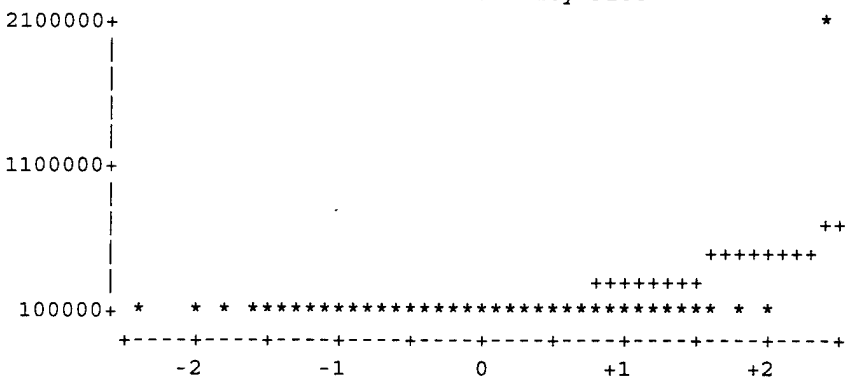
Variable=**HW**

W:Normal 0.15171 Pr<W 0.0001



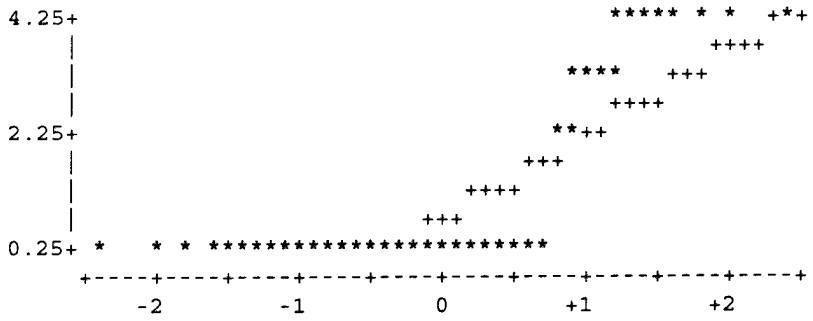
Variable=**OTHER**

W:Normal 0.123668 Pr<W 0.0001



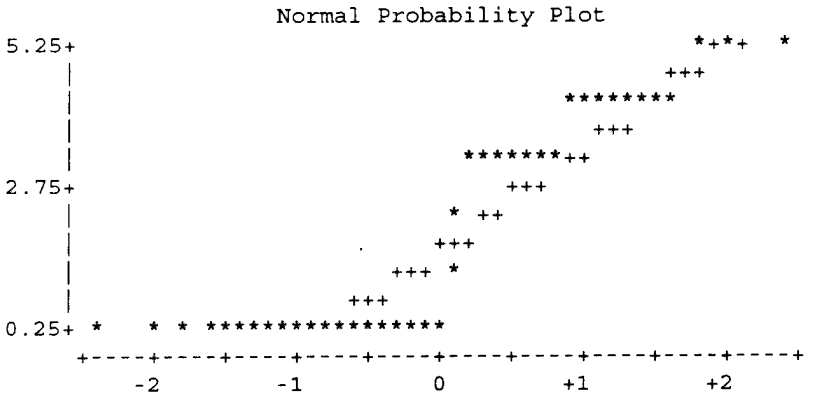
Variable=**PRODUCT**

W:Normal 0.543433 Pr<W 0.0001



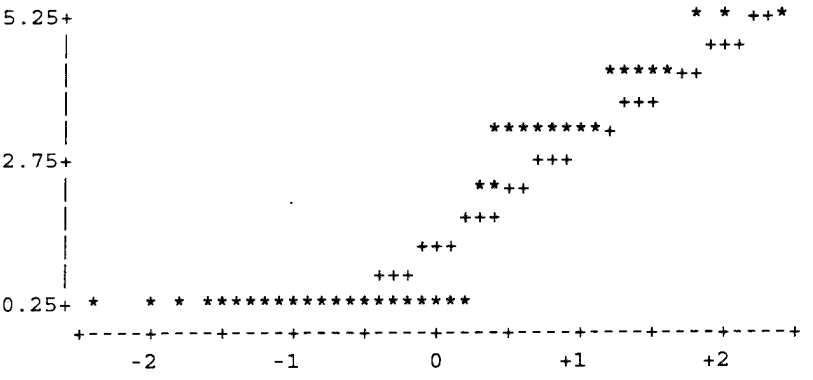
Variable=**RESUTIL**

W:Normal 0.742621 Pr<W 0.0001



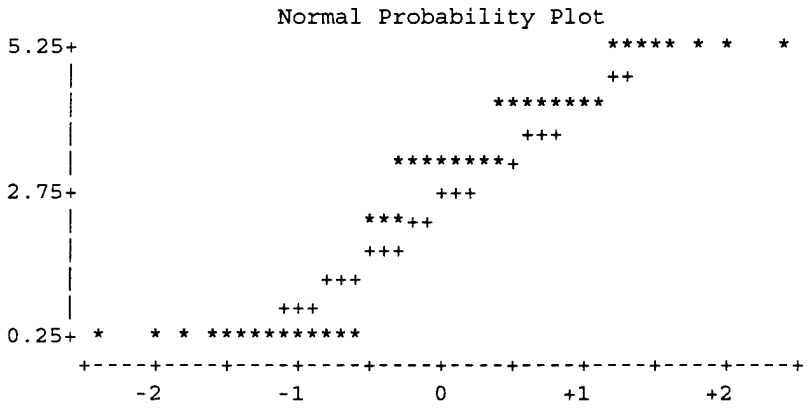
Variable=**MGT**

W:Normal 0.715638 Pr<W 0.0001



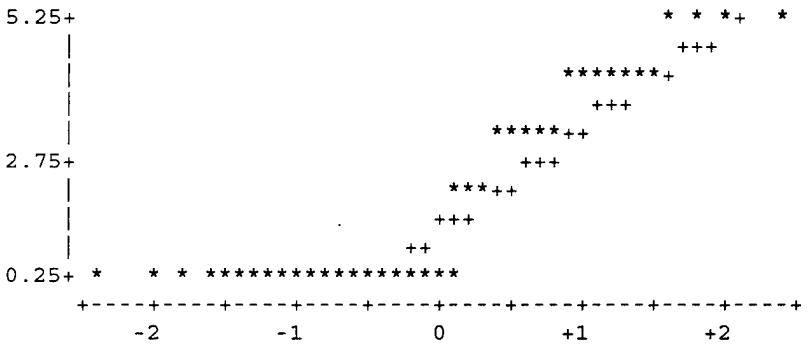
Variable=**IMAGE**

W:Normal 0.8286 Pr<W 0.0001



Variable=**MORALE**

W:Normal 0.739966 Pr<W 0.0001



Variable=**TECHCAP**

W:Normal 0.821476 Pr<W 0.0001

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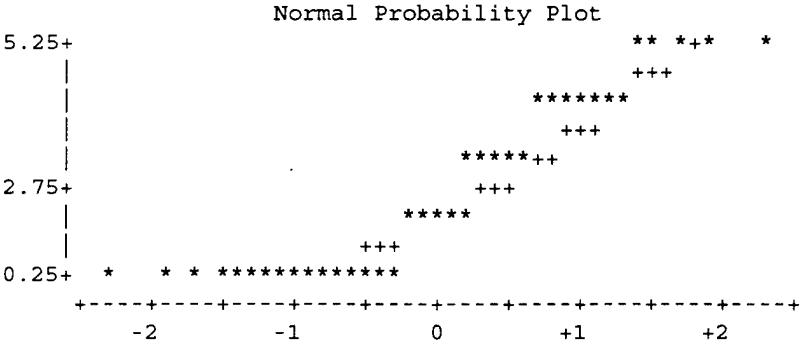


Appendix H. Kruskal-Wallis ANOVAs

The SAS System 11:16 Friday, May 30, 1997

N P A R 1 W A Y P R O C E D U R E

Average Scores Were Used for Ties

Wilcoxon Scores (Rank Sums) for Variable **ROYAL** Classified by Variable **FACIL**

FACIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	40	1329.0	1400.0	54.3338328	33.2250000
0	29	1086.0	1015.0	54.3338328	37.4482759

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 1.7076 DF = 1 Prob > CHISQ = 0.1913

Wilcoxon Scores (Rank Sums) for Variable **REIMB** Classified by Variable **FACIL**

FACIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	40	1413.0	1400.0	50.3644010	35.3250000
0	29	1002.0	1015.0	50.3644010	34.5517241

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.06663 DF = 1 Prob > CHISQ = 0.7963

Wilcoxon Scores (Rank Sums) for Variable **LICEN** Classified by Variable **FACIL**

FACIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	40	1403.50000	1400.0	36.9737009	35.0875000
0	29	1011.50000	1015.0	36.9737009	34.8793103

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.00896 DF = 1 Prob > CHISQ = 0.9246

Wilcoxon Scores (Rank Sums) for Variable **WRKAV** Classified by Variable **FACIL**

FACIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	40	1361.50000	1400.0	65.8954648	34.0375000
0	29	1053.50000	1015.0	65.8954648	36.3275862

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.34136 DF = 1 Prob > CHISQ = 0.5590

Wilcoxon Scores (Rank Sums) for Variable **DATA** Classified by Variable **FACIL**

FACIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	40	1431.0	1400.0	54.3304201	35.7750000
0	29	984.0	1015.0	54.3304201	33.9310345

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.32556 DF = 1 Prob > CHISQ = 0.5683

Wilcoxon Scores (Rank Sums) for Variable **SW** Classified by Variable **FACIL**

FACIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	40	1368.0	1400.0	36.9753726	34.2000000
0	29	1047.0	1015.0	36.9753726	36.1034483

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.74899 DF = 1 Prob > CHISQ = 0.3868

Wilcoxon Scores (Rank Sums) for Variable **HW** Classified by Variable **FACIL**

FACIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	40	1395.0	1400.0	23.9080364	34.8750000
0	29	1020.0	1015.0	23.9080364	35.1724138

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.04374 DF = 1 Prob > CHISQ = 0.8343

Wilcoxon Scores (Rank Sums) for Variable **OTHER** Classified by Variable **FACIL**

FACIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	40	1354.0	1400.0	33.3175581	33.8500000
0	29	1061.0	1015.0	33.3175581	36.5862069

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 1.9062 DF = 1 Prob > CHISQ = 0.1674

Wilcoxon Scores (Rank Sums) for Variable **PRODUCT** Classified by Variable **FACIL**

FACIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	40	1287.50000	1400.0	60.7221391	32.1875000
0	29	1127.50000	1015.0	60.7221391	38.8793103

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 3.4325 DF = 1 Prob > CHISQ = 0.0639

Wilcoxon Scores (Rank Sums) for Variable **RESUTIL** Classified by Variable **FACIL**

FACIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	40	1428.50000	1400.0	75.4606484	35.7125000
0	29	986.50000	1015.0	75.4606484	34.0172414

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.14264 DF = 1 Prob > CHISQ = 0.7057

Wilcoxon Scores (Rank Sums) for Variable **MGT** Classified by Variable **FACIL**

FACIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	40	1246.0	1400.0	72.6913502	31.1500000
0	29	1169.0	1015.0	72.6913502	40.3103448

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 4.4882 DF = 1 Prob > CHISQ = 0.0341

Wilcoxon Scores (Rank Sums) for Variable **IMAGE** Classified by Variable **FACIL**

FACIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	40	1284.50000	1400.0	79.9468334	32.1125000
0	29	1130.50000	1015.0	79.9468334	38.9827586

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 2.0872 DF = 1 Prob > CHISQ = 0.1485

Wilcoxon Scores (Rank Sums) for Variable **MORALE** Classified by Variable **FACIL**

FACIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	40	1224.0	1400.0	74.7248148	30.6000000
0	29	1191.0	1015.0	74.7248148	41.0689655

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 5.5475 DF = 1 Prob > CHISQ = 0.0185

Wilcoxon Scores (Rank Sums) for Variable **TECHCAP** Classified by Variable **FACIL**

FACIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	33	926.0	973.500000	61.1510507	28.0606061
0	25	785.0	737.500000	61.1510507	31.4000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.60336 DF = 1 Prob > CHISQ = 0.4373

Wilcoxon Scores (Rank Sums) for Variable **ROYAL** Classified by Variable **MANP**

MANP	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	36	1209.0	1260.0	54.9856759	33.5833333
0	33	1206.0	1155.0	54.9856759	36.5454545

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.86028 DF = 1 Prob > CHISQ = 0.3537

Wilcoxon Scores (Rank Sums) for Variable **REIMB** Classified by Variable **MANP**

MANP	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	36	1293.0	1260.0	50.9686228	35.9166667
0	33	1122.0	1155.0	50.9686228	34.0000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.41920 DF = 1 Prob > CHISQ = 0.5173

Wilcoxon Scores (Rank Sums) for Variable **LICEN** Classified by Variable **MANP**

MANP	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	36	1237.50000	1260.0	37.4172745	34.3750000
0	33	1177.50000	1155.0	37.4172745	35.6818182

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.36159 DF = 1 Prob > CHISQ = 0.5476

Wilcoxon Scores (Rank Sums) for Variable **WRKAV** Classified by Variable **MANP**

MANP	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	36	1294.0	1260.0	66.6860128	35.9444444
0	33	1121.0	1155.0	66.6860128	33.9696970

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.25995 DF = 1 Prob > CHISQ = 0.6102

Wilcoxon Scores (Rank Sums) for Variable **DATA** Classified by Variable **MANP**

MANP	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	36	1260.0	1260.0	54.9822222	35.0
0	33	1155.0	1155.0	54.9822222	35.0

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0 DF = 1 Prob > CHISQ = 1.0000

Wilcoxon Scores (Rank Sums) for Variable **SW** Classified by Variable **MANP**

MANP	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	36	1342.50000	1260.0	37.4189662	37.2916667
0	33	1072.50000	1155.0	37.4189662	32.5000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 4.8610 DF = 1 Prob > CHISQ = 0.0275

Wilcoxon Scores (Rank Sums) for Variable **HW** Classified by Variable **MANP**

MANP	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	36	1293.0	1260.0	24.1948611	35.9166667
0	33	1122.0	1155.0	24.1948611	34.0000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 1.8603 DF = 1 Prob > CHISQ = 0.1726

Wilcoxon Scores (Rank Sums) for Variable **OTHER** Classified by Variable **MANP**

MANP	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	36	1255.0	1260.0	33.7172689	34.8611111
0	33	1160.0	1155.0	33.7172689	35.1515152

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.02199 DF = 1 Prob > CHISQ = 0.8821

Wilcoxon Scores (Rank Sums) for Variable **PRODUCT** Classified by Variable **MANP**

MANP	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	36	1207.50000	1260.0	61.4506227	33.5416667
0	33	1207.50000	1155.0	61.4506227	36.5909091

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.72990 DF = 1 Prob > CHISQ = 0.3929

Wilcoxon Scores (Rank Sums) for Variable **RESUTIL** Classified by Variable **MANP**

MANP	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	36	1267.50000	1260.0	76.3659500	35.2083333
0	33	1147.50000	1155.0	76.3659500	34.7727273

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.00965 DF = 1 Prob > CHISQ = 0.9218

Wilcoxon Scores (Rank Sums) for Variable **MGT** Classified by Variable **MANP**

MANP	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	36	1204.50000	1260.0	73.5634284	33.4583333
0	33	1210.50000	1155.0	73.5634284	36.6818182

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.56920 DF = 1 Prob > CHISQ = 0.4506

Wilcoxon Scores (Rank Sums) for Variable **IMAGE** Classified by Variable **MANP**

MANP	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	36	1166.0	1260.0	80.9059556	32.3888889
0	33	1249.0	1155.0	80.9059556	37.8484848

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 1.3499 DF = 1 Prob > CHISQ = 0.2453

Wilcoxon Scores (Rank Sums) for Variable **MORALE** Classified by Variable **MANP**

MANP	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	36	1105.0	1260.0	75.6212886	30.6944444
0	33	1310.0	1155.0	75.6212886	39.6969697

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 4.2012 DF = 1 Prob > CHISQ = 0.0404

Wilcoxon Scores (Rank Sums) for Variable **TECHCAP** Classified by Variable **MANP**

MANP	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	31	874.0	914.500000	61.5941800	28.1935484
0	27	837.0	796.500000	61.5941800	31.0000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.43235 DF = 1 Prob > CHISQ = 0.5108

Wilcoxon Scores (Rank Sums) for Variable **ROYAL** Classified by Variable **TECHSTG**

TECHSTG	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	38	1303.0	1330.0	54.7537656	34.2894737
0	31	1112.0	1085.0	54.7537656	35.8709677

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.24316 DF = 1 Prob > CHISQ = 0.6219

Wilcoxon Scores (Rank Sums) for Variable **REIMB** Classified by Variable **TECHSTG**

TECHSTG	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	38	1350.0	1330.0	50.7536551	35.5263158
0	31	1065.0	1085.0	50.7536551	34.3548387

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.15528 DF = 1 Prob > CHISQ = 0.6935

Wilcoxon Scores (Rank Sums) for Variable **LICEN** Classified by Variable **TECHSTG**

TECHSTG	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	38	1338.50000	1330.0	37.2594616	35.2236842
0	31	1076.50000	1085.0	37.2594616	34.7258065

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.05204 DF = 1 Prob > CHISQ = 0.8195

Wilcoxon Scores (Rank Sums) for Variable **WRKAV** Classified by Variable **TECHSTG**

TECHSTG	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	38	1240.50000	1330.0	66.4047546	32.6447368
0	31	1174.50000	1085.0	66.4047546	37.8870968

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 1.8166 DF = 1 Prob > CHISQ = 0.1777

Wilcoxon Scores (Rank Sums) for Variable **DATA** Classified by Variable **TECHSTG**

TECHSTG	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	38	1284.0	1330.0	54.7503265	33.7894737
0	31	1131.0	1085.0	54.7503265	36.4838710

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.70590 DF = 1 Prob > CHISQ = 0.4008

Wilcoxon Scores (Rank Sums) for Variable **SW** Classified by Variable **TECHSTG**

TECHSTG	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	38	1375.0	1330.0	37.2611461	36.1842105
0	31	1040.0	1085.0	37.2611461	33.5483871

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 1.4585 DF = 1 Prob > CHISQ = 0.2272

Wilcoxon Scores (Rank Sums) for Variable **HW** Classified by Variable **TECHSTG**

TECHSTG	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	38	1327.0	1330.0	24.0928157	34.9210526
0	31	1088.0	1085.0	24.0928157	35.0967742

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.01550 DF = 1 Prob > CHISQ = 0.9009

Wilcoxon Scores (Rank Sums) for Variable **OTHER** Classified by Variable **TECHSTG**

TECHSTG	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	38	1323.0	1330.0	33.5750613	34.8157895
0	31	1092.0	1085.0	33.5750613	35.2258065

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.04347 DF = 1 Prob > CHISQ = 0.8348

Wilcoxon Scores (Rank Sums) for Variable **PRODUCT** Classified by Variable **TECHSTG**

TECHSTG	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	38	1304.0	1330.0	61.1914456	34.3157895
0	31	1111.0	1085.0	61.1914456	35.8387097

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.18054 DF = 1 Prob > CHISQ = 0.6709

Wilcoxon Scores (Rank Sums) for Variable **RESUTIL** Classified by Variable **TECHSTG**

TECHSTG	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	38	1143.50000	1330.0	76.0438652	30.0921053
0	31	1271.50000	1085.0	76.0438652	41.0161290

Average Scores Were Used for Ties

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 6.0149 DF = 1 Prob > CHISQ = 0.0142

Wilcoxon Scores (Rank Sums) for Variable **MGT** Classified by Variable **TECHSTG**

TECHSTG	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	38	1203.0	1330.0	73.2531638	31.6578947
0	31	1212.0	1085.0	73.2531638	39.0967742

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 3.0058 DF = 1 Prob > CHISQ = 0.0830

Wilcoxon Scores (Rank Sums) for Variable **IMAGE** Classified by Variable **TECHSTG**

TECHSTG	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	38	1034.0	1330.0	80.5647228	27.2105263
0	31	1381.0	1085.0	80.5647228	44.5483871

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 13.499 DF = 1 Prob > CHISQ = 0.0002

Wilcoxon Scores (Rank Sums) for Variable **MORALE** Classified by Variable **TECHSTG**

TECHSTG	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	38	1262.50000	1330.0	75.3023445	33.2236842
0	31	1152.50000	1085.0	75.3023445	37.1774194

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.80351 DF = 1 Prob > CHISQ = 0.3700

Wilcoxon Scores (Rank Sums) for Variable **TECHCAP** Classified by Variable **TECHSTG**

TECHSTG	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	31	889.500000	914.500000	61.5941800	28.6935484
0	27	821.500000	796.500000	61.5941800	30.4259259

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.16474 DF = 1 Prob > CHISQ = 0.6848

Wilcoxon Scores (Rank Sums) for Variable **ROYAL** Classified by Variable **PARTABIL**

PARTABIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	38	1404.50000	1330.0	54.7537656	36.9605263
0	31	1010.50000	1085.0	54.7537656	32.5967742

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 1.8513 DF = 1 Prob > CHISQ = 0.1736

Wilcoxon Scores (Rank Sums) for Variable **REIMB** Classified by Variable **PARTABIL**

PARTABIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	38	1311.0	1330.0	50.7536551	34.5000000
0	31	1104.0	1085.0	50.7536551	35.6129032

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.14014 DF = 1 Prob > CHISQ = 0.7081

Wilcoxon Scores (Rank Sums) for Variable **LICEN** Classified by Variable **PARTABIL**

PARTABIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	38	1340.0	1330.0	37.2594616	35.2631579
0	31	1075.0	1085.0	37.2594616	34.6774194

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.07203 DF = 1 Prob > CHISQ = 0.7884

Wilcoxon Scores (Rank Sums) for Variable **WRKAV** Classified by Variable **PARTABIL**

PARTABIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	38	1342.50000	1330.0	66.4047546	35.3289474
0	31	1072.50000	1085.0	66.4047546	34.5967742

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.03543 DF = 1 Prob > CHISQ = 0.8507

Wilcoxon Scores (Rank Sums) for Variable **DATA** Classified by Variable **PARTABIL**

PARTABIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	38	1311.50000	1330.0	54.7503265	34.5131579
0	31	1103.50000	1085.0	54.7503265	35.5967742

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.11417 DF = 1 Prob > CHISQ = 0.7354

Wilcoxon Scores (Rank Sums) for Variable **SW** Classified by Variable **PARTABIL**

PARTABIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	38	1338.50000	1330.0	37.2611461	35.2236842
0	31	1076.50000	1085.0	37.2611461	34.7258065

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.05204 DF = 1 Prob > CHISQ = 0.8196

Wilcoxon Scores (Rank Sums) for Variable **HW** Classified by Variable **PARTABIL**

PARTABIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	38	1292.0	1330.0	24.0928157	34.0000000
0	31	1123.0	1085.0	24.0928157	36.2258065

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 2.4877 DF = 1 Prob > CHISQ = 0.1147

Wilcoxon Scores (Rank Sums) for Variable **OTHER** Classified by Variable **PARTABIL**

PARTABIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	38	1392.0	1330.0	33.5750613	36.6315789
0	31	1023.0	1085.0	33.5750613	33.0000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 3.4100 DF = 1 Prob > CHISQ = 0.0648

Wilcoxon Scores (Rank Sums) for Variable **PRODUCT** Classified by Variable **PARTABIL**

PARTABIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	38	1274.50000	1330.0	61.1914456	33.5394737
0	31	1140.50000	1085.0	61.1914456	36.7903226

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.82263 DF = 1 Prob > CHISQ = 0.3644

Wilcoxon Scores (Rank Sums) for Variable **RESUTIL** Classified by Variable **PARTABIL**

PARTABIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	38	1235.0	1330.0	76.0438652	32.5000000
0	31	1180.0	1085.0	76.0438652	38.0645161

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 1.5607 DF = 1 Prob > CHISQ = 0.2116

Wilcoxon Scores (Rank Sums) for Variable **MGT** Classified by Variable **PARTABIL**

PARTABIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	38	1378.0	1330.0	73.2531638	36.2631579
0	31	1037.0	1085.0	73.2531638	33.4516129

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.42937 DF = 1 Prob > CHISQ = 0.5123

Wilcoxon Scores (Rank Sums) for Variable **IMAGE** Classified by Variable **PARTABIL**

PARTABIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	38	1247.0	1330.0	80.5647228	32.8157895
0	31	1168.0	1085.0	80.5647228	37.6774194

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 1.0614 DF = 1 Prob > CHISQ = 0.3029

Wilcoxon Scores (Rank Sums) for Variable **MORALE** Classified by Variable **PARTABIL**

PARTABIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	38	1330.50000	1330.0	75.3023445	35.0131579
0	31	1084.50000	1085.0	75.3023445	34.9838710

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.00004 DF = 1 Prob > CHISQ = 0.9947

Wilcoxon Scores (Rank Sums) for Variable **TECHCAP** Classified by Variable **PARTABIL**

PARTABIL	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	32	947.500000	944.0	61.4099314	29.6093750
0	26	763.500000	767.0	61.4099314	29.3653846

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.00325 DF = 1 Prob > CHISQ = 0.9545

Wilcoxon Scores (Rank Sums) for Variable **ROYAL** Classified by Variable **MARKET**

MARKET	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	33	1194.50000	1155.0	54.9856759	36.1969697
0	36	1220.50000	1260.0	54.9856759	33.9027778

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.51605 DF = 1 Prob > CHISQ = 0.4725

Wilcoxon Scores (Rank Sums) for Variable **REIMB** Classified by Variable **MARKET**

MARKET	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	33	1134.0	1155.0	50.9686228	34.3636364
0	36	1281.0	1260.0	50.9686228	35.5833333

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.16976 DF = 1 Prob > CHISQ = 0.6803

Wilcoxon Scores (Rank Sums) for Variable **LICEN** Classified by Variable **MARKET**

MARKET	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	33	1142.50000	1155.0	37.4172745	34.6212121
0	36	1272.50000	1260.0	37.4172745	35.3472222

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.11160 DF = 1 Prob > CHISQ = 0.7383

Wilcoxon Scores (Rank Sums) for Variable **WRKAV** Classified by Variable **MARKET**

MARKET	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	33	1179.0	1155.0	66.6860128	35.7272727
0	36	1236.0	1260.0	66.6860128	34.3333333

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.12952 DF = 1 Prob > CHISQ = 0.7189

Wilcoxon Scores (Rank Sums) for Variable **DATA** Classified by Variable **MARKET**

MARKET	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	33	1098.0	1155.0	54.9822222	33.2727273
0	36	1317.0	1260.0	54.9822222	36.5833333

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 1.0747 DF = 1 Prob > CHISQ = 0.2999

Wilcoxon Scores (Rank Sums) for Variable **SW** Classified by Variable **MARKET**

MARKET	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	33	1245.0	1155.0	37.4189662	37.7272727
0	36	1170.0	1260.0	37.4189662	32.5000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 5.7850 DF = 1 Prob > CHISQ = 0.0162

Wilcoxon Scores (Rank Sums) for Variable **HW** Classified by Variable **MARKET**

MARKET	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	33	1157.0	1155.0	24.1948611	35.0606061
0	36	1258.0	1260.0	24.1948611	34.9444444

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.00683 DF = 1 Prob > CHISQ = 0.9341

Wilcoxon Scores (Rank Sums) for Variable **OTHER** Classified by Variable **MARKET**

MARKET	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	33	1089.0	1155.0	33.7172689	33.0000000
0	36	1326.0	1260.0	33.7172689	36.8333333

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 3.8316 DF = 1 Prob > CHISQ = 0.0503

Wilcoxon Scores (Rank Sums) for Variable **PRODUCT** Classified by Variable **MARKET**

MARKET	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	33	1098.50000	1155.0	61.4506227	33.2878788
0	36	1316.50000	1260.0	61.4506227	36.5694444

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.84537 DF = 1 Prob > CHISQ = 0.3579

Wilcoxon Scores (Rank Sums) for Variable **RESUTIL** Classified by Variable **MARKET**

MARKET	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	33	1196.0	1155.0	76.3659500	36.2424242
0	36	1219.0	1260.0	76.3659500	33.8611111

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.28825 DF = 1 Prob > CHISQ = 0.5913

Wilcoxon Scores (Rank Sums) for Variable **MGT** Classified by Variable **MARKET**

MARKET	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	33	1183.0	1155.0	73.5634284	35.8484848
0	36	1232.0	1260.0	73.5634284	34.2222222

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.14487 DF = 1 Prob > CHISQ = 0.7035

Wilcoxon Scores (Rank Sums) for Variable **IMAGE** Classified by Variable **MARKET**

MARKET	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	33	1125.50000	1155.0	80.9059556	34.1060606
0	36	1289.50000	1260.0	80.9059556	35.8194444

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.13295 DF = 1 Prob > CHISQ = 0.7154

Wilcoxon Scores (Rank Sums) for Variable **MORALE** Classified by Variable **MARKET**

MARKET	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	33	1126.50000	1155.0	75.6212886	34.1363636
0	36	1288.50000	1260.0	75.6212886	35.7916667

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.14204 DF = 1 Prob > CHISQ = 0.7063

Wilcoxon Scores (Rank Sums) for Variable **TECHCAP** Classified by Variable **MARKET**

MARKET	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	29	873.500000	855.500000	61.7411830	30.1206897
0	29	837.500000	855.500000	61.7411830	28.8793103

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.08500 DF = 1 Prob > CHISQ = 0.7706

Wilcoxon Scores (Rank Sums) for Variable **ROYAL** Classified by Variable **COPYROY**

COPYROY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	44	1589.0	1540.0	52.9099913	36.1136364
0	25	826.0	875.0	52.9099913	33.0400000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.85766 DF = 1 Prob > CHISQ = 0.3544

Wilcoxon Scores (Rank Sums) for Variable **REIMB** Classified by Variable **COPYROY**

COPYROY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	44	1524.0	1540.0	49.0445802	34.6363636
0	25	891.0	875.0	49.0445802	35.6400000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.10643 DF = 1 Prob > CHISQ = 0.7442

Wilcoxon Scores (Rank Sums) for Variable **LICEN** Classified by Variable **COPYROY**

COPYROY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	44	1569.0	1540.0	36.0047892	35.6590909
0	25	846.0	875.0	36.0047892	33.8400000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.64875 DF = 1 Prob > CHISQ = 0.4206

Wilcoxon Scores (Rank Sums) for Variable **WRKAV** Classified by Variable **COPYROY**

COPYROY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	44	1541.50000	1540.0	64.1686457	35.0340909
0	25	873.50000	875.0	64.1686457	34.9400000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.00055 DF = 1 Prob > CHISQ = 0.9814

Wilcoxon Scores (Rank Sums) for Variable **DATA** Classified by Variable **COPYROY**

COPYROY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	44	1485.0	1540.0	52.9066680	33.7500000
0	25	930.0	875.0	52.9066680	37.2000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 1.0807 DF = 1 Prob > CHISQ = 0.2985

Wilcoxon Scores (Rank Sums) for Variable **SW** Classified by Variable **COPYROY**

COPYROY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	44	1570.0	1540.0	36.0064170	35.6818182
0	25	845.0	875.0	36.0064170	33.8000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.69420 DF = 1 Prob > CHISQ = 0.4047

Wilcoxon Scores (Rank Sums) for Variable **HW** Classified by Variable **COPYROY**

COPYROY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	44	1565.0	1540.0	23.2815160	35.5681818
0	25	850.0	875.0	23.2815160	34.0000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 1.1531 DF = 1 Prob > CHISQ = 0.2829

Wilcoxon Scores (Rank Sums) for Variable **OTHER** Classified by Variable **COPYROY**

COPYROY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	44	1555.0	1540.0	32.4444571	35.3409091
0	25	860.0	875.0	32.4444571	34.4000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.21375 DF = 1 Prob > CHISQ = 0.6438

Wilcoxon Scores (Rank Sums) for Variable **PRODUCT** Classified by Variable **COPYROY**

COPYROY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	44	1635.0	1540.0	59.1308892	37.1590909
0	25	780.0	875.0	59.1308892	31.2000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 2.5812 DF = 1 Prob > CHISQ = 0.1081

Wilcoxon Scores (Rank Sums) for Variable **RESUTIL** Classified by Variable **COPYROY**

COPYROY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	44	1520.50000	1540.0	73.4831696	34.5568182
0	25	894.50000	875.0	73.4831696	35.7800000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.07042 DF = 1 Prob > CHISQ = 0.7907

Wilcoxon Scores (Rank Sums) for Variable **MGT** Classified by Variable **COPYROY**

COPYROY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	44	1507.50000	1540.0	70.7864420	34.2613636
0	25	907.50000	875.0	70.7864420	36.3000000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.21080 DF = 1 Prob > CHISQ = 0.6461

Wilcoxon Scores (Rank Sums) for Variable **IMAGE** Classified by Variable **COPYROY**

COPYROY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	44	1436.0	1540.0	77.8517921	32.6363636
0	25	979.0	875.0	77.8517921	39.1600000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 1.7846 DF = 1 Prob > CHISQ = 0.1816

Wilcoxon Scores (Rank Sums) for Variable **MORALE** Classified by Variable **COPYROY**

COPYROY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	44	1457.0	1540.0	72.7666188	33.1136364
0	25	958.0	875.0	72.7666188	38.3200000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 1.3010 DF = 1 Prob > CHISQ = 0.2540

Wilcoxon Scores (Rank Sums) for Variable **TECHCAP** Classified by Variable **COPYROY**

COPYROY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
1	35	972.500000	1032.50000	60.4052783	27.7857143
0	23	738.500000	678.50000	60.4052783	32.1086957

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.98663 DF = 1 Prob > CHISQ = 0.3206

Wilcoxon Scores (Rank Sums) for Variable **ROYAL** Classified by Variable **SALESROY**

SALESROY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	51	1682.0	1785.0	48.3351074	32.9803922
1	18	733.0	630.0	48.3351074	40.7222222

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 4.5410 DF = 1 Prob > CHISQ = 0.0331

Wilcoxon Scores (Rank Sums) for Variable **REIMB** Classified by Variable **SALESROY**

SALESROY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	51	1807.0	1785.0	44.8039206	35.4313725
1	18	608.0	630.0	44.8039206	33.7777778

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.24111 DF = 1 Prob > CHISQ = 0.6234

Wilcoxon Scores (Rank Sums) for Variable **LICEN** Classified by Variable **SALESROY**

SALESROY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	51	1797.50000	1785.0	32.8916204	35.2450980
1	18	617.50000	630.0	32.8916204	34.3055556

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.14443 DF = 1 Prob > CHISQ = 0.7039

Wilcoxon Scores (Rank Sums) for Variable **WRKAV** Classified by Variable **SALESROY**

SALESROY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	51	1834.50000	1785.0	58.6202777	35.9705882
1	18	580.50000	630.0	58.6202777	32.2500000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.71304 DF = 1 Prob > CHISQ = 0.3984

Wilcoxon Scores (Rank Sums) for Variable **DATA** Classified by Variable **SALESROY**

SALESROY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	51	1863.0	1785.0	48.3320714	36.5294118
1	18	552.0	630.0	48.3320714	30.6666667

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 2.6045 DF = 1 Prob > CHISQ = 0.1066

Wilcoxon Scores (Rank Sums) for Variable **SW** Classified by Variable **SALESROY**

SALESROY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	51	1727.50000	1785.0	32.8931075	33.8725490
1	18	687.50000	630.0	32.8931075	38.1944444

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 3.0558 DF = 1 Prob > CHISQ = 0.0804

Wilcoxon Scores (Rank Sums) for Variable **HW** Classified by Variable **SALESROY**

SALESROY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	51	1769.0	1785.0	21.2684702	34.6862745
1	18	646.0	630.0	21.2684702	35.8888889

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.56594 DF = 1 Prob > CHISQ = 0.4519

Wilcoxon Scores (Rank Sums) for Variable **OTHER** Classified by Variable **SALESROY**

SALESROY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	51	1787.0	1785.0	29.6391339	35.0392157
1	18	628.0	630.0	29.6391339	34.8888889

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.00455 DF = 1 Prob > CHISQ = 0.9462

Wilcoxon Scores (Rank Sums) for Variable **PRODUCT** Classified by Variable **SALESROY**

SALESROY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	51	1753.50000	1785.0	54.0181129	34.3823529
1	18	661.50000	630.0	54.0181129	36.7500000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.34005 DF = 1 Prob > CHISQ = 0.5598

Wilcoxon Scores (Rank Sums) for Variable **RESUTIL** Classified by Variable **SALESROY**

SALESROY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	51	1764.0	1785.0	67.1294175	34.5882353
1	18	651.0	630.0	67.1294175	36.1666667

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.09786 DF = 1 Prob > CHISQ = 0.7544

Wilcoxon Scores (Rank Sums) for Variable **MGT** Classified by Variable **SALESROY**

SALESROY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	51	1770.0	1785.0	64.6658636	34.7058824
1	18	645.0	630.0	64.6658636	35.8333333

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.05381 DF = 1 Prob > CHISQ = 0.8166

Wilcoxon Scores (Rank Sums) for Variable **IMAGE** Classified by Variable **SALESROY**

SALESROY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	51	1871.0	1785.0	71.1203053	36.6862745
1	18	544.0	630.0	71.1203053	30.2222222

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 1.4622 DF = 1 Prob > CHISQ = 0.2266

Wilcoxon Scores (Rank Sums) for Variable **MORALE** Classified by Variable **SALESROY**

SALESROY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	51	1723.0	1785.0	66.4748236	33.7843137
1	18	692.0	630.0	66.4748236	38.4444444

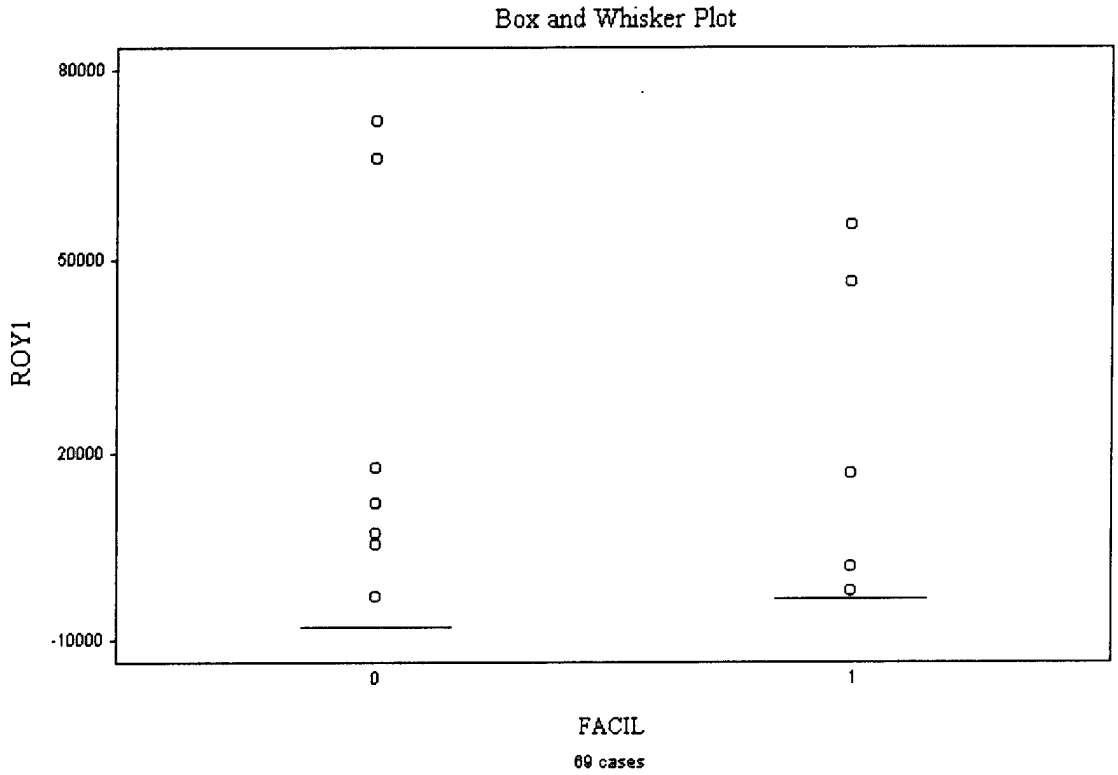
Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.86990 DF = 1 Prob > CHISQ = 0.3510

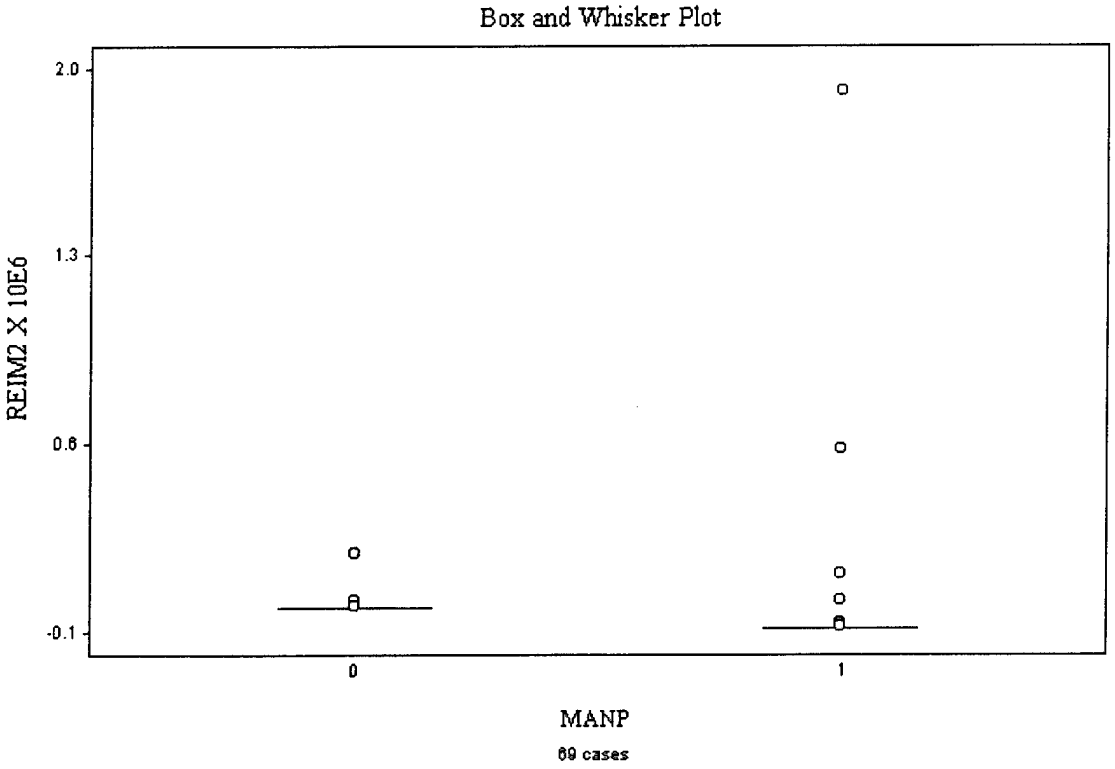
Wilcoxon Scores (Rank Sums) for Variable **TECHCAP** Classified by Variable **SALESROY**

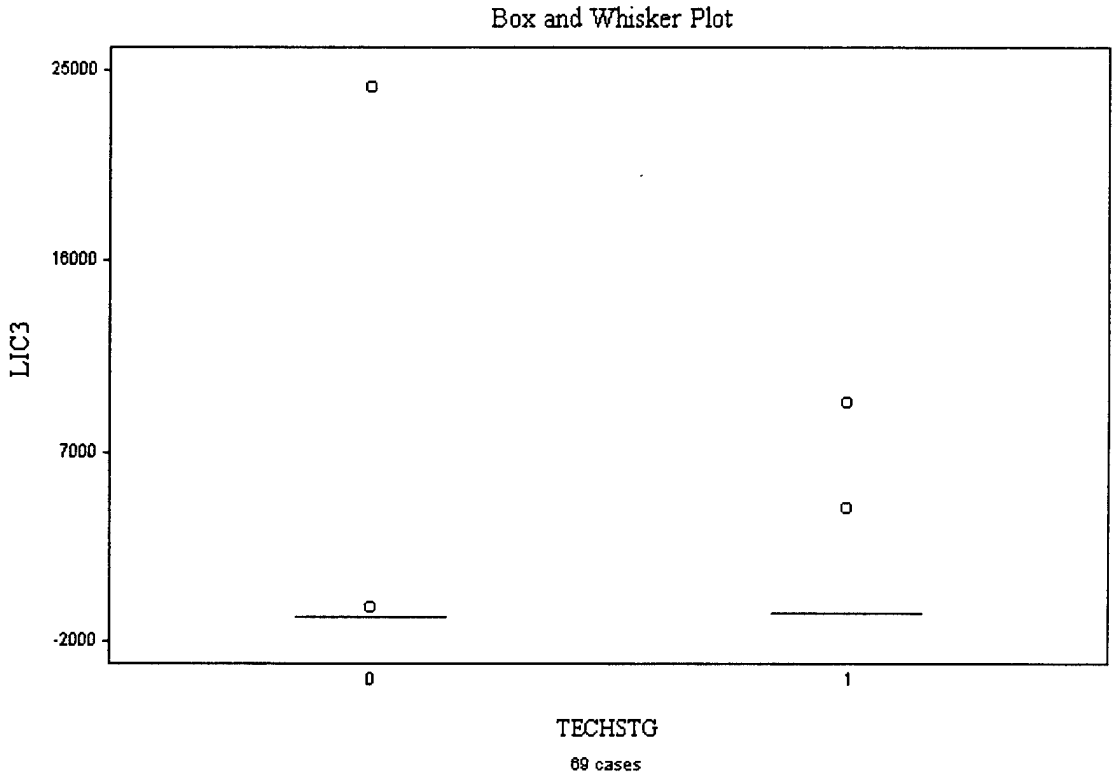
SALESROY	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	44	1259.50000	1298.0	52.8405470	28.6250000
1	14	451.50000	413.0	52.8405470	32.2500000

Kruskal-Wallis Test (Chi-Square Approximation)
CHISQ = 0.53087 DF = 1 Prob > CHISQ = 0.4662

Appendix I. Error Box Plots



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TECHSTG
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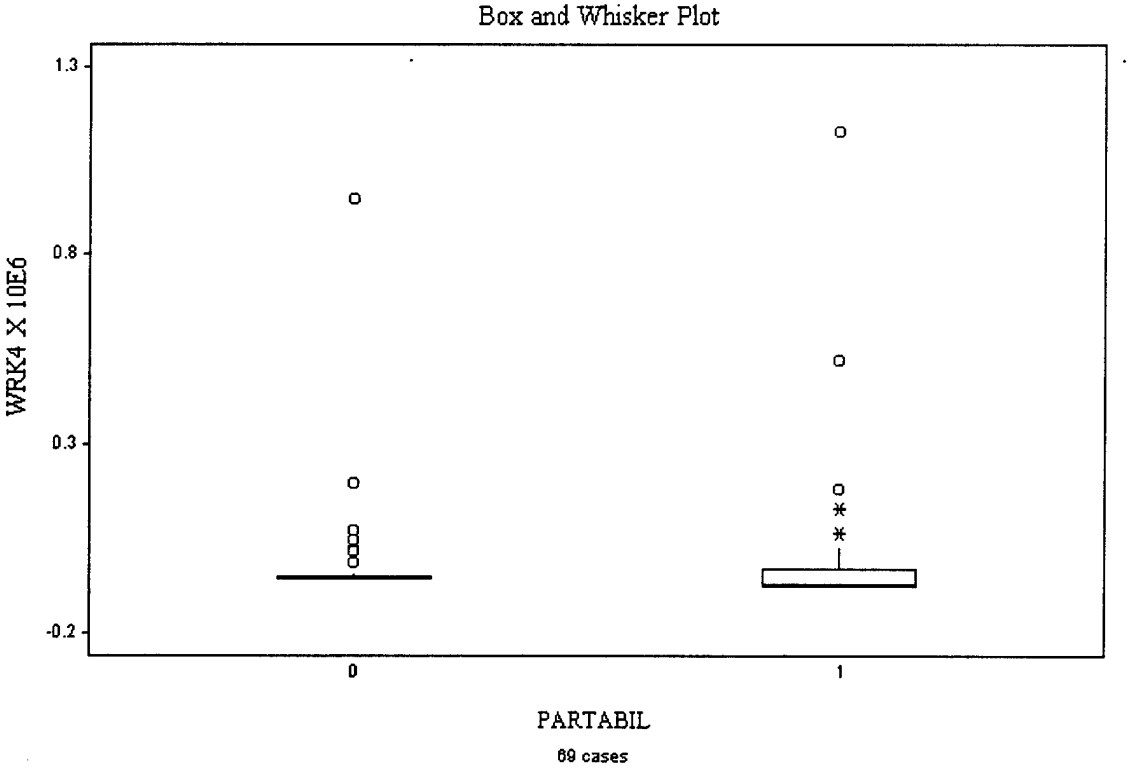
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0.3
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WRK4 X 10E6
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1
PARTABIL
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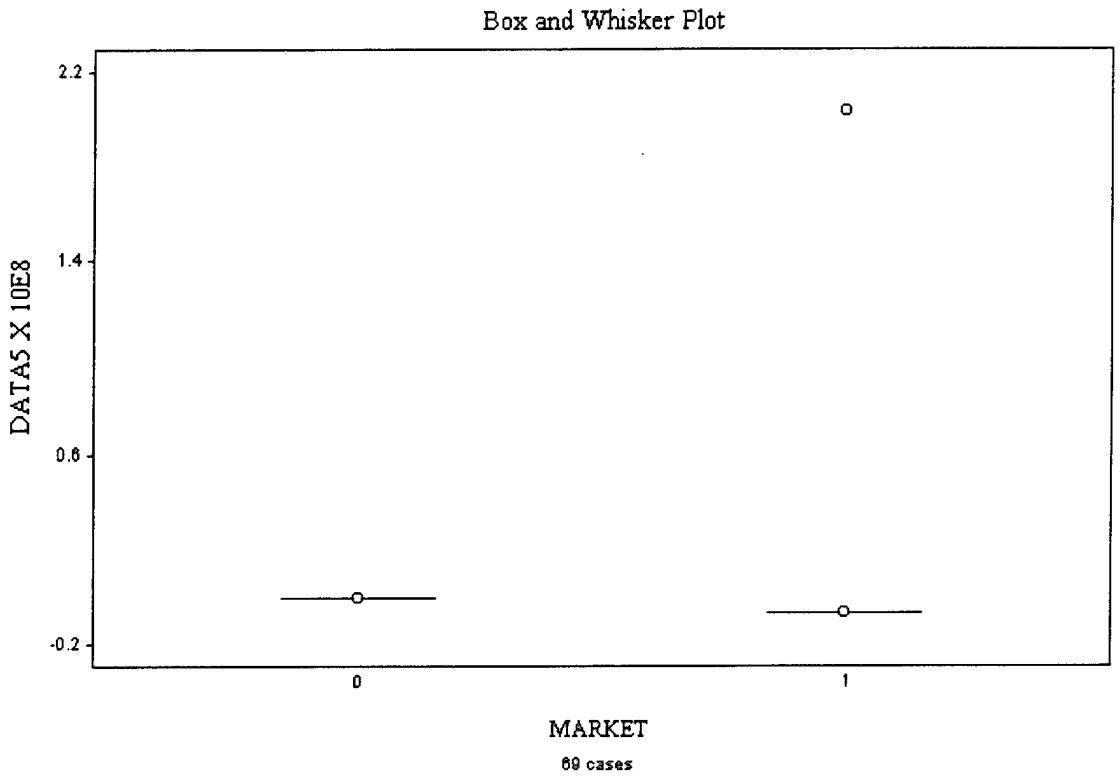
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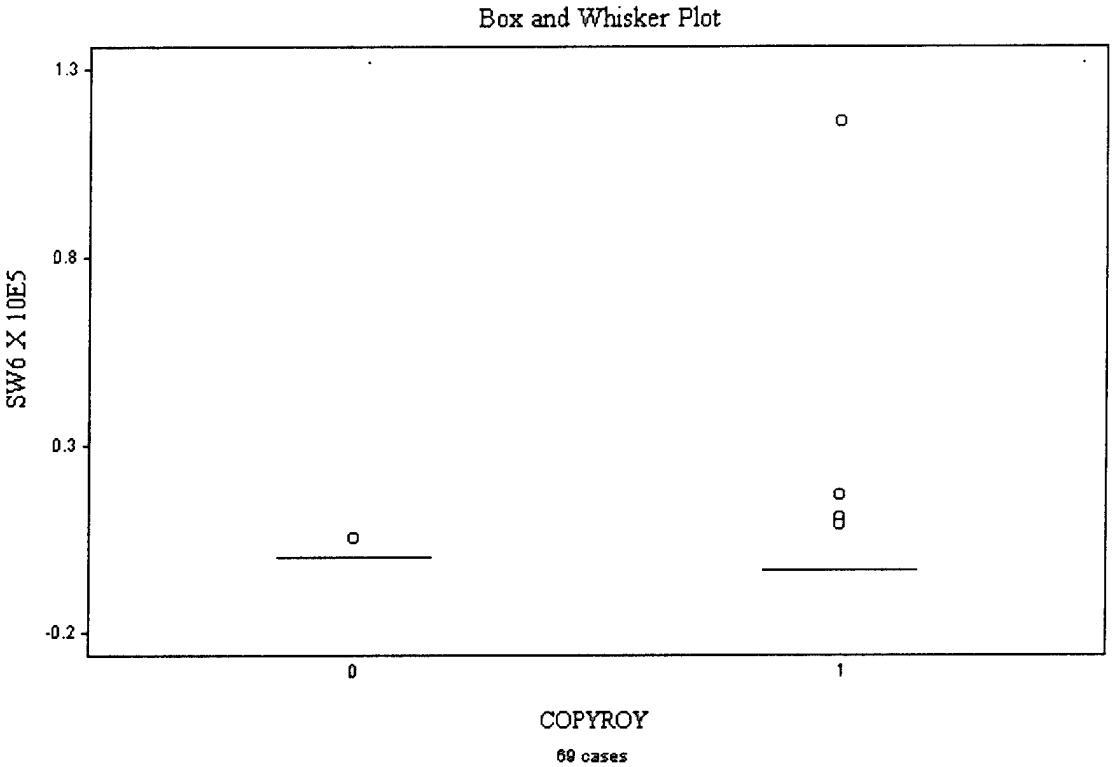
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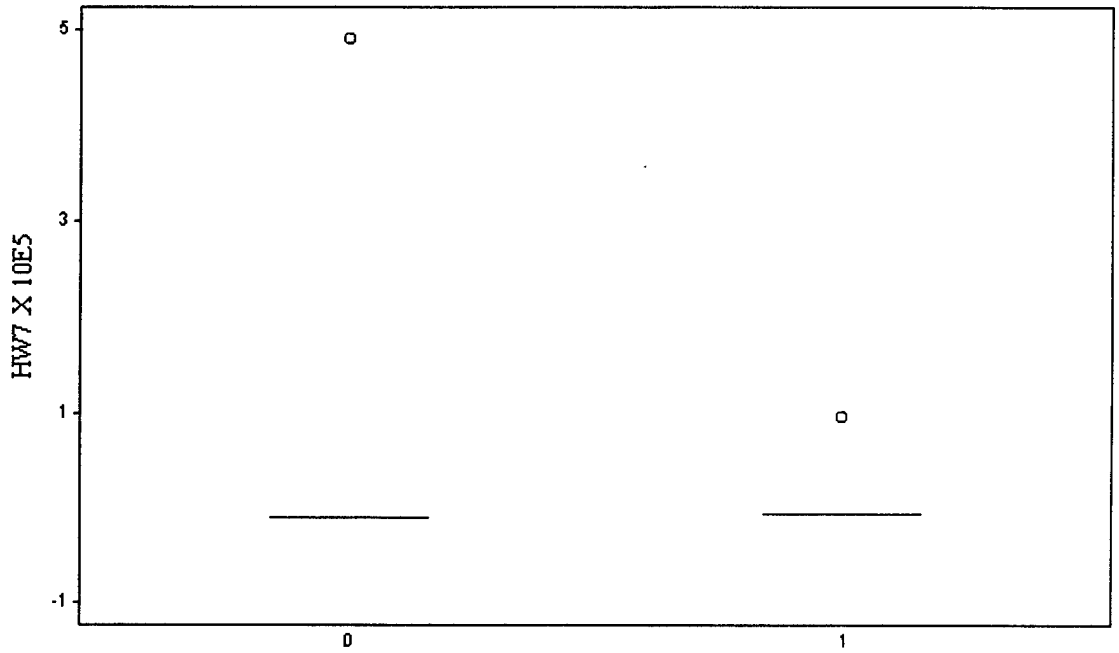

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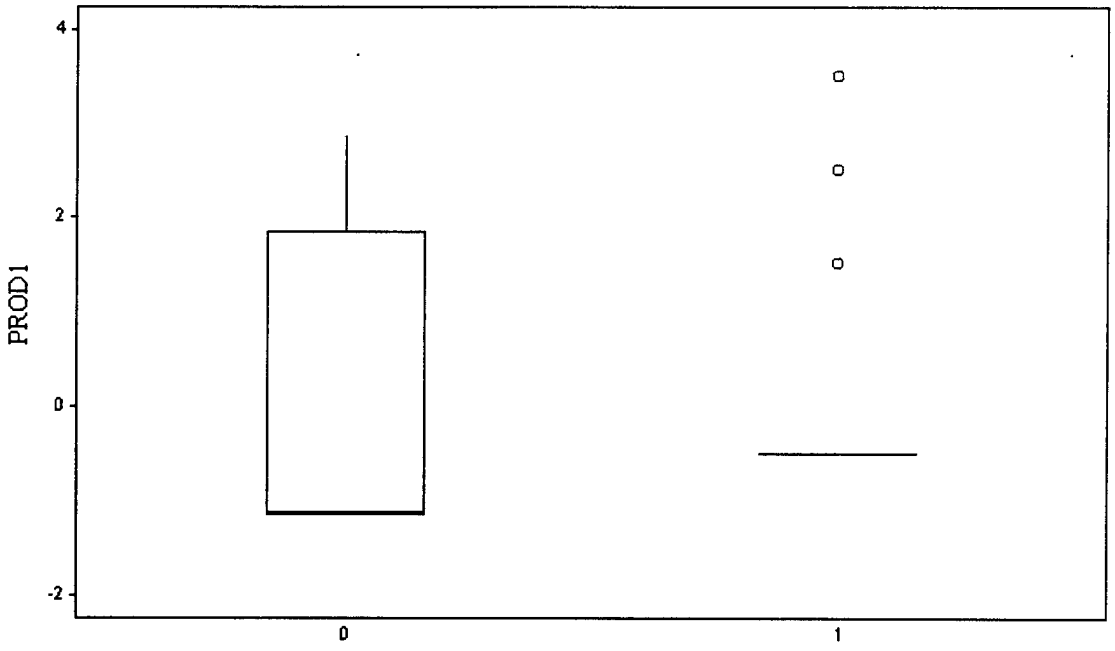

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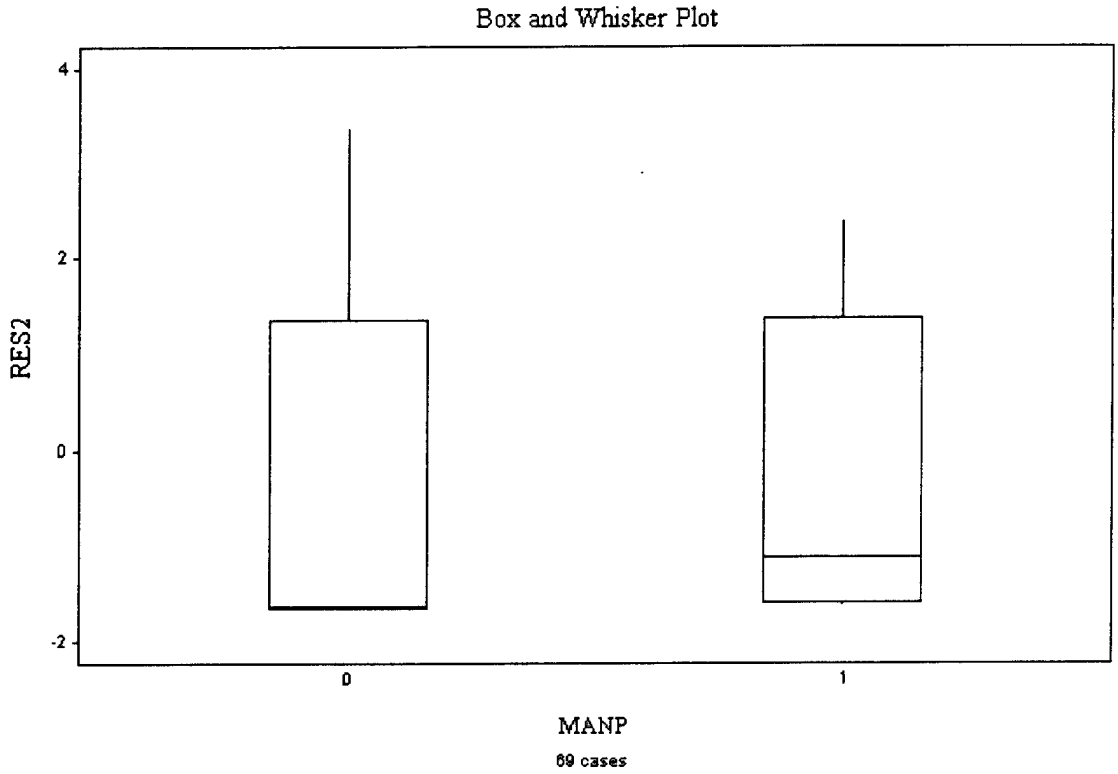
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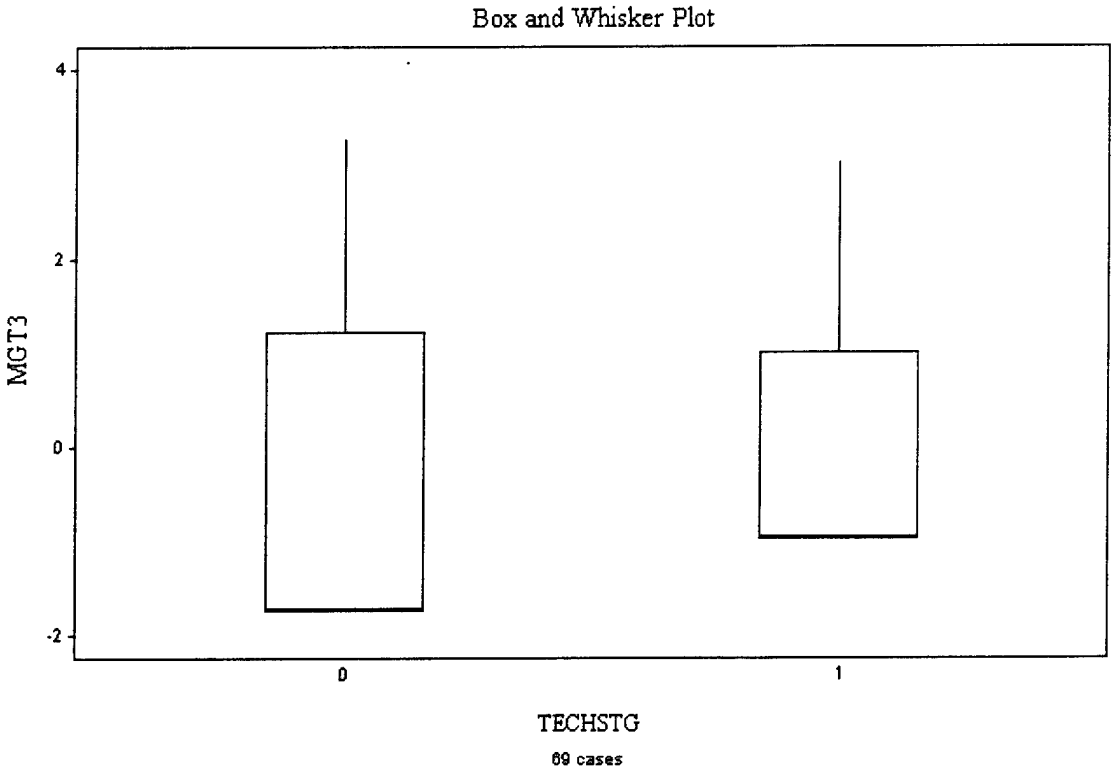
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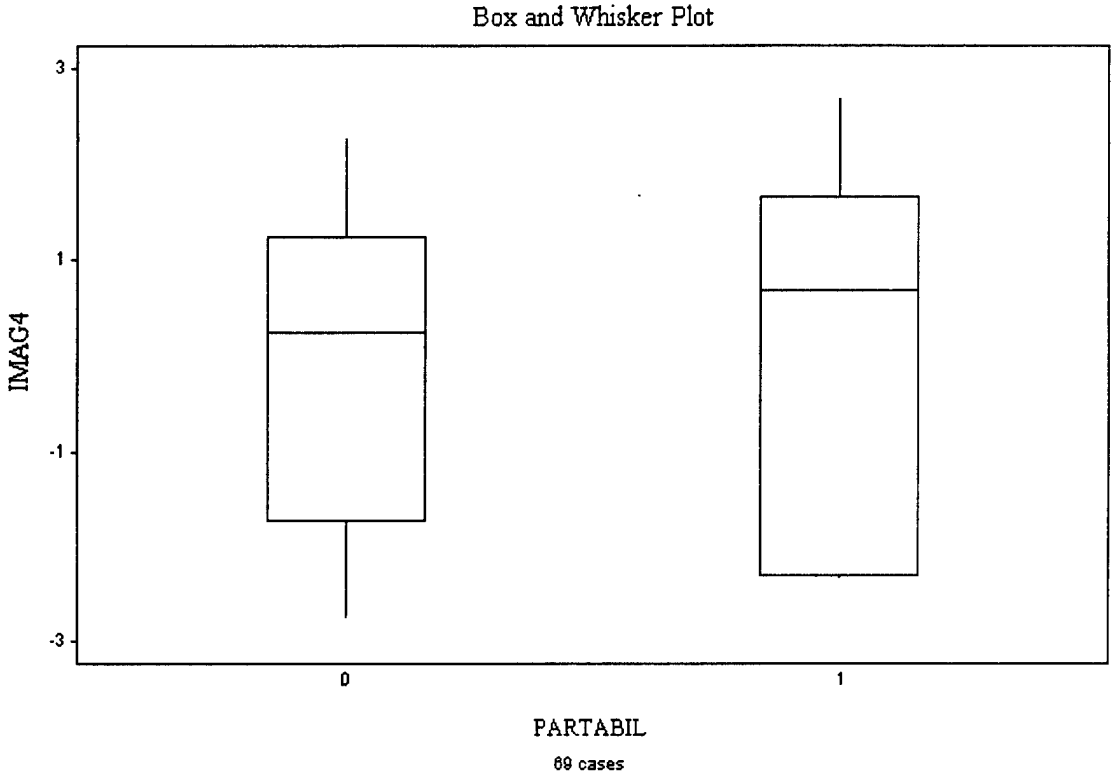
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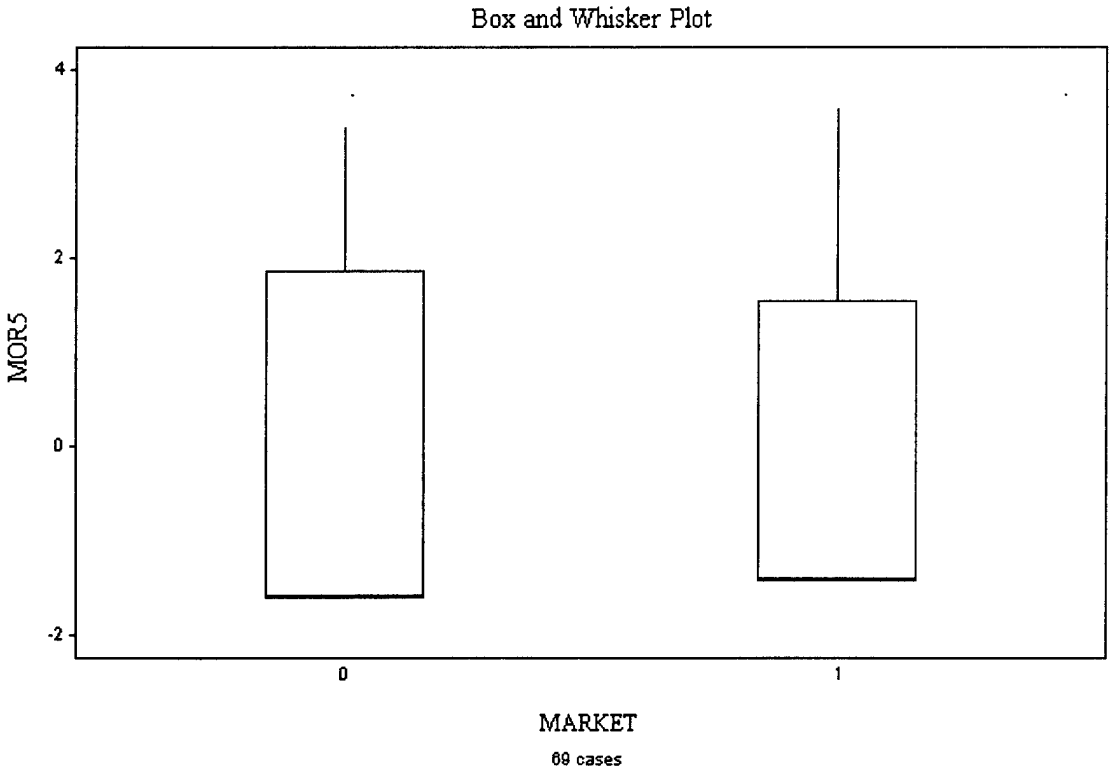
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13. ABSTRACT (*Maximum 200 Words*)

Technology transfer has become an increasingly important mission of federal laboratories over the past decade, with results that benefit the government, private companies, and the nation's economy. Cooperative Research and Development Agreements (CRDAs) are the most used mechanism to perform technology transfer from our nation's federal laboratories to the private sector.

The main objective of this research is to determine important CRDA elements that are associated with higher benefits to the government. Recommendations are provided for technology transfer managers to improve CRDAs by identifying the CRDA elements that are associated with higher or lower benefits to the government.

Key findings include that CRDAs, in general, provide many types of important benefits to the government. Some of the CRDA elements that are associated with significantly higher government benefits include quantified manpower requirements, the commercial partner's ability to commercialize CRDA technology, market information for the CRDA technology, quantified copyright royalty rates, and quantified sales royalty rates. CRDA elements associated with significantly lower government benefits include detailed facilities requirements and the CRDA technology's stage of development.

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