

AD-A285 274



DTIC  
ELECTE  
OCT 06 1994  
S B D

A DEMONSTRATION OF A BENCHMARKING  
TECHNIQUE TO COMPARE GRADUATE EDUCATION  
LEVELS OF AIR FORCE PROJECT MANAGERS  
AND SELECTED BENCHMARKING PARTNERS

THESIS

William D. Beatty, B.A.  
Capt, USAF

David H. Kelley, B.S.  
Capt, USAF

AFIT/GSM/LAS/94S-3

**DISTRIBUTION STATEMENT A**  
Approved for public release  
Distribution Unlimited

DEPARTMENT OF THE AIR FORCE  
AIR UNIVERSITY

**AIR FORCE INSTITUTE OF TECHNOLOGY**

Wright-Patterson Air Force Base, Ohio

AFIT/GSM/LAS/94S-3

A DEMONSTRATION OF A BENCHMARKING  
TECHNIQUE TO COMPARE GRADUATE EDUCATION  
LEVELS OF AIR FORCE PROJECT MANAGERS  
AND SELECTED BENCHMARKING PARTNERS

THESIS

William D. Beatty, B.A.  
Capt, USAF

David H. Kelley, B.S.  
Capt, USAF

AFIT/GSM/LAS/94S-3

DTIC QUALITY INSPECTED 2

Approved for public release; distribution unlimited

94-31765  


617

3

The views expressed in this thesis are those of the authors and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

<b>Accession For</b>	
NTIS GRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification _____	
By _____	
Distribution/ _____	
<b>Availability Codes</b>	
<b>Dist</b>	<b>Avail and/or Special</b>
A-1	

AFIT/GSM/LAS/94S-3

A DEMONSTRATION OF A BENCHMARKING TECHNIQUE TO COMPARE  
GRADUATE EDUCATION LEVELS OF AIR FORCE PROJECT MANAGERS  
AND SELECTED BENCHMARKING PARTNERS

THESIS

Presented to the Faculty of the  
Graduate School of Logistics and Acquisition Management  
of the Air Force Institute of Technology  
Air University  
in Partial Fulfillment of the  
Requirements for the Degree of  
Master of Science in Systems Management

William D. Beatty, B.A.  
Captain, USAF

David H. Kelley, B.S.  
Captain, USAF

September 1994

Approved for public release; distribution unlimited

## *Preface*

The objective of this research was to use a benchmarking technique to address a current Air Force issue. That issue is to determine a method for accurately measuring how many Air Force project manager officers need specialized graduate education in project management. The need for this kind of research stems from Headquarters, USAF direction to initiate a Process Action Team (PAT) and a separate AFIT study to review and improve the existing Graduate Education Management System (GEMS) process. The main goal of the PAT and AFIT study is to improve the process of defining graduate education requirements. We hope our research will assist USAF efforts in this area.

The execution of this research required a lot of planning and extensive review of files and education material. Many individuals were instrumental in the execution of this research. For guidance and a sense of humor during what seemed like endless planning, we owe special thanks to our advisors, Lieutenant Colonel Michael Heberling and Major Kevin Grant (always check your data before you brief the four-star!). Thanks to Debbie Bigelow, Executive Director of the Project Management Institute (PMI) in Upper Darby, Pennsylvania and her staff for allowing us to rummage through PMI's files. A special thanks is offered to Karen Condos and Barbara Pattinson of PMI who were kind enough not to ignore our initial inquiries and did a lot to help make our research productive. We would also like to thank Dr. Charles J. Bridgman, Associate Dean for Research in AFIT's School of Engineering, for assisting us in getting the necessary Air Force data.

Finally, I (Duane) would like to take this opportunity to offer my individual, sincerest appreciation to my wife, Elizabeth Beatty, and my children Erin, Michael, and Megan, for their enduring patience and understanding. I (Dave) want to thank my family and friends for support and ready humor. And a special wish for Caroline Grace Kelley, who punctuated this year with such joy.

William D. Beatty  
David H. Kelley

## Table of Contents

	Page
Preface.....	ii
List of Figures .....	vii
List of Tables.....	viii
Abstract.....	ix
I. Introduction .....	1
General Issue .....	1
Military Requirement for Advanced Education.....	1
Air Force Institute of Technology.....	2
Quantifying Air Force Graduate Education Requirements .....	2
Weaknesses in the Current Requirements	
Determination Method .....	3
GEMS is Reactive, Not Proactive .....	3
GEMS is Vulnerable to Inconsistency	
and Change .....	4
GEMS Confuses Training with Education .....	4
Benchmarking as an Alternative Method .....	5
Purpose.....	6
Research Objectives .....	6
Scope.....	7
Definitions .....	9
II. Literature Review.....	11
Introduction .....	11
What is Benchmarking? .....	13
Challenges.....	16
Benchmarking Networks .....	18
Benchmarking Steps .....	18
Identify What to Benchmark .....	18
Determine What Measures to Use .....	20
Identify Who to Benchmark .....	20
Internal Operations .....	21
External Competitors .....	22
Functional Leaders .....	23
Generic Competitors.....	24

	Page
Collect the Data .....	25
Internal Data .....	25
External Data .....	26
Questionnaires.....	26
Telephone Surveys.....	27
Direct Site Visit.....	27
Analyze the Data .....	28
Communicate the Results .....	29
III. Methodology .....	31
Overview .....	31
Selected Benchmarking Procedures .....	31
Identify What to Benchmark.....	31
Determine What Measures Will Be Used to Benchmark.....	33
Identify Who to Benchmark.....	37
Individual Project Manager Benchmark Partners .....	39
Aerospace Company Benchmark Partners .....	41
Collect Benchmark Data.....	44
Internal Air Force Data.....	44
PMP Data.....	45
Aerospace Company Data .....	47
Analyze Data.....	48
IV. Results and Conclusions .....	50
Results .....	50
Overview.....	50
Air Force Project Manager Profile .....	50
Project Management Professional (PMP) Profile .....	51
Defense Aerospace Company Profile.....	53
Comparison of Air Force 63AX and Benchmark Partner Profiles .....	54
Conclusions .....	56
Benchmarking Measures - Limitations.....	56
Who to Benchmark - Limitations .....	57
Unavailability of Data .....	59
Lack of Trend Analysis .....	59
Maturation of the Air Force .....	60
Dependency on Underlying Assumptions and Subjectivity .....	60
Recommendations .....	62
Pursue Benchmarking as a GEMS Substitute.....	62
Secure Senior Air Force Support .....	62
Develop Rigorous Best Practices Criteria.....	63
Use Trend Data .....	63
Develop Factors Bridging Benchmark Percentages with Objective Percentages .....	63

	Page
<b>Appendix A: Project Management Related Air Force Advanced Academic Degree (AAD) Codes .....</b>	<b>65</b>
<b>Appendix B: Record of Preliminary Telephone Inquiries to Determine Availability of Benchmark Data.....</b>	<b>67</b>
<b>Appendix C: Project Management Professional (PMP) Certification Requirements .....</b>	<b>68</b>
<b>Appendix D: Record of Telephone Inquiries to Defense Aerospace Contractors to Request Benchmark Data .....</b>	<b>70</b>
<b>Appendix E: ATLAS 63AX Data .....</b>	<b>72</b>
<b>Appendix F: Graduate Degree and Market Sector Codes for PMP's.....</b>	<b>92</b>
<b>Appendix G: Project Management Professional (PMP) Data.....</b>	<b>94</b>
<b>Appendix H: Confidence Interval Calculations for Project Management Institute Data .....</b>	<b>110</b>
<b>Bibliography .....</b>	<b>114</b>
<b>Vita .....</b>	<b>118</b>

*List of Figures*

<b>Figure</b>	<b>Page</b>
1. <b>Percentage of Air Force Officers Holding Graduate Degrees by Rank</b> .....	36
2. <b>Percentage of Air Force 63AX Officers with any Graduate Degrees, Project Management Relevant Graduate Degrees, and AFIT Systems Management (GSM) Graduate Degrees ..</b>	51
3. <b>Percentage of PMI PMP's with any Graduate Degrees and Project Management Relevant Graduate Degrees</b> .....	51
4. <b>Percentage of Defense/Aerospace PMP's with any Graduate Degrees and Project Management Relevant Graduate Degrees</b> .....	52
5. <b>Percentage of Project Managers with any Graduate Degrees</b> .....	54
6. <b>Percentage of Project Managers with Relevant Graduate Degrees</b> .....	55

*List of Tables*

<b>Table</b>	<b>Page</b>
1. <b>The Benchmarking Process</b> .....	12
2. <b>What to Benchmark</b> .....	19
3. <b>Air Force 63AX Specialties with Selected Duties and Responsibilities</b> .....	44
4. <b>Summary of Population Proportions for PMP Data</b> .....	53
5. <b>Potential Conclusions with Corresponding Assumptions</b> .....	61

*Abstract*

This thesis demonstrated a benchmarking technique to support determining graduate education requirements for officers in the Acquisition Program Management utilization field. The technique is also applicable to other Air Force career fields. The USAF currently uses the Graduate Education Management System (GEMS) to quantify officer graduate education requirements. Weaknesses in the GEMS-based process include the inability to address future technologies, vulnerability to inconsistency and change, and confusion of training with education. AFIT developed and recommended an alternative requirements determination approach that relies on benchmarking. This thesis reviewed literature on benchmarking principles. The research methodology developed and implemented benchmarking procedures to include identifying attributes to benchmark, determining measures, identifying suitable benchmark subjects, collecting benchmark data, and analyzing the data. Primary benchmark partners were project managers from the Project Management Institute (PMI), a non-profit professional organization. Percentages of Air Force, PMI, and PMI Defense/Aerospace sector project managers holding relevant graduate degrees were 53.21%, 12.41% and 18.67% respectively. Six limitations identified in the thesis prevented the determination of firm education requirements based solely on these results. Securing senior USAF support, developing rigorous best practices criteria, using trend data and developing numerical bridging factors were recommended to improve the benchmarking technique.

A DEMONSTRATION OF A BENCHMARKING TECHNIQUE TO COMPARE  
GRADUATE EDUCATION LEVELS OF AIR FORCE PROJECT MANAGERS  
AND SELECTED BENCHMARKING PARTNERS

*I. Introduction*

*General Issue*

***Military Requirement for Advanced Education.***

The United States must continue to rely heavily on technological superiority to offset quantitative advantages, to minimize risk to US forces, and to enhance the potential for swift decisive termination of conflict. (21:3)

US National Military Strategy, 1992

Today's US military is a high technology force depending on state-of-the-art research and development to attain military superiority. Widely publicized US successes with "smart weapons" and sophisticated systems such as the F-117 stealth fighter during the 1991 Gulf War illustrate US technological prowess.

The Department of Defense (DOD) supports advanced education for military officers as a fundamental principle underlying advanced military technology. DOD Directive 1322.10, "Policy on Graduate Education for Military Officers," identifies two purposes of DOD-sponsored graduate education:

- a. Raise the levels of individual military officer professionalism and technical competence so that those officers more effectively perform their required duties and responsibilities.
- b. Provide developmental incentives for military officers with high ability, dedication, and the capacity for professional growth to remain in the Service. (20:1)

***Air Force Institute of Technology.*** In the United States Air Force (USAF), the commitment to officer graduate education centers on the Air Force Institute of Technology (AFIT). AFIT was established in 1947 at Wright-Patterson AFB, OH with the mission "to support the Air Force through graduate and professional education, research and consultation" (13:1). AFIT offers in-residence graduate degree programs to selected officers and civilians in the Graduate School of Logistics and Acquisition Management and the School of Engineering (13:2). The AFIT Civilian Institution (CI) program also sponsors full-time graduate study "through regular accredited civilian programs when equivalents are not offered in the resident schools or if they can be obtained more economically than AFIT can provide them" (13:182).

***Quantifying Air Force Graduate Education Requirements.*** An important aspect of USAF's graduate education program is the annual determination of AFIT quotas. Quotas refer to the number of students matriculating in each curriculum (49). Quotas impact faculty requirements, course offerings and ultimately the number of graduates who will be available for Air Force assignments. The USAF quantifies requirements for over 20 in-residence graduate programs using the Graduate Education Management System (GEMS) described in Air Force Regulation (AFR) 36-19 (15:1). Under GEMS, individual Air Force offices identify positions requiring officers with specified graduate degrees. These positions are assigned Advanced Academic Degree (AAD) codes specifying the particular degree needed. For example, AAD code 1ASY identifies AFIT's Master of Science in Systems Management degree. The Graduate Systems Management (GSM) program is the AFIT curriculum leading to the M. S. in Systems Management degree (13:158). Identified AAD positions are consolidated at progressively higher levels, then reviewed and validated by the Air Force Education Requirements Board (AFERB) (10; 15:3). Validated Air Force-wide requirements are

then compared against the inventory of officers holding graduate degrees. Shortfalls (too few officers with required degrees) are the basis for annual quotas. Funding limitations may limit quotas, but by design the requirement/inventory shortfall is the major factor determining quotas (1:1).

***Weaknesses in the Current Requirements Determination Method.*** Several sources have documented weaknesses in existing graduate education requirements determination policy and its implementation within the Air Force (1:2-4; 19:4-7; 32:2). Recognizing these weaknesses, the Vice Chief of Staff of the Air Force in May 1993 tasked AFIT to develop and recommend an alternative approach to determining requirements (49). AFIT's response identified a Strategy-to-Task approach using benchmarking. Strategy-to-Task develops tasks and programs to implement high-level strategies, while benchmarking is a quality concept that measures practices against those of recognized leaders (2:4; 26:130). In January 1994 Headquarters, USAF directed initiation of a Process Action Team (PAT) to review the GEMS process, "focus(ing) on improving the process - defining requirements..." (32:2). This PAT focused further review on the Strategy-to-Task model. Together the AFIT team and PAT examined three significant problem areas in the GEMS-based requirements definition approach.

***GEMS is Reactive, Not Proactive.*** The AFIT team described GEMS' inability to envision requirements for projected specialties. GEMS "sets requirements based on existing positions which necessarily represent existing technology. There is no way to generate educational starts which address tomorrow's technology" (1:2). Although several Air Force programs project emerging technologies, GEMS allows offices to assign AAD codes only to current positions corresponding to current programs (15:5). GEMS reacts to present technological requirements more than it plans for future

requirements. This limitation particularly handicaps state-of-the-art technology areas such as stealth, artificial intelligence, and Very Large Scale Integration (VLSI) electronics (1:2, 3).

***GEMS Is Vulnerable to Inconsistency and Change.*** Under GEMS, individual judgments made at relatively low levels form the foundation of the requirements definition process. Personnel at the branch chief, division chief or program office director level must judge whether a position requires a special AAD educational background, and if so, the specific advanced degree needed. Although like most military decisions, these judgments are in turn subject to additional review, they remain the starting point for consolidation of AAD positions to increasingly higher levels (15:6).

The process described here is subject to inevitable inconsistencies in the way individual managers throughout the Air Force choose to identify or not to identify AAD positions. A hypothetical example illustrates the point. In a given year an office chief might believe a position requires particular AAD-based knowledge, and hence request the position be coded accordingly. The following year, a new office chief arrives and ascribes less importance to AAD qualifications. This new chief might then delete the AAD requirement. Personal preferences in working manpower and personnel issues, positive or negative experiences with other AAD positions, and simple differences in interpretation are all potential factors influencing the AAD position decision (1:3, 4; 15:5).

***GEMS Confuses Training with Education.*** The 1993-1995 AFIT graduate catalog states "university-level work is designed to give carefully selected officers...the broad educational background that will equip them both to understand their technological and cultural environment and to analyze and attempt to solve its problems" (13:1). There is a clear emphasis on long term benefits to both the service and the officer. Despite this, the AFIT team which studied GEMS pointed out that "the present system measures the need for...graduate education on the basis of the set of tasks the

graduate must perform at his next assignment. Preparation to perform a set of tasks, even scientifically advanced tasks, is the usual definition of training" (1:3). This dichotomy exists in part because DODD 1322.10 requires officers receiving fully-funded graduate education to serve a minimum amount of time in an AAD position matching their graduate program (20:2). A 1994 AFIT GSM graduate, for example, was limited to volunteering from a maximum of 28 positions at 12 different locations instead of being able to compete for any position within the Air Force for which he or she was qualified (28:8). Thus, while AFIT produces officers with broad-based, widely applicable education as a strategic resource, DOD policy treats these same officers as highly specialized trainees with limited utility for three years immediately following graduation from AFIT.

#### *Benchmarking as an Alternative Method*

The AFIT team developing GEMS alternatives focused on an approach using benchmarking to determine Air Force objective percentages for graduate education (1:5). This proposal involved comparing the specialized graduate education levels of various Air Force career areas against those of comparable organizations outside the Air Force (41). Weighted averages computed across different Air Force organization types would result in objective percentages for each graduate academic specialty. For example, under the Aeronautical Engineering, Guidance and Control academic specialty, benchmarking would first examine the percentage of officers holding this specialty in Air Force program offices, laboratories, and headquarters positions (each determined separately). Benchmarking would next identify the percentage of employees holding this same academic specialty at industry program offices, NASA laboratories, and corporate headquarters staffs, respectively. Shortfalls where the Air Force percentage fell significantly below that of the comparable organization may indicate a

need for additional AFIT quotas in the specialty. A weighted average of percentages from the three comparable organization types would then be the basis for an overall Air Force objective percentage (1:10).

This study details benchmarking procedures applied to one specific segment of the Air Force officer corps. The technique used here is designed to fulfill the broader objective of determining graduate education requirements for a wide variety of Air Force career fields. In other words, this technique provides a model for benchmarking graduate education that can be applied to other fields. Benchmarking a single Air Force segment illustrates the broadly-applicable technique.

#### *Purpose*

This thesis demonstrates a benchmarking technique to support the determination of graduate education requirements in the Air Force Acquisition Program Management utilization field. This career area, designated by the 63AX Air Force Specialty Code (AFSC) series, is most closely associated with AFIT's GSM program (13:158; 16:A10-30).

#### *Research Objectives*

This study includes three major research objectives. The first research objective is to characterize the graduate education profile of the Air Force Acquisition Program Management (63AX) officer force. After defining the Air Force 63AX corps, the thesis determines the number of 63AX officers holding graduate degrees by academic major. This allows determination of the percentages of 63AX officers holding any graduate degree and the percentage of 63AX officers holding project management related graduate degrees.

The second research objective is to characterize the graduate education profiles of project manager populations comparable to the 63AX force. The first step in this research objective is to identify groups of project managers for study. Two populations are ultimately selected: a set of individuals all of whom are recognized by a project management professional organization; and project managers employed by a large aerospace defense contractor. The first of these two populations is analyzed in the same manner as the Air Force 63AX population. Determining graduate degrees by academic major leads to calculations of the percentage holding any graduate degree and the percentage holding a project management related graduate degree. Graduate education characterization of the second benchmarking partner population (aerospace contractor project managers) is limited to the percentage of the population holding technical graduate degrees and the percentage holding business related graduate degrees.

The third objective is to compare the Air Force 63AX graduate education profile with those of the comparable populations. The percentages of project managers holding any graduate degree in each population and the percentage of project managers holding project management related graduate degrees in each population are depicted graphically to enable comparisons. These comparisons provide a basis for discussion of potential Air Force objective percentages for specialized graduate education in the concluding sections of the thesis.

### *Scope*

This thesis addresses a number of functions having potentially wide applications. Benchmarking, graduate education, military education requirements, and measures of project management competence all hold potential for extensive research. It is

important to recognize precisely what aspects of these areas are included and not included in this study.

The examination of graduate education profiles presented in this thesis is limited to a small portion of the Air Force. Only active duty officers serving in the Acquisition Program Management utilization field are studied. This study is not designed to address specifically graduate education requirements for other Air Force utilization fields or for civilian, sister service, or foreign students, although the benchmarking technique used here could serve as a model for these and other populations. Similarly, the results and conclusions presented in this thesis can be generalized to most other Air Force officer utilization fields, because with the exception of highly specialized fields (for example, medicine and law) all utilization fields rely on the same process for determining graduate education requirements (15:2).

This thesis profiles graduate education based only on the presence or absence of a single graduate degree, type of graduate degree, and academic major. Presence of multiple graduate degrees, method of gaining the graduate degree, means of financing, and period of time required to earn the graduate degree are not addressed. Although the level of graduate degree (for example, Masters or Doctorate) is noted in some data collection, comparisons of graduate education profiles for different populations do not include this data. Graduate education is the sole measure used to compare populations of project managers. Project management skill level, salary, experience, career success and similar measures are not used for comparison.

This research identifies, gathers and analyzes benchmarking data using methodology and resources detailed in chapter three. A limitation in this methodology includes the absence of funding to purchase benchmarking data or outside benchmarking consultant support. Other important limitations to identifying willing benchmarking partners and gathering useful data are discussed at length in the

methodology. These limitations are relevant to the scope of this thesis in that the limitations significantly narrow the potential breadth of the research. Many benchmarking data which could expand the scope of this research are not reasonably accessible.

### *Definitions*

Benchmarking partners are organizations which provide information on internal processes, policies and characteristics to another organization. This partner information provides the benchmarking organization a means of measuring and emulating best practices of the benchmarking partner (34:59, 60).

Objective percentage refers to a target number of Air Force officers receiving specialized graduate education in some academic discipline, as determined with benchmarking techniques (2:10). An objective percentage typically compares to the percentage of a benchmarking partner population holding that same graduate education.

Strategy-to-Task is a method of defining high-level strategies, then developing tasks and requirements at progressively lower levels in order to achieve those strategies. In the context of this thesis, Strategy-to-Task refers to the Air Force's strategy for determining internal graduate education requirements (2:4, 5).

This thesis uses the Project Management Book of Knowledge (PMBOK) to establish definitions for the terms "project", "program", and "program management". The PMBOK is published by the Project Management Institute (PMI), "a nonprofit organization dedicated to advancing the state-of-the-art of project management" (45:3). PMI represents a group of professionals uniquely focused on project management, while the PMBOK is used "to identify and establish standards" and defines project

management theory and practices recommended by the organization (46:1-1). The PMBOK defines "project," "program," and "project management" as follows:

**Project:** any undertaking with a defined starting point and defined objectives by which completion is identified. In practice most projects depend on finite or limited resources by which the objectives are to be accomplished.

**Program:** an endeavor of considerable scope encompassing a number of projects.

**Program management:** the management of a related series of projects . . . executed over a broad period of time, and which are designed to accomplish broad goals, to which the individual projects contribute (46:Glossary).

For simplicity, this study follows the convention adopted by other researchers and uses the terms "project" and "project management" exclusively (24:43; 38:2). It is understood that a "project" discussed in this thesis can refer to either a project or a program by the two definitions given above. These PMBOK definitions relate the two terms and differ chiefly in connotation of scale. By this same logic, "project management" in this thesis can refer to management of either a project or a program.

## *II. Literature Review*

### *Introduction*

Benchmarking in the United States, as a formal practice, is a relatively recent development. Typically used in the business community, benchmarking seeks to borrow and build upon proven techniques to improve efficiency, output, and service, thus enabling the organization to become a world class organization. Well publicized benchmarking successes have caught the attention of American business: the increasingly competitive global marketplace is compelling US firms to benchmark in order to survive. More and more organizations are using benchmarking. Companies such as Xerox, Motorola, American Telephone and Telegraph (AT&T), Hewlett-Packard, Eastman Kodak, and International Business Machines (IBM) are all strong advocates of measuring their performance against world leaders. Even those organizations recognized as top performers are benchmarking in the spirit of continuous improvement and in an attempt to achieve or maintain world class status (30:20). "Ultimately," notes Camp, "an organization will institutionalize benchmarking throughout its operation and ensure its continued success" (8:233).

Why do organizations benchmark? The International Benchmarking Clearinghouse (IBC), which will be discussed in more detail later, conducted a survey to identify reasons why organizations benchmark. The responses identified two primary reasons. First, The Malcolm Baldrige National Quality Award includes benchmarking as an important award criterion. The prestige of winning this award, sponsored by the US Department of Commerce, has driven many organizations to initiate benchmarking to fulfill the criterion (26:102). Second, benchmarking has proven to be a valuable approach to improve the quality of processes and services (27:37).

"To conduct a benchmarking study is to perform a research project" (52:23). Like any research project, benchmarking requires a defined process to accomplish the research effort. The abundance of literature in the benchmarking area offers numerous processes including step by step algorithms. Currently there is no single benchmarking process or model. Numerous models that do exist range from a simple four step process to more complicated paradigms involving over a dozen steps. In fact, there are as many benchmarking models as there are authors on the subject. The most straight forward models are based on Deming's classic quality four step process of Plan, Do, Check, and Act (27:38; 35:25). Table 1 synthesizes several prevalent benchmarking models:

TABLE 1

<b>The Benchmarking Process</b>
1. Identify What to Benchmark
2. Determine What Measures to Use
3. Identify Who to Benchmark
4. Collect the Data
5. Analyze the Data
6. Communicate Results

Steps 1, 2, and 3 above constitute Deming's Plan step; step 4, Collect the Data, represents the Do step; step 5, Analyze the Data, provides Deming's Check, and step 6, Communicate Results, partially fulfills the Act step. Deming's Act step, fully exercised, would include implementing benchmarking findings to eliminate performance gaps identified by the benchmarking effort.

### ***What is Benchmarking?***

Like most broad concepts, benchmarking is subject to a variety of definitions and interpretations. Port and Smith define it as "legally ripping off someone else's idea, then improving on it" (42:74). Bono represents many authors who concentrate on the "best practices" criterion. He calls benchmarking "the process of identifying and implementing the best practices to achieve top performance" (6:5). Evans and Lindsay place similar emphasis on the "best" criterion and expand benchmarking to include strategic concerns. Evans and Lindsay say benchmarking is "measuring your performance against that of best-in-class companies, determining how the best-in-class achieve those performance levels, and using the information as a basis for your own company's targets, strategies, and implementation" (26:143, 144). Watson also concentrates on the comparative nature of benchmarking, defining benchmarking as "a process for measuring your company's method, process, procedure, product, and service performance against those companies that consistently distinguish themselves in that same category of performance" (52:5). Camp's formal definition emphasizes the continuous nature of benchmarking, and encompasses a wide spectrum of organization types. Camp defines benchmarking as "the continuous process of measuring our products, services, and practices against those of our toughest competitors or companies renowned as leaders" (8:10). The most recognized and widely used definition in the literature is Camp's working definition: "the search for industry best practices that lead to superior performance" (8:12).

Benchmarking in the US dates back to the late 1970's when foreign competition, primarily Japanese and German, forced industry to reexamine fundamental manufacturing and business concepts. Benchmarking is based on Japanese principles developed over the past 40 years. The Japanese word *dantotsu*, meaning "best of the best", is frequently cited as the definitive term of the Japanese continuous improvement

philosophy from which benchmarking has emerged (26:147). Port and Smith point out that the US was late to adopt benchmarking because US industry was virtually unchallenged for over two decades after World War II. When foreign companies began to make significant gains in the domestic marketplace in the late 1960's, US managers first denied reality and identified unfair trading practices as the cause. These managers were initially unable to accept that non-American companies could produce high quality products at low cost. Benchmarking helped the US overcome this harmful "not invented here" syndrome by forcing the US to study worldwide competitors, accept that foreign practices can be superior, and borrow these superior foreign practices to enhance US performance (42:74).

Benchmarking has been categorized using a variety of criteria, but functional and strategic criteria have proven the most practical and most common categories in the literature. Camp selects four benchmarking types: internal (comparing internal operations and modeling the most effective), generic (referring to basic business practices such as making sales calls and filling customer orders), competitive (streamlining to match or improve on competitors' organizational efficiencies), and functional (9:25). Functional benchmarking is the key. This involves analyzing and modeling similar functions in outside organizations. External organizations studied in this manner are considered benchmarking partners. Biesada likens functional benchmarking to asking the question, "How can we excel at this process?" (4:30). The most important characteristic of functional benchmarking is that the benchmarking partner does not necessarily have to be in the same line of business as the organization doing the benchmarking. Camp cites a prime example of this cross-industry practice in explaining how a high-technology copier firm (Xerox) benchmarked a mail-order apparel company (L.L. Bean) to understand how L.L. Bean handled orders three times more

quickly than Xerox. The similarity between order handling functions in both industries allowed Xerox to adapt successfully many of L.L. Bean's techniques (9:25).

Strategic benchmarking is the second major generally-acknowledged benchmarking type. Biesada illustrates the difference between strategic benchmarking and functional benchmarking by asking two questions. The question "how can we excel at this process" would be asked for functional benchmarking (4:30). The question asked for strategic benchmarking is "how can we become world-class in tomorrow's probable economic environment" (4:30). By concentrating on these questions, organizations can maintain the vision to stay competitive in the long-term. Biesada goes on to describe how Maine's Bath Iron Works shipyard benchmarked several foreign shipyards to comprehend strategic options available to maintain business in an era of declining military shipbuilding contracts. Bath Iron Works broadened into energy-related and civilian areas, as many foreign shipyards had, to ensure future opportunities (4:30, 31). Functional and strategic benchmarking account for most benchmarking now occurring in the US.

Benchmarking is expanding from a traditionally manufacturing-based phenomenon to a wider variety of applications including human resources development. Port and Smith use the original Japanese benchmarking efforts of the 1950's to illustrate the practice's earliest applications. Japanese firms targeted the products of American manufacturing industries to study which products were being manufactured and how these products were being produced (42:74). Ford believes the nature of manufacturing industries and their unique requirements make them best-suited to successful application of benchmarking techniques. Highly quantifiable measures such as cycle time and production costs prove ideal for benchmarking analyses. Operations and service industries have also benefited (27:38).

Recently, the virtual explosion of commonplace computing capabilities combined with advances in management sciences have allowed human resources development to benefit from benchmarking. Ford identifies human resources development as the disciplines of training, career planning and development, organizational design and restructuring, and work-group design (27:38). Applying benchmarking to these "soft" areas can help organizations develop more effective individuals and teams. Graduate education's contribution to career planning and development makes graduate education a key element in human resources development for any large, technology-based organization. Crow and Van Epps have pinpointed benchmarking's disciplined framework as the most valuable addition to the human resources equation (12:3). Building on this research, Ford surveyed a series of 14 human resources development criteria at three companies that had been awarded the Malcolm Baldrige National Quality Award. He demonstrated that these successful companies were consistent in achieving results through quantifiable education and training investments measured in employee education and training time, education and training costs, and similar metrics. Less successful corporations typically made substantially smaller investments in employee education and training (27:40, 41).

### *Challenges*

Researchers have documented a number of common challenges to benchmarking success. Bono cites a tendency for benchmarking companies to limit their studies solely to firms in the same industry as a major source of benchmarking failure. Many neophyte benchmarkers, he points out, concentrate on emulating the detailed processes of their direct competition and miss the bigger picture behind benchmarking (6:7). Hiebeler summarizes this basic benchmarking tenet well by explaining, "Companies that succeed at...benchmarking...do so by applying the insights

obtained through benchmarking, rather than by adopting the precise practices utilized by their benchmarking partners" (31:53). Biesada goes further and explains a more intuitive notion: direct competitors will be less likely to support a corporation's benchmarking efforts since the whole idea behind benchmarking is to win a larger share of the market, which by definition means impacting the very competitors who supported that firm in the first place. In other words, why should one firm help another if that help may jeopardize market share? Biesada has shown that the best solution to this challenge is to establish strategic partnerships and customer/supplier relationships with select competitors. Benchmarking then becomes a symbiotic function that assists both companies (4:36).

Another common source of benchmarking difficulty is failure to institutionalize benchmarking as a continuous process rather than a short-term project. Bono has found that over 50 percent of benchmarking initiatives result only in reports and action items instead of the long-term change in corporate mind-set that must permeate an organization from top to bottom (6:7). Executives, supervisors, and shop floor workers must all view benchmarking "not as an isolated quick fix, but a continuous practice that must harmonize with other company initiatives" (6:6). Port and Smith further illustrate Bono's remarks by pointing out that in benchmarking, "We're in a race without a finish line" (42:74).

A final challenge in benchmarking is to know the limits of the technique. Bono recommends establishing early in the benchmarking process what he terms a "red zone" of areas off limits to benchmarking study. This is especially applicable for the vast majority of cases where some reciprocal information sharing arrangement exists. Bono identifies compensation policies and certain finance areas as those most commonly included in the "red zone" (6:7). Hiebeler explains the other critical challenges to benchmarking: organizations must take a measured approach without trying to achieve

too much too quickly. Clearly identifying the area to be improved and the goals to be achieved is the key to keeping benchmarking in its proper perspective (31:53).

### *Benchmarking Networks*

Numerous benchmarking experts cite the foundation of benchmarking networks as the single most useful benchmarking initiative within the past five years (27:40; 30:24; 31:53; 34:119, 120; 42:75). The American Productivity and Quality Center's International Benchmarking Clearinghouse (IBC) is the preeminent model. The IBC is designed as a central repository for benchmarking services, advice and information. The IBC also includes electronic bulletin boards to assist organizations in finding benchmarking partners. Hiebeler has found that the IBC's most important development has proven to be the Process Classification Framework that subdivides business activities into a series of common processes and practices to facilitate cross-industry benchmarking (31:53). A similar network, the Benchmarking Forum, provides clearinghouse services specifically tailored to human resource development. Ford's studies indicate a 100% increase in benchmarking activities through the Benchmarking Forum in the past two years, with projections of sustained growth expected over the next three years (27:40).

### *Benchmarking Steps*

**Identify What To Benchmark.** Identifying what to benchmark is among the most critical, and often most difficult, steps in the benchmarking process. Choosing the wrong function to benchmark can doom a benchmarking effort to failure (27:38). The literature suggests numerous methods to identify what to benchmark. Although the methods differ depending upon the author, there is agreement on a general plan of attack. First, a plan should be developed. This plan does not need to be a detailed document, but a flow of activities that are to be accomplished with guidelines for each

activity (52:42). Fundamentally, when deciding what to benchmark, the researcher needs to consider the items in Table 2 (8:42; 51:82).

TABLE 2

<b>What To Benchmark</b>
1. Identify the Mission
2. Identify Your Product
3. Identify the Customer
4. Identify the Customer's Needs

The first activity involves clarifying the mission of the benchmarking organization. This activity is important because it will keep the researcher focused on the purpose and ultimate goal of the benchmarking exercise. Second, the researcher must identify the benchmarking organization's product. Every organization has a product or output, whether it be physical goods, services, reports, or specially qualified people (8:16). Identifying the product helps to ensure that the benchmark is directed at the organization's output. Third, identifying the customer is fundamental because all output is generated for some customer. Without proper customer focus, the output may be misdirected. Finally, identifying the customer's needs will enable the researcher to pick a benchmark that will answer the question "what benefits customer satisfaction most" (8:27)? Planning what to benchmark will define the scope of the benchmarking effort (5:182).

After determining what to benchmark, the researcher must consider what measurements to use. Properly determining what to benchmark assists the researcher to develop metrics to measure the selected benchmark (35:25).

***Determine What Measures to Use.*** Identifying appropriate benchmarking measures should begin with what Bono terms “one of the fundamental benchmarking rules: Know what you are doing before you ask others what they are doing” (6:6). It is essential for the benchmarking organization to characterize its own internal processes before it can effectively compare the processes to those of benchmarking partners. Vaziri calls this establishing “internal baseline data,” and notes that besides providing a reference point for comparison, “the knowledge gained during internal data gathering prepares the benchmarking team to collect data in other [external] organizations and lends credibility to the process” (51:83). In practice, to establish baseline data is to isolate measurable parameters that have a high likelihood of occurring in a benchmarking partner. For example, an obvious measure for a food processing plant would be the number of cans of food output in an eight hour period. The simplicity and intuitive nature of this measure make it almost certain that other processing plants would track the same figure for their own output.

The measurements selected for the benchmarking process are vital to uncovering best practices. The metrics should be true indicators of the process performance (8:51). Furthermore, the data obtained for the selected measurements must be usable at a later date in order to quantify the effects of changing the current process (8:47). In other words, selected measures must be capable of gauging differences between the current system and the benchmarked system and clearly show gaps between the two systems.

***Identify Who to Benchmark.*** Identifying who to benchmark requires examining the benchmarking categories of internal operations, external competitors, functional leaders, and generic competitors (8:60). Before the researcher launches into this comprehensive examination, however, Karlof and Ostblom agree with Watson that two initial steps are helpful in finding a benchmarking partner. First, the researcher should

look within his or her own organization. This differs from internal benchmarking in that the researcher is not benchmarking internal operations but is gathering information from internal operations documentation, market research, and employees to determine who the most appropriate benchmarking partners might be (52:51). Karlof and Ostblom point out that "there may be experience and knowledge in your own organization that can point to companies who fulfill the requirements of a benchmarking partner" (34:111). The second initial step in selecting a benchmarking partner is to search public domain information such as trade and management journals and magazines, public data bases, and customers. The sources cited above may lead to additional sources through references cited in journal entries (8:58). Information can also be obtained from trade associations, trade shows, industry experts, and consultants. The researcher should not underestimate the amount of information that can be gained through public domain searches. Watson relays a quote from former Director of Central Intelligence Richard Helms that over 85 percent of Central Intelligence Agency (CIA) research stems from open literature (52:52).

**Internal Operations.** Internal benchmarking is the first major step to take in the process of determining who to benchmark. An important distinction must be made between establishing internal baseline data (discussed earlier) and internal benchmarking. Establishing internal baseline data calibrates the existing system in absolute terms such as output per time. Baseline data then provides a starting point for identifying, collecting, and analyzing comparative benchmark information. This benchmark information may originate with internal benchmarking. Although internal benchmarking will typically not reveal world-class processes, it may uncover processes that can improve productivity (34:115). Assuming top management is committed, internal benchmarking offers easily available data. The benchmarking data gathered can be complete (no data gaps) and there should be no problems with confidentiality of

data (8:61). Care must be taken, however, not to underestimate the complexity of an internal benchmarking effort. If an organization is very large, with many decentralized subsidiaries, divisions, or international offices, operations that appear similar may in fact be conducted using vastly different processes. Care must be exercised in comparing these dissimilar processes (34:115). Even if internal benchmarking fails to identify an adequate benchmarking partner, the effort can help the benchmarking researcher focus on important issues that will be faced during an external benchmarking effort and may further define the scope of the effort (8:62). Karlof also points out that conducting internal benchmarking is an excellent way to train employees in the benchmarking process (34:115).

**External Competitors.** Benchmarking external competitors means seeking out the best practices of those organizations that produce the same product or a substitute product as the benchmarking organization. While this category of benchmarking may seem the obvious approach because of the direct comparability of processes producing like outputs, Camp points out a couple of difficulties for the benchmarker. First, the benchmarking researcher must be careful to ensure that the competitor's organization is truly comparable. For example, while the competitor's output may be the same, the size of the operations could be so different that the production processes don't compare. Camp illustrates this phenomenon using as an example one organization having a large throughput requiring rail shipment, compared to another organization making the same product but with smaller throughput requiring only truck shipments (8:63). If shipping is the benchmark, this competitor may not be a good benchmarking partner. A second potential problem is that getting information from a direct competitor may be difficult. Competitors may consider the information requested to be proprietary and "the basis for the firm's competitive advantage" (8:63). While these issues may be frustrating, Camp encourages the benchmarking researcher

to continue pursuing external competitors. Offers of reciprocal benchmarking privileges often help open these avenues.

Vaziri documents another concern with benchmarking direct competitors. He points out that "focusing benchmarking initiatives strictly on direct competitors limits a company's goals and creativity to the levels obtained by the competition, rather than achieving superiority" (51:83). For public service organizations, where there is often no apparent competition, the emphasis should be on selecting as a benchmarking partner an organization that exhibits outstanding performance in the area of interest for a particular benchmarking effort (51:83).

**Functional Leaders.** Benchmarking functional leaders is simply finding an organization that performs the process under investigation, regardless of what the final product of the organization might be. The benchmarking partner need not be a competitor, but may operate in a completely different industry. The important criterion is that the process or function being performed is the function of interest for the benchmarking effort. Camp agrees on this criterion with Karlof and Ostblom who go on to point out that once a suitable functional benchmarking partner has been found, there is usually little difficulty gaining cooperation and access to the required benchmarking information (34:116). Camp suggests that greater access to information for functional benchmarking may be due to less of a requirement to keep the information confidential, and a reciprocal interest on the part of the benchmarking partner to understand the practices of the benchmarking organization (8:64).

Karlof and Ostblom, unlike many functional benchmarking researchers, do not believe that the functional partner need be the best in the industry or a world class performer. Karlof and Ostblom warn the benchmarking organization against overreaching its benchmarking effort. Rather than trying to emulate the industry leaders, the benchmarking organization should consider sufficient improvement rather than

maximum improvement (34:121). Karlof and Ostblom believe this is a more realistic expectation that recognizes the wisdom of seeking continuous incremental improvement rather than seemingly achieving world-class status overnight (34:122).

**Generic Competitors.** Generic benchmarking is concerned with benchmarking a process that could be the same regardless of the industry. Many organizations perform generic functions to satisfy their customers and meet business requirements. Camp illustrates this category of benchmarking using the real-life example of a professional in the pharmaceutical industry who visited a bank and noticed a paper currency sorting operation. Realizing inherent commonalities between the bank's sorting requirements and his own industry, the professional ultimately was able to adapt the bank's operation to sort packages in a pharmaceutical warehouse (8:65). Camp suggests that generic benchmarking requires "broad conceptualization" skills to transfer processes from one field to another (8:65). This category of benchmarking can significantly expand the list of potential benchmarking partners.

After a list of who to benchmark has been compiled, three to five candidates, from whatever category or categories are appropriate for the particular benchmarking effort, should usually be selected (9:27; 27:34; 51:83). Some of these benchmarking partners may be eliminated because they are not the best performer, they are unwilling to share benchmarking information, or the benchmarking data they supply is questionable (51:83). In cases like these, a compromise may be necessary. Instead of using the best benchmarking partner, the benchmarking researcher may have to use a lesser performer or look for a partner whose operational circumstances resemble but do not replicate those of the benchmarking organization (34:122).

### *Collect The Data*

After determining what to benchmark, correct benchmark measures, and who to benchmark, gathering data is the heart of the benchmarking effort. The general philosophy in data collection is to progress from less difficult collection methods to more difficult (8:78). Collecting the data can be divided into two steps. First is to gather internal data that can contribute to the benchmarking effort. This step can help refine the chosen measure. The second step is to collect external data. The goal is not to try to collect perfect information, but to gather sufficient information to measure and, ultimately, improve the process that is the focus of the benchmarking effort. The benchmarking researcher must, however, ensure the data is accurate. The sufficiency of the information must be judged in relation to accessibility, bias, reliability, accuracy, timeliness, scope, and cost (51:83).

**Internal Data.** While conducting an external search for competitors and functional leaders may appear interesting and is often the first step thought of by novice benchmarkers, there is no need to start with the most difficult, and costly, method when a less difficult method may surface the required data. Camp makes a distinction between gathering external data and doing original research (8:76). This distinction means strictly internal data gathering may suffice in producing useful benchmarking data. Vaziri, in contrast, universally considers original research to be synonymous with external data collection (51:83).

Internal data collection may include previous benchmarking efforts capable of providing enormous benefits for the current effort. Piggybacking on previous studies is part of the continuous improvement process in which benchmarking can facilitate continuous incremental improvements (8:81). There may also be sources within the researcher's organization which possess valuable information that can aid the benchmarking effort if benchmarking has not already occurred. Even if the internal

sources do not possess the actual data required, they may provide leads to the data. An internal search may also locate individuals with expertise in the area of interest or in previous studies that could assist the benchmarking effort (8:82).

**External Data.** External data comes from two main sources: completed research and original research (51:83). The search for external data should begin with completed research or public domain information. Camp cites a typical example where a library search surfaced a speech containing detailed information that would have been very costly and time consuming to benchmark (8:84). Another potentially rich source of benchmarking information lies in professional trade associations. These are often repositories for extensive amounts of data and information that may be reviewed or provided upon request. If internal and public domain searches prove fruitless or insufficient, then original research is required.

The first step in conducting original research is to develop a plan. The plan should include contacting benchmarking partners, determining the exact data to collect, and how and where to collect it. If the benchmarking partner is one with whom there exists a business relationship, contact through a customer representative may be most appropriate or most productive. If no relationship exists, a high level professional to professional contact may prove most fruitful (8:95). Once agreement between the parties is secured, three primary methods of conducting original research are available: questionnaires, telephone surveys, and site visits.

**Questionnaires.** Questionnaires can serve many purposes. First, the questionnaire will document all the questions of interest to the benchmarking effort. A questionnaire may also result in more extensive data gathering than may be possible during a site visit, and a questionnaire can ensure anonymity where it is important (8:89). A questionnaire sent out prior to a site visit can provide the benchmarking partner with some insight into what the researcher is looking for. Pre-visit questionnaires

also give the partner time to gather the resources for making the site visit more productive and less time consuming for both parties. Also, if there are questions concerning interpretation of the questionnaire, they can be answered when the researcher makes the site visit (8:90).

**Telephone Surveys.** Telephone surveys have both advantages and disadvantages. The biggest advantage is the relatively low cost. The cost of a telephone call is much lower than the cost of sending a team on a site visit (34:135). Disadvantages include the lack of face-to-face contact that allows the mood and reactions of the benchmarking partner to be interpreted. Interviews also create a personal relationship with the benchmarking partner that could benefit a long term benchmarking relationship (34:135). Several researchers cite the biggest disadvantage of a telephone interview to be difficulty finding the right person with the knowledge, ability, and inclination to answer the benchmarking questions (8:93; 34:135; 52:2).

**Direct Site Visit.** The direct site visit requires the most careful planning to ensure productive use of all participants' time. Issues of what data to collect, how to collect it, where to collect it, and from whom should be determined prior to the visit. When representatives from the host organization know specifically what data the researcher wants, they can decide how best to support the collection effort. Following the site visit, some kind of debriefing should be conducted with the host. The debriefing can take place at the host site immediately following the benchmarking effort or by a follow-up report. This is an important consideration because the benchmarking effort generates costs for the host organization; therefore, it might be interested in the findings. Additionally, a productive relationship should be maintained so future benchmarking efforts, in the spirit of continuous improvement, will be well received by the benchmarking partner (8:97).

### *Analyze The Data*

Accurate analysis of benchmarking data is, according to Kinni, the key to identifying the difference between where the organization is and where it could be (35:28). Camp defines this difference as the performance gap. Camp further differentiates between positive and negative performance gaps. Positive performance gaps occur when the organization exceeds the benchmarking partner's performance for the chosen measure. A negative performance gap is the reverse, when the benchmarking partner's performance exceeds that of the researcher's organization (8:121). A negative performance gap is obviously the basis for benchmarking improvements. The analysis should create a realistic picture of what elements, defined by the measures selected, comprise the performance gap and how the benchmarking partner uses those elements to achieve superior performance (35:28).

The use of tables and charts can help quantify the gap such that the internal and external data can be accurately compared. Once the data is transformed to tables and charts, this information can be used to determine performance gaps and evaluate the *best practice*. Sometimes, however, it may not be clear which practice is best. What can be done to determine the best practice? In many business related benchmarking exercises the data is empirical and unequivocal, making the calculation of the performance gap easier. For example, if company A takes 1000 man-hours to process 5000 invoices and company B takes 800 man-hours to process 10,000 similar invoices, it is clear that company B has a superior process. Other benchmarking efforts, like those in the human resources development arena, might not yield such clear results. In cases where the best process is not so clear, expert judgment may be sought from either internal sources or external consultants. Another method is for the researcher to collect benchmarking data from several superior organizations and compare trends for those organizations with the researcher's own (8:145). This method, if the data is not

contradictory, can assist in the interpretation of which practice is best. Data stratification, where data is segmented into appropriate and distinct subgroups, can be accomplished to ensure data collected from many sources is compared on an equal footing and may help avoid contradictory findings. Stratification will also help identify sources of variance if some of the data does conflict (52:79).

### *Communicate The Results*

Properly communicating benchmarking results is an important phase in the process because there will usually be resistance to change within the organization regardless of how well the benchmarking effort is accomplished (8:163). Accurate communication of the analysis helps to avoid possible misinterpretation of the data and provides a mechanism for productive feedback (51:85). Camp believes that a well designed “communications campaign” is the key to overcoming the reluctance to accept the findings” (8:163). Camp further poses that this natural reluctance will tend to cause the benchmarking organization to scrutinize every aspect of the benchmarking effort. Therefore, “the methodology of the benchmarking study, the results, and the specific opportunities must be [effectively] communicated both within the function and within the corporate hierarchy” (8:163). Karlof and Ostblom further emphasize the importance of gaining organizational acceptance of the benchmarking study, declaring “if you do not succeed in getting your results agreed [upon] by the organization, the implementation phase is bound to run into obstacles when it gets underway” (34:174).

Earning management approval and commitment based on benchmarking results, while critical, is only part of the required buy-in. Watson notes that gaining support from the groups that will be directly impacted by the implementation of benchmarking results is also important (52:99). Employees who must actually implement changes can either help or hinder the effort depending on their level of

acceptance. Karlof and Ostblom state that their experience suggests accurate communication of factual findings can even help in dealing with labor unions, which are traditionally less accepting of innovation than other groups. This may be particularly vital if the benchmarking effort creates efficiencies that eliminate some positions (34:174).

### *III. Methodology*

#### *Overview*

Precise benchmarking procedures vary with researcher, application, purpose, and benchmarking type. Camp and other researchers segregate specific benchmarking steps into four broad categories of Planning, Analysis, Integration and Action (8:259; 34:65; 52:25). This research concentrates on the first two categories. Planning and Analysis involve data identification, gathering and analysis for reporting purely quantitative results. Integration and Action interpret the quantitative results to establish goals, implement action plans and recalibrate benchmarks.

#### *Selected Benchmarking Procedures*

This research involved development and implementation of benchmarking procedures according to the following outline:

##### **Planning**

1. Identify what attributes to benchmark
2. Determine what measures will be used to benchmark
3. Identify suitable subjects to benchmark
4. Collect benchmark data

##### **Analysis**

5. Analyze data

Each of the five benchmarking steps is detailed below.

***Identify What to Benchmark.*** In identifying what to benchmark, this thesis paralleled initial benchmarking research performed by the Air Force Institute of Technology Department of Operational Sciences (AFIT/ENS) in 1994. The AFIT/ENS

team explored benchmarking as a means of determining specialized graduate education requirements for Air Force officers in the Developmental Engineer, Aeronautical utilization field. Air Force Specialty Codes (AFSC's) 62E1A and 62E3A are used to identify the utilization field (16:A12). This thesis concentrated on an analogous benchmarking task directed at the Acquisition Program Management utilization field. The 63AX AFSC series is used to designate officers assigned to the Acquisition Program Management field (16:A12). The research effort in this instance benchmarked specialized graduate education requirements for Air Force officers in the 63AX utilization field.

Chapter two of this thesis detailed typical steps necessary to identify what to benchmark. This first benchmarking phase begins with identifying the mission, proceeds to identifying a product and customer, and concludes by focusing on customer needs. This paradigm progressively narrows the benchmarking effort from a broad mission to a specific, customer-oriented goal designed to support that mission.

At a macro level, the Air Force succinctly phrases its mission:

To defend the United States through control and exploitation of air and space.

Air Force Chief of Staff, 1992 (39:3)

Department of Defense (DOD) and Air Force policies cited in chapter one of this thesis demonstrate the importance of advanced education to help achieve the Air Force mission. Within the Air Force, the Air Force Materiel Command (AFMC) is designated the principle organization responsible for pursuing advanced technology and acquiring weapons systems. The AFMC holds most 63AX Acquisition Program Management positions and correspondingly most AFIT Graduate Systems Management (GSM) graduates are assigned to AFMC. 13 of 16 Air Force officers graduating from the AFIT GSM program in 1994 were assigned to AFMC (29:2). These facts lead to the second and third steps in identifying what to benchmark. Officers holding specialized graduate

education are the direct product of the Air Force's advanced education system. Further, the Air Force acquisition infrastructure, in particular the AFMC, represents the customers requiring these educated officers. In simple terms, the Air Force advanced education system supplies educated officers for the Air Force acquisition community.

Having identified mission, product, and customer, the final step is to determine the customer's needs. This critical stage quickly becomes complicated if Air Force and AFMC manpower, personnel and acquisition policies, AFIT curricula, and the needs of individual program offices are considered in detail. These and other factors are continually under review to ensure the AFIT program graduates properly-educated officers in appropriate strength. This study assumes the customer (the Air Force acquisition community) requires some number of competent, knowledgeable acquisition program managers qualified by experience and specialized AFIT graduate education to manage Air Force acquisition programs. Determining the right number of officers to receive this specialized education is precisely the objective of the benchmarking technique demonstrated in this research effort.

***Determine What Measures Will Be Used to Benchmark.*** Benchmarking measures are an essential element in any coherent benchmarking procedure. Correctly chosen measures are required to ensure credibility of the end results (8:45, 51; 50:81). This study concentrated on two measures deemed relevant to the Air Force project manager: possession of a graduate degree and (for those having a degree) whether the degree is in a major related to project management. Both measures would facilitate internal baseline data gathering via review of available Air Force education databases (51:83). Just as important, both measures proved suitable for collecting comparative benchmarking data on the Project Management Institute (PMI) Project Management Professional (PMP) population.

What are appropriate measures which will provide an effective benchmark? This thesis examined a variety of measures to answer this question. At a high level, this study first selected an appropriate organization and measured the ratio of the number of project managers with graduate degrees to the total number of project managers. Using this measure, the only important data point was the project manager's possession of a graduate degree, not the academic major. At a second, lower level, this research determined whether more detailed measures were required and, if so, what these detailed measures would be.

For this research to examine graduate education relevant to project management, some definition for project management-related academic curricula was required. The Air Force uses over 2,500 unique codes to specify precise educational backgrounds of officers (3). These codes are assigned to individual officers to assist Air Force officials in making informed decisions including assigning officers to specific positions based on educational background (14:1; 47).

This research effort isolated 14 academic codes judged relevant to project management based on similarity to a PMI list of project management related disciplines (given below) and applicability to Air Force project management duties. Appendix A lists these codes with full descriptions of each. The 14 project management related Air Force academic codes are:

- Systems Management (applies to non-AFIT programs)
- Contracting and Manufacturing Management
- Facilities Management
- Engineering and Environmental Management
- Engineering Management
- Construction Management
- Operations Management
- General Management
- Research and Development Management

**Systems Management - Management (AFIT program)  
Space Systems Management  
Business Administration and/or Management  
Technical Management  
Administration Management and Military Science (3)**

**PMI defines 10 academic disciplines as "project management and related fields."**

**Adding the disciplines of Management and Systems Management results in a total of 12 academic disciplines judged related to project management by PMI:**

**Management  
Systems Management  
Project Management  
Program Management  
Operations Management  
Engineering Management  
Construction Management  
Facilities Management  
Technology Management  
Energy Management  
Project Finance Management  
Risk and Decision Analysis in Projects (45:51)**

**The Air Force and PMI lists are obviously not identical. A primary reason for substantial contrast between the two lists lies in the methods used to categorize academic disciplines. The Air Force uses an elaborate categorization system detailed in Air Force Instruction (AFI) 36-2305, "Educational Classification and Coding Procedures" (14). AFI 36-2305 denotes academic specialties using four digit codes; successive digits indicate deeper levels of specialization. The lowest level is "subspecialization" denoted by the fourth digit. "Graduate study with specific research is an example of a readily identifiable subspecialization" (14: 6). The existence of over 2,500 unique academic codes provides a measure of this system's intended precision. For example, there are 13 unique subspecialties under the Industrial/Production Management specialty, including Line Supervision, Production Planning and Control, and Time and**

Motion Study (3). In contrast to the Air Force, PMI only evaluates academic disciplines to the level of academic major. This level is equivalent to the second digit of the four digit Air Force classification system (14:5).

A factor in the incidence of Air Force officers holding graduate degrees is the recognized career advancement potential of a graduate degree. Advanced education is an officially recognized criterion in Air Force officer promotion, and the percentage of officers holding a graduate degree increases with rank (17:10; 18:8). Table 3 depicts the percentage of Air Force officers with graduate degrees for ranks Second Lieutenant (O1) through Colonel (O6).

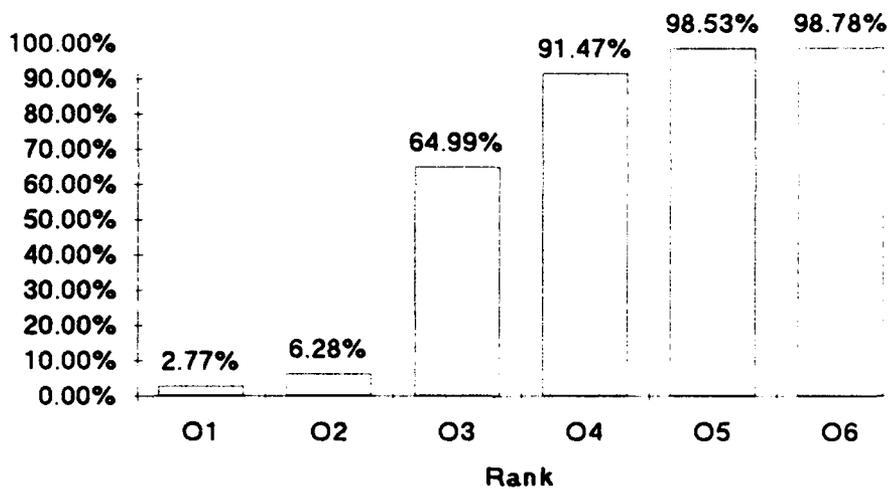


Figure 1. Percentage of Air Force Officers Holding Graduate Degrees by Rank

The benchmarking measures selected were:

1. Ratio of project managers with graduate degrees to total project managers (broad measure), and;
2. Ratio of project managers with project management related graduate degrees to total project managers (detailed measure).

***Identify Who to Benchmark.*** This step focuses on finding the best practitioners of the discipline under examination. The discipline under study here is project management.

This research involved benchmarking at two levels. The first benchmarking approach focused on 1,450 individual project managers from a variety of industries and government sectors. The common element binding these project managers was certification as Project Management Professionals (PMP's) by PMI, a professional achievement recognizing individual excellence in project management. The second thrust attempted to benchmark aerospace companies that conduct technical project management on a large scale. Identifying particular firms and gathering required data for this second area of research was significantly more involved and presented greater challenges for a number of reasons that are outlined below.

Benchmarking nominally relies on identifying best practices used in processes analogous to the process to be improved. For this research, the most direct analogy would examine organizations funding full-time graduate study for a substantial number of employees on a continuing basis. Such an approach would benchmark the process of determining how many employees should receive graduate education. A hypothetical example provides the best illustration. A company could allocate annually a fixed percentage of corporate revenues for full-time graduate study. A committee charged with assessing long term educational goals might determine the appropriate revenue percentage. To benchmark the company's education requirements process, research would examine how the committee determined this revenue percentage. The committee could poll company managers, consult outside educational experts, rely on data compiled by government and private research institutions, or choose virtually any decision support mechanism to arrive at its conclusions. Research would identify and adopt the committee's best practices, perhaps with some modification. This example

describes benchmarking against a process that directly parallels the Air Force's graduate education requirements process. Such a direct analogy is not necessarily required, however. Benchmarking can involve a broad spectrum of practices with little apparent resemblance to the internal process. Several considerations detailed below drove this effort to benchmark project manager graduate education levels rather than the processes leading project managers to attain that graduate education.

The primary reason for not benchmarking the graduate education requirements process was the lack of benchmarking partners. Very few large scale organizations have continuing programs to fund full-time, specialized graduate project management education for employees. Organizations conducting such programs in-house are even more limited in number. The Air Force is rare in this regard. The AFIT in-residence Graduate Systems Management (GSM) program constitutes an in-house accredited graduate program. The Naval Postgraduate School's M.S. in Acquisition and Contract Management is similar, designed for officers in the acquisition management field (22:34). Some sizable companies have in-house institutions granting graduate degrees. These include Motorola and General Electric. A larger number of companies cooperate with established graduate schools in programs tailored to the needs of the company. For example, American Telephone and Telegraph (AT&T) sends approximately 40 middle managers to Pace University each year to pursue an M.S. in Business (6:6). Other companies sponsor employees for non-tailored graduate degrees, and a high number of US companies provide reimbursement programs for employees to pursue graduate degrees on their own time. As the number of candidate organizations increases in each category, the categories become less analogous to AFIT's GSM program and its highly specialized, fully-sponsored, curriculum and enrollment.

A second cause for not benchmarking the graduate education requirements process was difficulty attaining useful data from private companies. For example,

preliminary telephone inquiries of a series of large companies selected by convenience revealed several companies have established policies not to participate in outside surveys. Others expressed general willingness to support this research but would not commit resources to compiling and supplying the type of data required. Ultimately only a single firm provided limited benchmarking data. This limited data consisted of rough numbers reflecting the company's current graduate education profile. Internal company data sufficient to describe any corporate requirements process would presumably be much more involved. Process related information is also more likely to be considered company proprietary. These factors make corporate process data even less readily available than simple education profiles. Appendix B documents the telephone inquiries cited here.

This thesis benchmarked the graduate education of project managers without regard to the method by which the education was earned. In other words, it examined the type of graduate degree and not how the degree was attained. The research assumed that the graduate degrees of benchmark partners represented the full spectrum of degree sources outlined above. Some degrees represented full-time study, others part-time study. Some degrees represented fully sponsored in-house programs (for example, a very small number of benchmark partners attended AFIT in-residence) while others were funded by the student. This effort did not seek to characterize degree source in any way. Instead the focus was on the implied enhancement in project management proficiency gained through a graduate degree, regardless of degree source.

***Individual Project Manager Benchmark Partners.*** The first segment to identify was a group of individual project managers. Applying the best practices criterion to this group meant distinguishing some segment of all project managers recognized as pursuing best project management practices. The goal was to identify the best project

managers, then benchmark their graduate education. The inherent subjectivity of this identification task opened up numerous possible approaches.

How does one define what makes a best project manager? Virtually any technical organization of sufficient size must recognize its best project managers in order to retain them and motivate continued project management success. "Project Manager of the Year" awards typify this category. Typical criteria focus on achieving cost, schedule and performance goals. A list of best individual project managers could be generated by surveying organizations to identify individuals who've been recognized for project management achievement. A separate survey of the identified individuals would then be required to ascertain their graduate education backgrounds. Reluctance or inability of large corporations to support this approach (as described above) made this approach infeasible.

PMI's PMP certification program was an established means of identifying individual project managers. The PMP program, begun in 1983, certifies individual attainment of project management experience and expertise. Application is voluntary and applicants must pass a written exam and hold relevant work experience to gain certification. Appendix C outlines PMP requirements. Some qualifications should be noted in selecting PMP's for benchmarking. First, this was a relatively narrow group. For an individual to be in this group, they must have applied and tested for PMP, then gained certification. As of 31 December 1993 just over 2,000 project managers had taken these steps (36). Since all three steps are voluntary, this thesis assumed the group lacked many excellent project managers who have not taken any of these steps for any reason. Second, the group reflects a cross section of disciplines much broader than the disciplines within the Air Force acquisition community. PMP's range across disciplines as diverse as construction and pharmaceuticals. Despite these qualifications

the criteria required to attain PMP status made this a highly competent group with notable dedication to excellence and professionalism in project management.

**Aerospace Company Benchmark Partners.** Identifying partners for benchmarking on a group basis was more involved than the individual-based model described above. Benchmarking on a group basis would ideally involve identifying organizations that were the best practitioners of project management. Once identified, the study would then examine graduate education of individual project managers within those organizations. This approach implies that organizations most competent at project management count among their ranks the best individual project managers. Organizational performance and competence reflect performance and competence of employees within the organization (24:12).

A fundamental question that must be answered in this approach is, What constitutes the best project management organization? This parallels the issue of defining a best individual project manager. Six potential criteria for identifying best project management organizations were examined:

1. Defense contractors recognized for project management success by the Air Force. This could include "Contractor of the Year" or comparable awards presented by the Air Force Materiel Command (AFMC).

2. Winners of the Malcolm Baldrige National Quality Award. The Baldrige Award is presented annually to organizations in recognition of outstanding success implementing quality principles (26:102).

3. Winners of the PMI Project of the Year award presented annually to recognize excellence in project management as demonstrated on a specific project. Organizations from virtually any sector of project management are eligible for this award. Winners have tended to include companies in construction and civil engineering (43:9).

4. Defense contractors demonstrating financial success measured in terms of profitability. One assumption here is that project management excellence is a significant factor in achieving corporate profitability. Successful project management involves meeting cost, schedule and performance goals that earn the contractor high award fees and incentive fees, sustain corporate growth through additional contract awards, and promote general profitability.

5. Project management organizations most dedicated to employee graduate education. This could be measured using a variety of metrics to include graduate education funding on a per employee basis, absolute funding for graduate education, or percentage of employees receiving sponsored graduate education.

6. Finally, in the absence of more rigorous approaches, organizations most willing to support this research.

This research project examined each of these six approaches and ultimately relied on the final approach. The other five proved unworkable or unreliable for a variety of reasons. The first approach (AFMC-recognized contractors) was impossible because no official award exists to single out best AFMC contractors. AFMC does not regularly recognize contractor performance excellence in any public forum. The second approach (Baldrige Award winners) did not really address project management success. The Baldrige Award focuses entirely on quality. While a Baldrige winner involved in project management would probably tend towards high proficiency in the practice of project management, there is no real direct correlation between quality implementation and project management (27:40). The third approach (PMI Project of the Year award winners) was rejected primarily because award winners were relatively small organizations with very limited numbers of project managers. This contrasts with large organizations such as major defense contractors whose scale more closely mirrors the

USAF's acquisition community. A second reason this approach was rejected was that PMI award winners have been limited mostly to construction and civil engineering firms (44:50). These represent a narrow sector of project management with significant differences from mainstream USAF project management. While the USAF does engage in construction and civil engineering efforts, these occur outside the weapon system acquisition community.

The fourth and fifth potential approaches for identifying best project management organizations both proved unmanageable due to insufficient data. The fourth approach (most profitable defense contractors) was rejected because graduate education data from identified contractors was not available. Current information existed to determine defense contractor profitability, but efforts to solicit several contractors for graduate education data failed. This methodology included contacting several Human Resources and/or Education and Training offices, outlining research intentions, and requesting assistance in gathering relevant data. This direct appeal for data proved unsuccessful. Appendix A documents the specific communications undertaken to attempt to gain corporate graduate education data. The fifth approach (organizations most dedicated to employee graduate education) suffered from the same inability to gather data as the fourth approach. The two approaches targeted the same class of organization. Once again, large firms were generally not prepared to support direct requests that would mean substantial internal effort for compiling and reporting data.

The final approach (defense contractors most willing to support this research) was the only one capable of generating data. Even this data, however, was minimal: only one of four contractors that had previously coordinated with the Air Force on similar research supplied benchmarking data to this study. The supplied data lacked detail but did address some research goals. This research attempted to take advantage of corporate benchmarking contacts established by AFIT/ENS during 1994. AFIT/ENS

cited data from four major defense aerospace contractors selected by convenience. The same four contractors were contacted to solicit project management graduate education data, and one of these four contractors provided benchmarking data for this thesis. See note in Appendix D.

**Collect Benchmark Data.** Collecting benchmark data entails developing exact investigative questions and finding their answers. The key is to ensure the investigative questions address the desired benchmark measures (8:24). This thesis included data collection in two phases.

**Internal Air Force Data.** The first major area of data collection concerned internal data on USAF project managers. This thesis defined the population of interest to be current active duty officers serving in the Air Force Acquisition Program Management (63AX) utilization field. The field encompasses three Air Force officer specialties defined by Air Force Regulation 36-1, Air Force Officer Assignments (16:A10-31/A10-35). Table 3 identifies the specialties and selected duties and responsibilities of each.

TABLE 3

AIR FORCE 63AX SPECIALTIES WITH SELECTED DUTIES AND RESPONSIBILITIES

<b>Specialty</b>	<b>Selected Duties and Responsibilities</b>
Acquisition Management Officer AFSC 63A4	"Provides overall program management. Performs as Program Manager for the acquisition of any program not meeting the definition of a major program." (16:A10-31)
Acquisition Project Officer AFSC 63A3/63A1	"Plans and manages acquisition of system, subsystem, equipment, or follow-on development or modification programs." (16:A10-33)
Computer Systems Acquisition Manager AFSC 63A3A/63A1A	"Plans, organizes, and manages systems research and development activities..." (16:A10-35)

This study used the Air Force Manpower and Personnel Center's (AFMPC) ATLAS database to collect required data. AFMPC uses ATLAS to support various manpower and personnel management functions. Three categories of data were collected for analysis:

1. Number of officers in this utilization field.
2. Number of officers in 1. above currently holding graduate degrees.
3. Type and academic major of the graduate degree for each officer in 2. above.

This thesis accessed selected ATLAS data supplied to AFIT and dated March 1994. AFMPC provides ATLAS data quarterly to support planning and analysis at AFIT. Appendix E lists ATLAS 63AX data used for this thesis.

The second category of benchmark data related to benchmark partners. This external data included individual-based data on PMI PMP's plus organizational data from a defense contractor.

**PMP Data.** PMI maintains original hardcopy PMP application packages at its headquarters in Upper Darby, PA. The packages are arranged alphabetically and date from 1983 (when the PMP certification program began) through 1993. All packages represented applicants who gained certification; failed application packages were not retained. Packages also represented professional and educational data at the time of application. Any education and experience gained since application were not reflected.

Research first involved gaining permission from PMI to review these packages. PMI generously granted permission and three conditions were agreed to: review would be done on-site at PMI, PMP applicants' anonymity would be protected by referencing

individual packages without regard to names, and PMI would receive a report of this research (36). A data entry form was developed using relational database software.

Data fields included:

1. Package identification number (sequential number assigned to each package).
2. Whether or not the applicant held a graduate degree.
3. Graduate degree type (Master of Arts, Master of Science, etc.). Numerical codes were assigned to represent common degree types.
4. Academic major (Systems Management, Operations Management, etc.). The PMI defined a list of 10 academic majors relevant to project management. Numerical codes were assigned to represent these project management related majors, plus several other common majors.
5. Field to identify academic majors not listed in 4. above.
6. Market sector in which the applicant was employed. Numerical codes were assigned to Special Interest Groups (SIG's) identified by PMI to address sector-specific issues in project management. Appendix F lists the categories and assigned numerical codes referenced in items 3., 4., and 6. above.

This study reviewed 1,450 applications at PMI in May 1994. Some application packages lacked complete data due to changes made in the application over time and failure by some applicants to provide certain information. Incomplete data was indicated with codes for "none given." Appendix G lists PMP data collected for this thesis.

The sample of 1,450 PMP applications reviewed represented 71.96% of the 2,015 alphabetically arranged applications on file at PMI. Review started at the alphabetical beginning and proceeded sequentially through the 1,450th file. This

technique sampled files on a nonprobability representation basis; some files did not have a nonzero chance of being reviewed. Drawing each sample element individually from the population at large represented unrestricted element selection. Cooper and Emory use these two sampling characteristics to define a convenience sampling design (11:244).

The alphabetical arrangement of the 2,015 PMP application packages permitted use of a convenience sampling design. Of the six data fields described above for characterizing individual PMP graduate education profiles, fields 2. through 6. represent nominal (nonnumerical) education and market sector attributes. Field 1. is simply a sequential file number. An individual PMP's alphabetical placement within the PMP population is assumed to have no impact on that individual's educational or market sector attributes. In other words, a PMP named "Baker" has the same probability of holding a graduate degree as a PMP named "Smith."

***Aerospace Company Data.*** The second focus of external data collection dealt with project managers at four defense aerospace contractors. This study involved requesting three pieces of data from each company:

1. The number of employees currently classed as project managers. Each company was given this study's general definition for a project manager. A project manager was defined here as an individual responsible for cost, schedule and performance of any technical system or subsystem. In the single case where a contractor did provide benchmark data, the company used this definition for guidance but ultimately relied on existing personnel codes to distinguish project managers from other positions.

2. The number of project managers currently holding graduate degrees.
3. Degree type and academic major for the degree holders in 2. above.

Only one company provided corporate benchmark data in response to these requests.

**Analyze Data.** PMP data was collected and entered into a database in the following fields:

ID  
Graduate Degree  
Degree Type  
Major  
Other Major  
Market Sector

The "ID" field was a counter to identify the different records. The "Graduate Degree", "Degree Type" and "Major" fields were used as measures to benchmark the data collected from the Air Force against PMP's. The database was queried to count the number of records in the "Graduate Degree" field. This query provided the number of project managers with graduate degrees. Next, the database was used to find the number of "Majors" characterized as project management related degrees. These data were used to identify the number of project managers with project management related degrees. The total count in the "ID" field was used as the denominator representing the total number of project managers. Similar data manipulations were repeated for PMI data. Under the "Market Sector" field, data were collected for those PMP's employed by defense or aerospace related organizations. This item was used to break out Defense/Aerospace PMP's from other PMP's.

From the ratios calculated as outlined above, two bar charts were developed. The first included four bars displaying the percentage of project managers holding graduate degrees for the Air Force, all PMP's, Defense/Aerospace PMP's and the

corporate partner. The second bar chart included three bars and displayed the percentage of project managers with graduate degrees in project management for the Air Force, all PMP's, and Defense/Aerospace PMP's.

## *IV. Results and Conclusions*

### *Results*

**Overview.** This chapter addresses the three primary research objectives identified in chapter one by means of an analysis of the collected benchmarking data and graphical presentation of the results. Analysis and results are then used to draw conclusions about this benchmarking effort, identify notable limitations of benchmarking research, and recommend future benchmarking efforts in the graduate education requirements area.

**Air Force Project Manager Profile.** There were 2,814 Air Force officers serving in the 63AX utilization field as of March, 1994. These 2,814 individuals constitute the Air Force Acquisition Program Management corps. Officers holding any graduate degree accounted for 1,853 or 65.85% of the population. Officers holding project management related graduate degrees accounted for 986 or 53.21% of the population. Officers holding the 1ASY Advanced Academic Degree (AAD) code representing Air Force Institute of Technology (AFIT) Graduate Systems Management (GSM) program graduates numbered 166 or 5.90% of the population. 1ASY officers hold the Master of Science in Systems Management degree from AFIT. Figure 2 shows percentages of 63AX officers with any graduate degree, project management relevant graduate degrees, and the AFIT Systems Management degree.

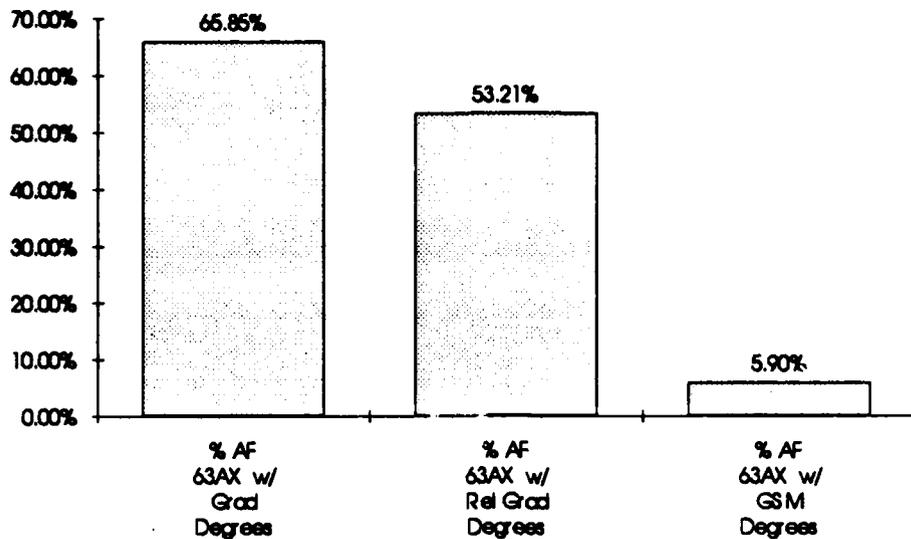


Figure 2. Percentage of Air Force 63AX Officers with any Graduate Degrees, Project Management Relevant Graduate Degrees, and AFIT Systems Management (GSM) Graduate Degrees

**Project Management Professional (PMP) Profile.** There were 2,015 PMP's as of December, 1993. Of the 1,450 records reviewed, 717 or 49.45% held graduate degrees. PMP's holding project management related graduate degrees accounted for 89 or 12.41% of the sample. Figure 3 depicts these two percentages.

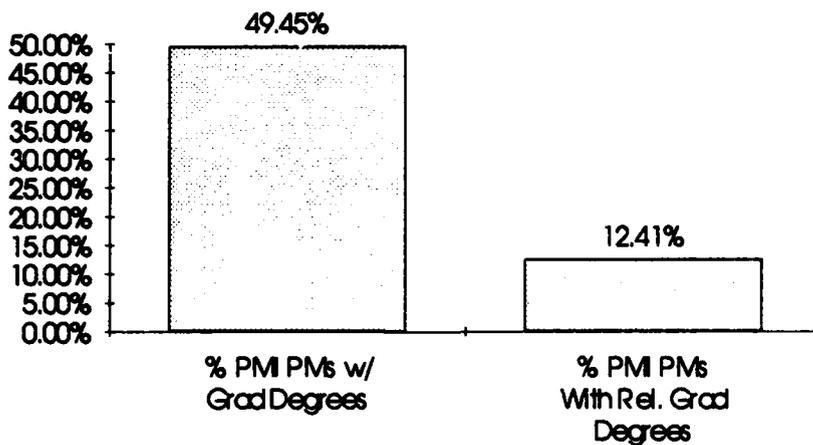


Figure 3. Percentage of PMI PMP's with any Graduate Degrees and Project Management Relevant Graduate Degrees

PMP's working in the Defense/Aerospace industry numbered 230 or 15.86% of the 1,450 sampled. These PMP's were identified by the PMI Defense/Aerospace Special Interest Group (SIG). Within this subset of 230, 166 or 72.18% held graduate degrees. Within the same subset, 31 or 18.67% held project management related graduate degrees. Figure 4 shows percentages of Defense/Aerospace PMP's with graduate degrees and project management related graduate degrees.

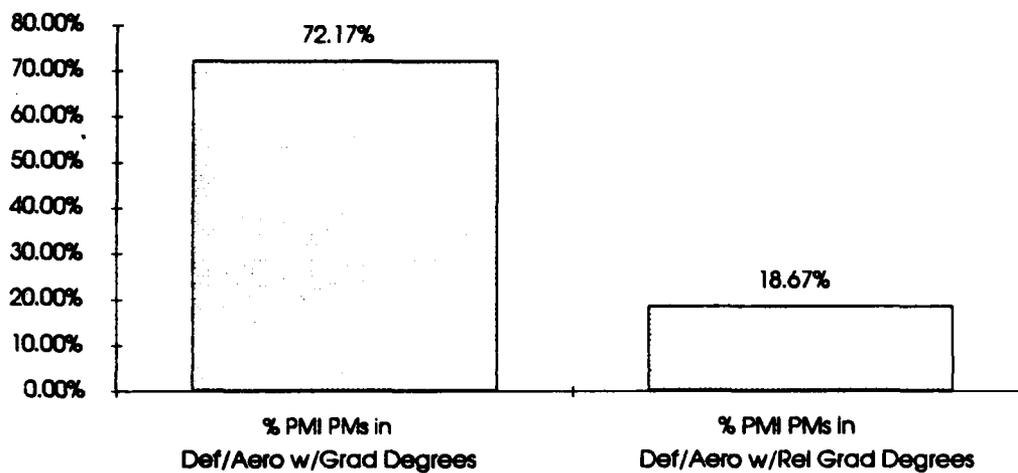


Figure 4. Percentage of Defense/Aerospace PMP's with any Graduate Degrees and Project Management Relevant Graduate Degrees

A technique to determine a large sample confidence interval for a population proportion was used to calculate 99% confidence intervals for PMP data because review of the full PMP population was not possible (23:268, 269). Results are summarized below in table 4 and calculations are given in Appendix H.

**TABLE 4**  
**SUMMARY OF POPULATION PROPORTIONS FOR PMP DATA**

<b>Category</b>	<b>Observed Proportion</b>	<b>99% Confidence Interval</b>
<b>PMP with Graduate Degrees</b>	<b>49.45%</b>	<b>46.1% to 52.8%</b>
<b>PMP with Relevant Graduate Degrees</b>	<b>12.41%</b>	<b>10% to 14.8%</b>
<b>PMP in Defense/Aerospace with Graduate Degrees</b>	<b>72.18%</b>	<b>61.9% to 82.4%</b>
<b>PMP in Defense/Aerospace with Relevant Graduate Degrees</b>	<b>18.57%</b>	<b>12.5% to 24.8%</b>

***Defense Aerospace Company Profile.*** Data on commercial project manager graduate education was extremely limited as described in chapter three. A single major defense aerospace company did respond but only provided limited data. The company provided percentages but declined to provide the absolute numbers to support the percentages, or any other supporting data, so the percentages could not be verified. The company identified 0.9% of its employees as project managers. Of the project managers, 55% were identified as holding graduate degrees. Of those holding graduate degrees, 43% of those hold degrees in engineering or scientific disciplines and 57% hold degrees in business or management related disciplines. The company provided no further information on the precision of these data or the exact nature of the graduate degrees held.

Figure 5 includes the percentage of this aerospace firm's project managers holding graduate degrees. Because of the inexact nature of supplied data, this study did not attempt to isolate the percentage of this population holding project management related graduate degrees.

**Comparison of Air Force 63AX and Benchmark Partner Profiles.** Figure 5 shows the percentages of project managers with graduate degrees for Air Force 63AX officers and the three benchmarking partners discussed above.

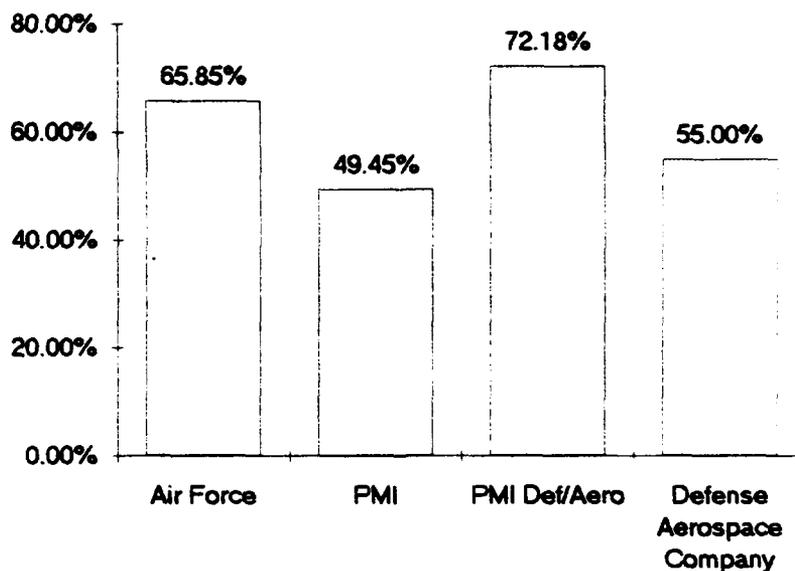


Figure 5. Percentage of Project Managers with any Graduate Degrees

The four percentages in Figure 5 form a relatively small range, from a minimum of 49.45% for all PMP's to a maximum of 72.18% for Defense/Aerospace PMP's. Expressed differently, the range represents approximately five of ten PMP's and seven of ten Defense/Aerospace PMP's holding some type of graduate degree. The Air Force percentage (65.85%) falls in the higher end of this range. A higher percentage of Air Force 63AX officers than PMP's or industry partner project managers hold graduate degrees, while a greater percentage of Defense/Aerospace PMP's than Air Force 63AX officers hold graduate degrees. In terms of graduate education without regard to academic discipline, the Air Force 63AX corps is slightly more educated than all PMP's or industry partner project managers, and slightly less educated than Defense/Aerospace PMP's.

A second, more pertinent basis of comparison between graduate education profiles was made using project management related graduate degrees. This basis assumed project management related education is more valuable to the project manager (and, in turn, the project manager's employer) because of its inherent applicability to the project management career field. Figure 6 shows the percentage of individuals with project management related graduate degrees for Air Force 63AX's, all PMP's and Defense/Aerospace PMP's. The Air Force percentage is much higher than those of the two benchmarking partners.

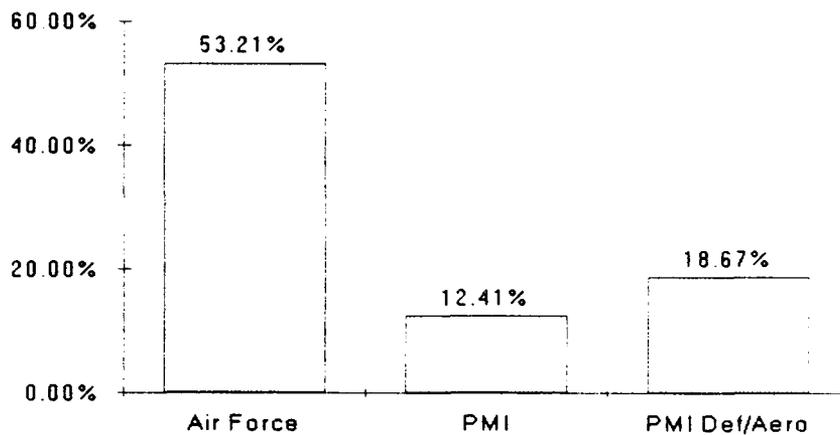


Figure 6. Percentage of Project Managers with Relevant Graduate Degrees

Education profile comparison using this second basis is the nominal source of objective percentages for AFIT project management education. Compared to all PMP's and Defense/Aerospace PMP's, the Air Force Acquisition Program Management corps is currently far ahead in terms of project management related education. The percentage of Air Force 63AX officers with relevant graduate degrees is approximately 4.4 times that of all PMP's and 2.9 times that of Defense/Aerospace PMP's. What

conclusions can be drawn from the performance gaps identified by this benchmarking effort? The following section discusses limitations on drawing firm conclusions from the preceding data and results.

### *Conclusions*

Unequivocal objective percentages for Air Force graduate education cannot reasonably be drawn based on the results presented above. Objective percentages (goals for the percentages of officers receiving specialized graduate education) are the ultimate output intended for this benchmarking technique. Benchmarking results developed in this study cannot by themselves support conclusions about the direction the Air Force should take concerning the number of officers needing graduate education in program management. The major conclusion that can be drawn is that the Air Force currently has a certain percentage of project managers with a specific graduate education profile, and selected benchmarking partners have their own unique profiles. A series of significant limitations helps explain the inconclusiveness of this interpretation.

***Benchmarking Measures - Limitations.*** Selection of benchmarking measures for study was influenced by the HQ USAF-mandated AFIT team reviewing graduate education requirements discussed in chapter one. A major challenge was to determine what metric to use to compare the Air Force graduate education profile with those of private industry or other benchmarking partners. To reiterate Camp, the benchmarking measure should be a true indicator of the process performance and should be capable of reflecting changes in the existing process or system (8:51, 47). The basic measure used in this benchmarking effort mirrored the measure chosen for AFIT's Department of Operational Sciences (AFIT/ENS) study. A fundamental question regarding this

measure (the percentage of 63AX officers with graduate degrees or relevant graduate degrees) is whether it meets either of Camp's requirements.

First, is this measure a true indicator of the process performance? Chapter one clearly explained that the selected measure compares where the Air Force stands relative to benchmarking partners but does not indicate anything about the process performance. That is, no information is available about the processes leading to the relative standings or whether the graduate education process is even a consideration. There is also no indication that this measure is used by either the Air Force or selected partners to evaluate the desirability of attaining a given level of project managers with graduate degrees. This measure suffers because there is no evidence it is an indicator, accurate or not, of the process of determining how many project managers should have graduate degrees.

Secondly, is the data obtained using this measure capable of quantifying effects of changing the current graduate education requirements process? It does not appear to be. The measure can quantify the position of the Air Force relative to benchmarking partners but offers no concrete information on the effects of change. Would a change improve efficiency or effectiveness? Would a change make the Air Force better or worse? Would the Air Force be saving money by making a change? None of these questions can be answered with this measure and every one of these questions would be of critical concern to a private sector organization.

**Who To Benchmark - Limitations.** Determining who to benchmark for this research relied on principles of generic benchmarking. Internal benchmarking was not conducted in that the Air Force project manager population was not compared to other Air Force or Department of Defense (DOD) populations. Competitive benchmarking was

not conducted because as Vaziri points out, public service organizations such as the Air Force typically do not have direct competitors (51:83). Functional benchmarking, strictly interpreted, requires the comparison of functions or processes. No true process was investigated in this study. Instead, a picture of how the Air Force 63AX graduate education profile compares to benchmarking partners was developed.

If the goal of deciding who to benchmark in generic benchmarking is to pick industry leaders or organizations exhibiting best practices, as Camp's working definition would suggest, the first requirement of this research would be to identify conclusively the industry leader in project management or the practitioner of best project management practices (8:135). This is a difficult task. What approach can determine best project management organizations? Chapter three outlined restrictions of several possible approaches. There is no single established definition of what makes an organization the best at project management. PMI did provide benchmarking data for a project manager population of recognized competence. However, attempts to gather data for contractors meeting various best project management criteria were futile with but one exception.

What are the consequences of resorting to convenience or only to organizations willing to respond with data? By not guaranteeing the best organizations, or at least organizations that have been qualified by some criteria as superior to the benchmarking organization, the researcher loses the ability to conclude that a change to match the benchmarking partner's process is warranted. If there is no criterion demonstrating that the benchmarking partner's processes are better than the researcher's, the only thing that can be identified is a performance gap. Such data will not support a conclusion regarding the correctness or superiority of either process. In this benchmarking effort

there were no criteria clearly demonstrating that PMP's or the participating aerospace contractor exhibit absolute best project management practices or even that their project management practices are better than Air Force practices. Therefore, when performance gaps were identified, no conclusion could be drawn that the Air Force should change the number of officers getting specialized graduate degrees to match the benchmarking partners. Why should the Air Force change when the possibility exists that its methods are as good as, or better than, the benchmarking partners? Once again, the best conclusion that can be drawn is that Air Force 63AX's are at one level and the benchmarking partners are at another.

**Unavailability of Data.** A serious impediment experienced in this study was difficulty gaining data from anticipated benchmark partners within industry. Chapter three detailed the unwillingness or inability of all but one of 13 companies to provide data answering this study's request. Typical reasons given for not cooperating appeared to be based on sound reasoning rather than rash decisions not to support the thesis. Many companies cited a reluctance to expend manpower to gather, organize and provide the requisite data based solely on a request from this study's researchers. While some firms appeared to have relatively easy access to the benchmark data, many would have required internal surveys, collating, or other time-intensive efforts by company personnel. Another major reason given for not responding was the proprietary nature of requested data. Some companies did not wish to make the requested data available to outside organizations as a matter of policy. Difficulty gaining adequate benchmark data sharply reduced the intended scope and detail of this study.

**Lack of Trend Analysis.** Another limitation of this benchmarking technique is the fact that all data references a single point in time. It is not possible to determine trends with this data. Graduate education profiles of the populations in this thesis may vary over time; single point data does not allow study of this phenomenon. Thus, the

technique does not address whether graduate education profiles are strengthening, weakening, or stable. For example, 65.85% of Air Force project managers currently hold graduate degrees compared to 49.45% of PMPs. If PMP's were considered the best in industry, the Air Force could conceivably conclude that the percentage of project managers with graduate degrees can be allowed to drop to a level commensurate with PMPs' lower percentage, only to discover that PMP education levels are rapidly increasing. The wrong decision would be made because Air Force decision makers lack trend data. Time-based data would provide a more comprehensive picture of the education profiles.

***Maturation of the Air Force.*** Another variable with implications that may confound the results of this study is the increase in the percentage of Air Force officers holding graduate degrees as they advance in rank. Figure 1 (page 36) clearly shows that the proportion of officers holding a graduate degree increases as officers progress through the ranks. Although similar data for industry project managers was not collected, it can be assumed that graduate education levels also increase for industry project managers as they advance in seniority. Accounting for this maturation effect would contribute to the benchmarking technique.

***Dependency on Underlying Assumptions and Subjectivity.*** Figure 6 (page 56) shows that compared to all PMP's and Defense/Aerospace PMP's, the Air Force 63AX corps is currently far ahead in terms of project management related education. The percentage of Air Force 63AX officers holding relevant graduate degrees is approximately 2.9 times that of Defense/Aerospace PMP's. Using the latter benchmark partner, a variety of preliminary conclusions could be drawn depending on the assumptions chosen. Table 5 outlines some potential conclusions and their underlying assumptions.

TABLE 5

POTENTIAL CONCLUSIONS WITH CORRESPONDING ASSUMPTIONS

Potential Conclusions	Assumptions
<p>1. Decrease percentage of Air Force 63AX's receiving specialized graduate education.</p>	<ul style="list-style-type: none"> <li>- Defense/Aerospace PMP's represent the ideal (correct) level of specialized graduate education.</li> <li>- Air Force 63AX corps is currently overeducated.</li> <li>- Air Force would be able to perform project management as well as Defense/Aerospace PMP's with fewer project managers receiving specialized graduate education. Non-academic strengths of Air Force 63AX corps would make up for decreased Air Force graduate education.</li> </ul>
<p>2. Maintain current percentage of Air Force 63AX's receiving specialized graduate education.</p>	<ul style="list-style-type: none"> <li>- A greater percentage of Air Force 63AX's than Defense/Aerospace PMP's require specialized graduate education due to different job requirements.</li> </ul>
<p>3. Increase percentage of Air Force 63AX's receiving specialized graduate education.</p>	<ul style="list-style-type: none"> <li>- Significant downsizing of Air Force manpower will require accomplishing more with less personnel. This demand for efficiency will place added importance on the education, knowledge and competence of remaining personnel. (Note: this is a commonly expressed sentiment in the current military environment. The commander of the USAF Air Education and Training Command (AETC) remarked in 1994, "if our Air Force of the future is going to be half the size it was, we're all going to have to be twice as smart" (7:69; 25:38).</li> <li>- Increasing percentage of Air Force 63AX corps with specialized graduate education will make 63AX corps better equipped for additional challenges facing individual officers.</li> </ul>

Table 5 helps illustrate the wide range of objective percentages which could be derived from the above data. This variety of conclusions and assumptions in turn illustrates the subjective nature of benchmarking applied to the education requirements task. Policy changes will ultimately contain subjective elements which depend on the background, inclinations, and interests of Air Force education policy makers.

### *Recommendations*

Limitations experienced in this thesis do not detract from the its utility as a means of understanding the benchmarking process applied to graduate education. Lessons outlined above lead to the follow recommendations for further benchmarking study.

***Pursue Benchmarking as a GEMS Substitute.*** This thesis recommends benchmarking be pursued as a possible alternative to the existing Graduate Education Management System (GEMS) approach to determining graduate education requirements. Results demonstrated in rigorous application of mature benchmarking techniques, as referenced in benchmarking literature, make benchmarking a viable candidate for developing education requirements. The technique developed and implemented in this thesis may provide some detailed foundation for further Air Force efforts.

***Secure Senior Air Force Support.*** Successful, comprehensive benchmarking of Air Force graduate education requirements will depend on high level Air Force commitment and support. This support is particularly vital to gaining pertinent data from benchmark partners in industry. Senior Air Force involvement will probably generate interest in the private sector. Data-gathering difficulties experienced in this research should be reduced. Complete data may have to involve funding benchmarking

consultants to assist in this effort. Industry often relies on experienced consultants for benchmarking support. Funding may also be required to purchase data from benchmarking partners unwilling to provide free data. Senior leadership intervention may also persuade some firms to make available data currently considered proprietary.

***Develop Rigorous Best Practices Criteria.*** Additional benchmarking research should emphasize development of rigorous criteria to identify what makes a potential benchmarking partner the best in industry or a project management leader. It is imperative to select as benchmarking partners organizations clearly superior to the benchmarking organization.

***Use Trend Data.*** Future benchmarking efforts should examine graduate education trends. Trend data will allow the researcher to identify and measure shifts in graduate education profiles. Objective percentages should then account for shifts if they exist.

***Develop Factors Bridging Benchmark Percentages with Objective Percentages.*** Research should be directed at developing numerical factors to generate objective percentages from the type of simple benchmark percentages presented in this study. The limitations outlined above demonstrate that benchmark percentages alone cannot dictate meaningful objective percentages. A simple one-to-one correspondence does not exist. Factors such as maturation of the Air Force must be allowed for and specified. A hypothetical example illustrates the risks of neglecting this principle.

Analysis of an external benchmarking partner reveals that 50% of the project managers employed by the partner hold relevant graduate degrees. Internal Air Force data shows that 20% of Air Force project managers hold relevant graduate degrees. Ignoring any other differences between the two populations, the Air Force automatically

selects 50% as the goal necessary to match the partner's performance. The benchmark percentage also defines the objective percentage.

This thesis demonstrated the fallacy of such a simplistic approach. Any credible benchmarking study of graduate education requirements must explicitly recognize and account for complicating factors. The ideal model would account for these factors numerically. For example, educational maturation of Air Force officers would be expressed as a function of officer seniority. First Lieutenants might compare directly with external benchmarking partners while Majors would require some adjustment to allow accurate comparison with their partners, because a very high percentage of Majors hold graduate degrees. Numerical factors would help provide a "level playing field" for comparing inherently different populations. Research to develop these factors should begin with the limitations described in this study and seek any additional factors which influence benchmarking conclusions.

Appendix A: Project Management Related Air Force Advanced Academic Degree (AAD) Codes

0YKY	<b>Systems Management:</b> A study of the managerial coordination and integration of all the inputs to engineering systems, as practiced in Air Force System Program Offices.
1ACC	<b>Contracting and Manufacturing Management:</b> Provides the knowledge and skills necessary to specify, evaluate and manage the human, financial, material, and contractual resources. Graduates will be middle and upper level managers in the contracting management career field.
1AGA	<b>Facilities Management:</b> A study of the concepts of scientific management and the application of management science to the allocation of human, financial, material and contractual resources necessary for efficient operations of manufacturing, logistics, operations and other facilities.
1AGE	<b>Engineering and Environmental Management:</b> The study of management policy issues relative to environment and decision making process at all levels of government. Comparisons are made between political, economic, social, and technological policy alternatives. Emphasis is placed on the application of policy analysis in environmental assessment and evaluation of complex environmental issues.
1AGY	<b>Engineering Management:</b> A study of the philosophy, methods, and principles of the efficient management of engineering functions.
1AJF	<b>Construction Management:</b> A degree program which emphasizes knowledge of the construction process as a developer, contractor, owner, or operator of the built environment.
1AJG	<b>Operations Management:</b> A study of the acquisition of practical knowledge in the area of project planning, quality assurance, safety management, inventory techniques, legal considerations, and human factor analysis.
1AJY	<b>General Management:</b> A study of the formulation of general operating policies within which a management group will function in the operation of a business.
1APY	<b>Research and Development Management:</b> A study of processes, operations and techniques of science and technology as applied to the creation of products, processes, and services which may benefit an enterprise.
1ASY	<b>Systems Management - Management:</b> A study of the managerial coordination and integration of all the inputs to engineering systems, as practiced in Air Force System Project Offices.

1AVS	<b>Space Systems Management:</b> A study of terminologies, operations, ecology, theory and history related to the management of various space systems. The graduate of this program has broad knowledge in the areas of space communications, space law and the man/machine interface in the space environment.
1AYY	<b>Business Administration and/or Management:</b> A study of the application of management principles to business organizations, with emphasis on techniques, procedures, and processes required in the leadership of personnel, the logistic planning for materials, and the administration of funds.
1CAK	<b>Technical Management:</b> A study of scientific and engineering principles, maintenance practices and procedures, manufacturing processes, marketing techniques, and management principles, concepts, and systems associated with the supervision of activities engaged in the maintenance, overhaul, testing, manufacture, or sale of mechanical/electrical systems and equipment; stresses the development of both technical and supervisory knowledge and skills.
1YYY	<b>Administration Management and Military Science:</b> A study of organizing, planning, coordinating, controlling, and directing an enterprise with the aim of reaching a stated objective by means of a coordinated effort.

Ref: 3

**Appendix B: Record of Preliminary Telephone Inquiries to Determine Availability of Benchmark Data**

<b>Name Position</b>	<b>Date</b>	<b>Company</b>	<b>Reason(s) given for data inavailability</b>
Robert Kenneth Manager, Total Quality Programs	11 April 1994	Ames Rubber Co.	- Company does not perform project management on large scale basis - No significant project manager population
Marilyn Kapel Human Resources Manager	14 April 1994	AT&T Network Systems Group	- Company not willing to expend resources required to gather data
Beth Basco Training and Consulting Officer	11 April 1994	Chevron Corp. San Francisco, CA	- Specific reason not given
Charles A. Gibson Personnel Manager	13 April 1994	Eastman Chemical Co.	- Company not willing to expend resources required to gather data
Ann Dimisa Director, Human Resources	11 April 1994	Martin Marietta Corp. Washington, DC	- Company not willing to expend resources required to gather data
Pam Butler Human Resources Manager	12 April 1994	Tenneco Corp. Houston, TX	- Company not willing to expend resources required to gather data
Art Lacey Human Resources Manager	13 April 1994	Texas Instruments Corp. Dallas, TX	- Specific reason not given
(Name not recorded)	11 April 1994	Loral Corp.	- Company does not participate in surveys
Matt Chudy Employee Administrative Services Officer	11 April 1994	Xerox Corp. Rochester, NY	- Data not readily available in personnel database

**Appendix C: Program Management Professional (PMP) Certification Requirements**

**Qualifying In The Area Of Education**

Minimum credit points = 5

Maximum credit points = 55

**Points**

- 5 High School Diploma or Equivalent
- 5 Per Year college/Technical School (Maximum of 3 years)
- 15 Bachelor's Degree
- 10 Master's Degree
- 10 Terminal Degree (Ph.D., Ed.D., D.B.A., etc.)
- 5 Section Certificates (Example: Certified Civil Engineer) (Maximum of 10 points)
- 1 4 CEUs (Continuing Education Courses: 4 CEUs equal 40 classroom hours)

Maximum of 15 points allowed

**Qualifying In The Area Of Experience**

**Points**

- 4 Per Year Specialist or Senior Specialist
- 5 Per Year Supervisor (3 or More Professionals)
- 7 Per Year Manager (3 or More Professionals)
- 10 Per Year Assistant Project Manager
- 15 Per Year Project Manager/PM Consultant
- 15 Per Year Executive
- 5 Per Year Teaching (Educator) (Maximum of 20 Points)

## **Qualifying In The Area Of Service**

### **Points**

- 1 Per Year PMI/Other Professional Organization Member

#### **International Activity:**

- 5 PMI or Other Organization Founder
- 3 International Organization Officer
- 2 Per Year on International Committee/Appointed Position/Seminar Attendance/Other Professional Organization

#### **Chapter Activity:**

- 1 Chapter Member
- 1 For Each Year Attendance up to 50%
- 2 For Each Year Attendance Over 50%
- 3 Each Chapter Founder
- 1 Per Year Chapter Officer

#### **Other Activity:**

- 5 For Each Workshop/Seminar/Program (Leader, Speaker or Committee Involvement)
- 5 For Each Published Paper in the Project management Field
- 3 Each PMI Award/Other Professional Award

**Appendix D: Record of Telephone Inquiries to Defense Aerospace Contractors to Request Benchmark Data**

<b>Name Position</b>	<b>Date</b>	<b>Company</b>	<b>Reason(s) given for not responding</b>
Dennis Corbly Human Resources Manager	19 May 1994	General Electric Corp. Jet Engine Division Cincinnati, OH	- Data not readily available in personnel database - Company not willing to expend resources required to gather data
Joe Jaskowski	25 May 1994	Grumman Corp. Bethpage, NY	- Data not maintained in any database - Company not willing to expend resources required to gather data
Mark Mispagel Compensation Specialist	14 June 1994	Note: this contractor provided data but did not give permission to identify the company in this thesis. The contractor is not named here to preserve anonymity.	(Provided limited data)
Bob Smith Public Relations Officer	7 June 1994	Boeing Aircraft Co. Seattle, WA	Requested data is company proprietary (see correspondence next page)

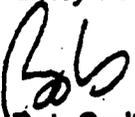
June 7, 1994

To: Capt. William D. Beatty  
(513)476-7988  
Air Force Institute of Technology

Subject: Program Manager Data

I'm afraid I don't have good news to pass along to you. Our Human Resources people have concluded they would rather not pass along any information on the number of program managers Boeing has at work. They believe it to be company proprietary information.

Sorry I couldn't be of more assistance.

  
Bob Smith  
Public Relations  
(206) 773-0983  
(206) 773-3900 (fax)







**Appendix E: Atlas 63AX Data**

<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>	<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>	<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>
1AKY	N	63A3	02	4JYY	N	63A3	02	6YYY	N	63A1	02
1ANY	N	63A1	02	4JYY	N	63A3	02	6YYY	N	63A1	02
1ANY	N	63A3	02	4JYY	N	63A3	02	6YYY	N	63A3	02
1ANY	N	63A1	02	4JYY	N	63A3	02	6YYY	N	63A1	02
1AOY	P	63A3	02	4JYY	N	63A1	02	6YYY	N	63A3	02
1ASY	O	63A3	02	4JYY	N	63A1	02	6YYY	N	63A1	02
1AVY	N	63A3	02	4JYY	N	63A1	02	6YYY	N	63A3	02
1AVY	N	63A3	02	4KAB	N	63A3	02	6YYY	N	63A3	02
1AYY	P	63A3	02	4KAB	N	63A1	02	6YYY	N	63A3	02
1AYY	N	63A1	02	4KAB	N	63A1	02	6YYY	N	63A3	02
1AYY	N	63A1	02	4KAB	N	63A1	02	6YYY	N	63A3	02
1AYY	N	63A3	02	4KAB	N	63A1	02	6YYY	N	63A3	02
1AYY	N	63A3	02	4KDY	N	63A1	02	6YYY	N	63A3	02
1AYY	N	63A3	02	4LYY	N	63A1	02	6YYY	N	63A3	02
1AYY	N	63A3	02	4LYY	N	63A1	02	6YYY	N	63A3	02
1AYY	N	63A3	02	4LYY	N	63A3	02	6YYY	N	63A3	02
1AYY	N	63A3	02	4LYY	N	63A3	02	6YYY	N	63A3	02
1AYY	N	63A3	02	4MYY	N	63A3	02	6YYY	N	63A1	02
1AYY	P	63A1	02	4MYY	N	63A1	02	6YYY	N	63A1	02
1AYY	P	63A3	02	4MYY	N	63A1	02	6YYY	N	63A1	02
1AYY	P	63A3	02	4MYY	N	63A1	02	6YYY	N	63A1	02
1AYY	N	63A1	02	4MYY	N	63A1	02	6YYY	N	63A3	02
1AYY	N	63A3	02	4MYY	N	63A3	02	6YYY	N	63A3	02
1AYY	P	63A3	02	4MYY	N	63A3	02	8CYY	N	63A3	02
1AYY	P	63A3	02	4MYY	N	63A3	02	8CYY	N	63A1	02
1BBA	N	63A1	02	4MYY	N	63A3	02	8GYY	N	63A1	02
2EYY	N	63A1	02	4MYY	N	63A3	02	8HYY	N	63A1	02
2FDY	N	63A1	02	4MYY	N	63A1	02	9BFA	N	63A3	02
3BHY	N	63A1	02	4NYY	N	63A3B	02	9BYY	N	63A3	02
4AYY	N	63A3	02	4VCY	N	63A3	02	9BYY	N	63A3	02
4AYY	N	63A3	02	4VCY	N	63A3	02	9BYY	N	63A3	02
4AYY	N	63A1	02	4VCY	O	63A3B	02	9BYY	N	63A3	02
4AYY	N	63A3	02	4VJB	N	63A1B	02	9BYY	N	63A1	02
4AYY	N	63A1	02	4VQY	N	63A3B	02	9BYY	N	63A1	02
4AYY	N	63A1	02	4VQY	N	63A3	02	9BYY	N	63A1	02
4BYY	N	63A3	02	4VYY	N	63A3	02	9BYY	N	63A3	02
4BYY	N	63A3	02	4VYY	N	63A3	02	9BYY	N	63A3	02
4BYY	N	63A3	02	4VYY	N	63A3	02	9BYY	N	63A3	02
4BYY	N	63A1	02	4VYY	N	63A3	02	9BYY	N	63A3	02
4BYY	N	63A3	02	4VYY	N	63A3	02	9BYY	N	63A3	02
4BYY	N	63A3	02	4VYY	N	63A1	02	9BYY	N	63A1	02
4BYY	N	63A3	02	4VYY	N	63A1	02	9EYY	N	63A3	02
4BYY	N	63A3	02	4VYY	N	63A1	02	9EYY	N	63A1	02
4BYY	N	63A3	02	4WYY	N	63A1	02	9EYY	N	63A1	02
4BYY	N	63A3	02	6YYY	N	63A3	02	9EYY	N	63A1	02
4HBB	N	63A3	02	6YYY	N	63A3	02	9EYY	N	63A1	02
4HYY	N	63A3	02	6YYY	N	63A3	02	9EYY	N	63A1	02
4HYY	N	63A3	02	6YYY	N	63A3	02	9FEF	N	63A3	02
4HYY	N	63A3	02	6YYY	N	63A3	02	9FFB	N	63A1	02
4IYY	N	63A1	02	6YYY	N	63A3	02	9FYY	N	63A3	02
4IYY	N	63A3	02	6YYY	N	63A3	02	9FYY	N	63A3	02
4IYY	N	63A3	02	6YYY	N	63A3	02	9FYY	N	63A3	02
4IYY	N	63A1	02	6YYY	N	63A3	02	9FYY	N	63A1	02
4IYY	N	63A1	02	6YYY	N	63A1	02	9FYY	N	63A1	02
4IYY	N	63A3	02	6YYY	N	63A1	02	9FYY	N	63A1	02

**Appendix E: Atlas 63AX Data**

<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>	<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>	<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>
9GYY	P	63A3	02	0YKY	P	63A3	03	1ACA	O	63A4	03
9GYY	P	63A1	02	0YKY	P	63A3	03	1ACA	P	63A3	03
0CAY	N	63A3	03	0YKY	P	63A3	03	1ACA	P	63A3	03
0CAY	N	63A1	03	0YKY	P	63A3	03	1ACA	P	63A3	03
0CAY	P	63A3	03	0YKY	P	63A3	03	1ACA	P	63A3	03
0CYY	P	63A3	03	0YKY	P	63A3	03	1ACA	P	63A3	03
0CYY	N	63A1	01	0YKY	P	63A3	03	1ACA	P	63A3	03
0CYY	P	63A4	03	0YKY	P	63A4	03	1ACA	P	63A3	03
0CYY	P	63A4	04	0YKY	P	63A4	03	1ACA	P	63A3	03
0CYY	NF	63A4	03	0YKY	PF	63A4	03	1ACA	P	63A3	03
0CYY	N	63A1	02	0YKY	P	63A4	03	1ACA	P	63A3	03
0CYY	N	63A3	03	0YKY	P	63A4	03	1ACA	P	63A3	03
0CYY	N	63A3	03	0YKY	P	63A4	03	1ACA	P	63A3	03
0CYY	PP	63A4W	06	0YKY	P	63A4	03	1ACA	P	63A4	03
0GYY	N	63A3	03	0YKY	P	63A4	03	1ACA	P	63A1A	03
0GYY	N	63A3	03	0YKY	P	63A1	03	1ACA	PA	63A4	03
0GYY	N	63A3	03	0YKY	O	63A1	03	1ACY	P	63A3	03
0GYY	N	63A4	03	0YKY	P	63A1	03	1ACY	P	63A4	03
0GYY	N	63A3	03	0YKY	P	63A1	03	1ACY	P	63A1	03
0GYY	N	63A3	02	0YKY	P	63A1	03	1ACY	P	63A3	03
0GYY	N	63A3	03	0YKY	P	63A1	03	1ADY	P	63A3	03
0GYY	N	63A3	03	0YKY	P	63A1	03	1AGY	P	63A3	03
0GYY	N	63A3	03	0YKY	P	63A1	03	1AGY	P	63A3	03
0GYY	N	63A3	03	0YKY	P	63A1	03	1AGY	P	63A3	03
0GYY	N	63A3	03	0YKY	P	63A1	03	1AGY	P	63A3	03
0GYY	N	63A3	03	0YKY	P	63A1	03	1AGY	P	63A3	03
0GYY	N	63A3	03	0YKY	P	63A1	03	1AGY	P	63A3	03
0GYY	N	63A3	03	0YKY	P	63A1	03	1AGY	P	63A3	03
0GYY	N	63A3	03	0YKY	P	63A3	03	1AGY	P	63A3	03
0GYY	N	63A3	03	0YKY	O	63A3	03	1AGY	P	63A3	03
0IYY	O	63A4	03	0YKY	O	63A3	03	1AGY	P	63A3	03
0IYY	P	63A3B	03	0YKY	P	63A3	03	1AGY	P	63A3	03
0Y EY	N	63A3	03	0YKY	P	63A3	03	1AGY	P	63A3	03
0Y EY	N	63A3	03	0YKY	P	63A4	03	1AGY	P	63A3	03
0Y EY	P	63A3	03	0YKY	P	63A3	03	1AGY	P	63A3	03
0Y EY	N	63A3	03	0YKY	P	63A3	03	1AGY	P	63A3	03
0YJY	PX	63A3	03	0YKY	P	63A4	03	1AGY	P	63A3	03
0YKY	P	63A3	03	0YKY	P	63A1	03	1AGY	P	63A3	03
0YKY	P	63A3	03	0YKY	P	63A1	03	1AGY	O	63A3	03
0YKY	P	63A3	03	0YKY	P	63A4	03	1AGY	P	63A3	03
0YKY	P	63A3	03	0YKY	PN	63A4W	03	1AGY	P	63A3	03
0YKY	P	63A3	03	0YKY	P	63A3	03	1AGY	P	63A4	03
0YKY	P	63A3	03	0YLB	N	63A3	03	1AGY	P	63A3	03
0YKY	P	63A3	03	0YRY	N	63A3	03	1AGY	P	63A3	03
0YKY	P	63A3	03	0YRY	N	63A3	03	1AGY	P	63A4	03
0YKY	P	63A3	03	0YRY	N	63A1	03	1AGY	P	63A4	03
0YKY	P	63A3	03	0YRY	N	63A1	03	1AGY	P	63A4	03
0YKY	P	63A3	03	0YRY	P	63A1	03	1AGY	P	63A4	03
0YKY	P	63A3	03	0YSY	P	63A3	03	1AGY	P	63A1	03
0YKY	P	63A3	03	0YSY	PN	63A3W	03	1AGY	P	63A3	03
0YKY	P	63A3	03	0YTA	P	63A1	03	1AGY	P	63A3	03
0YKY	P	63A3	03	1AAY	P	63A3	03	1AGY	P	63A3	03
0YKY	P	63A3	03	1AAY	P	63A3	03	1AGY	P	63A4	03

**Appendix E: Atlas 63AX Data**

<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>	<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>	<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>
1AGY	P	63A3	03	1AJY	N	63A3	03	1AJY	O	63A1	03
1AGY	P	63A3	03	1AJY	N	63A3	03	1AJY	P	63A1	03
1AGY	P	63A3	03	1AJY	N	63A3	03	1AJY	N/P	63A1W	03
1AGY	P	63A1	03	1AJY	N	63A3	03	1AJY	P	63A3	03
1AGY	P	63A1	03	1AJY	O	63A3	03	1AJY	P	63A3	03
1AGY	P	63A1	03	1AJY	O	63A3	03	1AJY	N	63A3	03
1AGY	P	63A3	03	1AJY	N	63A4	03	1AJY	N	63A3	03
1AGY	P	63A3	03	1AJY	O	63A3	03	1AJY	N	63A3	03
1AGY	P	63A3	03	1AJY	O	63A3	03	1AJY	P	63A3	03
1AGY	P	63A3	03	1AJY	O	63A3	03	1AJY	P	63A3	03
1AGY	P	63A4	03	1AJY	O	63A3	03	1AJY	P	63A3	03
1AGY	P	63A3	03	1AJY	O	63A3	03	1AJY	P	63A3	03
1AGY	P	63A3	03	1AJY	O	63A3	03	1AJY	P	63A3	03
1AGY	P	63A3	03	1AJY	O	63A3	03	1AJY	P	63A3	03
1AGY	O	63A3	03	1AJY	N	63A3	03	1AJY	P	63A3	03
1AGY	P	63A3	03	1AJY	P	63A1	03	1AJY	P	63A3	03
1AGY	P	63A3	03	1AJY	P	63A3B	03	1AJY	P	63A3	03
1AGY	P	63A3	03	1AJY	P	63A3B	03	1AJY	P	63A3	03
1AGY	P	63A3	03	1AJY	O	63A3B	03	1AJY	P	63A3	03
1AGY	P	63A3	03	1AJY	P	63A3B	03	1AJY	P	63A3	03
1AGY	P	63A3	03	1AJY	P	63A1	03	1AJY	P	63A3	03
1AGY	P	63A3B	03	1AJY	N	63A1	03	1AJY	P	63A3	03
1AGY	O	63A4	03	1AJY	P	63A4	03	1AJY	P	63A3	03
1AGY	P	63A3	03	1AJY	P	63A1	03	1AKY	P	63A3B	03
1AGY	P	63A4	03	1AJY	P	63A4	03	1AKY	P	63A1	03
1AGY	P	63A4	03	1AJY	N	63A3	03	1AKY	P	63A3B	03
1AHY	PF	63A3	03	1AJY	N	63A3	03	1AKY	O	63A3B	03
1AHY	N	63A3	03	1AJY	N	63A3	03	1AKY	P	63A3B	03
1AHY	P	63A4	03	1AJY	P	63A3	03	1AKY	N	63A3B	03
1AHY	P	63A4	03	1AJY	P	63A3	03	1AKY	P	63A1	03
1AHY	P	63A3	03	1AJY	N	63A3	03	1AME	P	63A3	03
1AHY	P	63A3	03	1AJY	P	63A3	03	1AMH	P	63A3	03
1AHY	P	63A3	03	1AJY	P	63A3	03	1AMJ	P	63A3	03
1AHY	P	63A1	03	1AJY	P	63A3	03	1AMJ	P	63A3	03
1AHY	P	63A3	03	1AJY	P	63A3	03	1AMJ	P	63A3	03
1AHY	P	63A3	03	1AJY	P	63A3	03	1AMS	P	63A3	03
1AHY	P	63A3	03	1AJY	P	63A3	03	1AMY	P	63A3	03
1AHY	P	63A3	03	1AJY	N	63A3	03	1AMY	P	63A1	03
1AHY	P	63A3	03	1AJY	N	63A3	03	1AMY	P	63A1	03
1AHY	O	63A3	03	1AJY	N	63A3	03	1AMY	PN	63A1W	03
1AJB	P	63A3	03	1AJY	P	63A3	03	1AMY	P	63A3	03
1AJY	P	63A3	03	1AJY	P	63A3	03	1AMY	P	63A1	03
1AJY	P	63A3	03	1AJY	P	63A3	03	1ANY	P	63A3	03
1AJY	P	63A3	03	1AJY	N	63A3	03	1ANY	O	63A3	03
1AJY	P	63A3	03	1AJY	N	63A3	03	1AOC	P	63A3	03
1AJY	P	63A3	03	1AJY	N	63A3	03	1AOY	P	63A1	03
1AJY	P	63A3	03	1AJY	N	63A3	03	1AOY	O	63A3	03
1AJY	P	63A3	03	1AJY	N	63A3	03	1AOY	P	63A3B	03
1AJY	P	63A3	03	1AJY	P	63A3B	03	1AOY	P	63A3	03
1AJY	P	63A3	03	1AJY	PP	63A3W	03	1AOY	P	63A3	03
1AJY	P	63A1	03	1AJY	N	63A3	03	1AOY	P	63A4W	03

**Appendix E: Atlas 63AX Data**

<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>	<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>	<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>
1AOY	P	63A3	03	1ASY	P	63A3	03	1ASY	P	63A3	03
1AOY	P	63A3	03	1ASY	P	63A3	03	1ASY	P	63A3	03
1AOY	P	63A3	03	1ASY	P	63A3	03	1ASY	P	63A3	03
1AOY	P	63A1	03	1ASY	P	63A3	03	1ASY	P	63A3	03
1AOY	P	63A3	03	1ASY	P	63A3	03	1ASY	P	63A3	03
1AOY	O	63A1	03	1ASY	P	63A3	03	1ASY	P	63A3	03
1AOY	P	63A3	03	1ASY	P	63A3	03	1ASY	P	63A3	03
1APY	P	63A3	03	1ASY	P	63A4	03	1ASY	P	63A3	03
1APY	P	63A3	03	1ASY	P	63A3	03	1ASY	P	63A3	03
1APY	P	63A3	03	1ASY	P	63A4	03	1ASY	P	63A4	03
1APY	P	63A3	03	1ASY	P	63A3	03	1ASY	P	63A3	03
1APY	P	63A3	03	1ASY	P	63A4	03	1ASY	P	63A3	03
1APY	P	63A3	03	1ASY	P	63A4	03	1ASY	P	63A3	03
1AQX	N	63A3	03	1ASY	P	63A4	03	1ASY	P	63A3	03
1ARY	P	63A3B	03	1ASY	P	63A4	03	1ASY	P	63A3	03
1ASM	P	63A3	03	1ASY	P	63A4	03	1ASY	P	63A3	03
1ASM	P	63A3	03	1ASY	P	63A4	03	1ASY	P	63A3	03
1ASM	P	63A3	03	1ASY	P	63A3	03	1ASY	P	63A3	03
1ASM	P	63A3	03	1ASY	P	63A3	03	1ASY	P	63A3	03
1ASM	P	63A3	03	1ASY	P	63A4	03	1ASY	P	63A3	03
1ASM	P	63A3	03	1ASY	P	63A4	03	1ASY	PT	63A4	03
1ASM	P	63A3	03	1ASY	P	63A1	03	1ASY	O	63A3	03
1ASM	P	63A3	03	1ASY	P	63A3	03	1ASY	P	63A3	03
1ASM	P	63A4	03	1ASY	P	63A3	03	1ASY	P	63A4	03
1ASM	P	63A4	03	1ASY	P	63A3	03	1ASY	N	63A3	03
1ASM	P	63A4	03	1ASY	P	63A3	03	1ASY	P	63A3	03
1ASM	P	63A3	03	1ASY	P	63A3	03	1ASY	P	63A3	03
1ASY	P	63A3	03	1ASY	P	63A3	03	1ASY	O	63A1	03
1ASY	P	63A3	03	1ASY	P	63A3	03	1ASY	P	63A3	03
1ASY	P	63A3	03	1ASY	P	63A4	03	1ASY	P	63A3	03
1ASY	P	63A3	03	1ASY	P	63A3	03	1ASY	P	63A4	03
1ASY	P	63A3	03	1ASY	P	63A4	03	1ASY	P	63A3	03
1ASY	P	63A3	03	1ASY	P	63A4	03	1ASY	P	63A3	03
1ASY	P	63A3	03	1ASY	P	63A3	03	1ASY	P	63A3	03
1ASY	P	63A3	03	1ASY	P	63A3	03	1ASY	P	63A4	03
1ASY	P	63A3	03	1ASY	P	63A1	03	1ASY	P	63A3	03
1ASY	P	63A3	03	1ASY	P	63A1	03	1ASY	P	63A3	03
1ASY	P	63A3	03	1ASY	P	63A4	03	1ASY	P	63A3	03
1ASY	P	63A3	03	1ASY	P	63A3	03	1ASY	P	63A3	03
1ASY	P	63A3	03	1ASY	P	63A3	03	1ASY	P	63A3	03
1ASY	P	63A4	03	1ASY	P	63A3	03	1ASY	P	63A3	03
1ASY	P	63A4	03	1ASY	P	63A3	03	1ASY	P	63A3	03
1ASY	P	63A4	03	1ASY	P	63A4	03	1ASY	P	63A3	03
1ASY	P	63A1	03	1ASY	P	63A3	03	1AUJ	P	63A3	03
1ASY	P	63A3	03	1ASY	P	63A3	03	1AUJ	O	63A3	03
1ASY	P	63A3	03	1ASY	P	63A3	03	1AUJ	P	63A3	03
1ASY	P	63A3	03	1ASY	P	63A3	03	1AUJ	P	63A3	03
1ASY	P	63A3	03	1ASY	P	63A3	03	1AVS	P	63A3B	03
1ASY	P	63A3	03	1ASY	P	63A3	03	1AVS	P	63A3B	03
1ASY	P	63A3	03	1ASY	P	63A3	03	1AVS	P	63A1	03
1ASY	P	63A3	03	1ASY	P	63A3	03	1AVY	P	63A3	03
1ASY	P	63A3	03	1ASY	P	63A3	03	1AVY	N	63A3B	03

**Appendix E: Atlas 63AX Data**

<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>	<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>	<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>
1AVY	P	63A1	03	1AYY	P	63A3	03	1AYY	P	63A3	03
1AVY	N	63A3	03	1AYY	P	63A3	03	1AYY	P	63A3	03
1AVY	N	63A3	03	1AYY	P	63A3	03	1AYY	O	63A3B	03
1AVY	P	63A1	03	1AYY	P	63A3	03	1AYY	P	63A1	03
1AVY	P	63A3	03	1AYY	P	63A3	03	1AYY	PC	63A3	03
1AVY	P	63A1	03	1AYY	P	63A4	03	1AYY	P	63A3	03
1AVY	P	63A3	03	1AYY	P	63A3	03	1AYY	P	63A3	03
1AXY	P	63A3	03	1AYY	P	63A3	03	1AYY	P	63A3	03
1AXY	P	63A3	03	1AYY	P	63A3	03	1AYY	P	63A3	03
1AXY	N	63A3	03	1AYY	P	63A3	03	1AYY	P	63A4	03
1AYY	O	63A3	03	1AYY	P	63A3	03	1AYY	P	63A3	03
1AYY	P	63A3	03	1AYY	P	63A3	03	1AYY	O	63A3	03
1AYY	O	63A3	03	1AYY	P	63A3	03	1AYY	O	63A3	03
1AYY	P	63A3	03	1AYY	P	63A3	03	1AYY	O	63A3	03
1AYY	P	63A3	03	1AYY	P	63A3	03	1AYY	P	63A3	03
1AYY	P	63A3	03	1AYY	P	63A3	03	1AYY	P	63A3	03
1AYY	P	63A3	03	1AYY	P	63A1	03	1AYY	O	63A1	03
1AYY	P	63A3	03	1AYY	P	63A3	03	1AYY	O	63A3	03
1AYY	P	63A3	03	1AYY	P	63A3	03	1AYY	O	63A3	03
1AYY	P	63A3	03	1AYY	P	63A3	03	1AYY	O	63A3	03
1AYY	P	63A3	03	1AYY	P	63A3	03	1AYY	O	63A3	03
1AYY	P	63A3	03	1AYY	P	63A3	03	1AYY	O	63A3	03
1AYY	P	63A3	03	1AYY	P	63A3	03	1AYY	O	63A3	03
1AYY	P	63A3	03	1AYY	P	63A3	03	1AYY	O	63A3	03
1AYY	P	63A3	03	1AYY	P	63A3	03	1AYY	O	63A3	03
1AYY	P	63A3	03	1AYY	P	63A3	03	1BBA	N	63A3	03
1AYY	P	63A3	03	1AYY	P	63A3	03	1BBA	N	63A3	03
1AYY	P	63A3	03	1AYY	P	63A3	03	1CAK	P	63A3B	03
1AYY	O	63A3B	03	1AYY	P	63A3	03	1CAK	P	63A3	03
1AYY	P	63A3	03	1AYY	P	63A3	03	1CAK	P	63A3	03
1AYY	P	63A3	03	1AYY	P	63A3	03	1CAN	PN	63A3W	03
1AYY	P	63A4	03	1AYY	P	63A3	03	1CAN	P	63A1	03
1AYY	PN	63A4W	03	1AYY	O	63A1	03	1CAN	P	63A3	03
1AYY	P	63A4	03	1AYY	P	63A4	03	1CAN	P	63A3	03
1AYY	P	63A1	03	1AYY	N	63A3B	03	1CAN	P	63A3	03
1AYY	P	63A1	03	1AYY	P	63A3	03	1CAN	P	63A3	03
1AYY	P	63A1	03	1AYY	P	63A3	03	1CAN	P	63A3	03
1AYY	P	63A3B	03	1AYY	P	63A3	03	1CAN	P	63A3	03
1AYY	P	63A3B	03	1AYY	P	63A4	03	1CAN	P	63A3	03
1AYY	P	63A3B	03	1AYY	P	63A4	03	1CAN	P	63A3	03
1AYY	P	63A3B	03	1AYY	P	63A4	03	1CAN	P	63A3	03
1AYY	P	63A3B	03	1AYY	P	63A4	03	1CAN	P	63A3	03
1AYY	P	63A3	03	1AYY	P	63A1	03	1CAN	P	63A3	03
1AYY	P	63A3	03	1AYY	P	63A3	03	1CAN	P	63A3	03
1AYY	P	63A3	03	1AYY	P	63A3	03	1CAN	P	63A3	03
1AYY	P	63A3	03	1AYY	P	63A3	03	1CAN	P	63A3	03
1AYY	P	63A3	03	1AYY	P	63A3	03	1CAN	O	63A3	03
1AYY	P	63A3	03	1AYY	P	63A3	03	1CAN	O	63A3	03
1AYY	P	63A3	03	1AYY	P	63A3	03	1CAN	O	63A3	03
1AYY	P	63A3	03	1AYY	P	63A3	03	1CAN	O	63A3	03
1AYY	P	63A3	03	1AYY	P	63A3	03	1CAN	O	63A3	03
1AYY	P	63A3	03	1AYY	P	63A3	03	1CAN	O	63A3	03
1AYY	P	63A3	03	1AYY	P	63A4	03	1CAN	O	63A3	03
1AYY	P	63A3	03	1AYY	P	63A1	03	1CAN	P	63A4	03
1AYY	P	63A3	03	1AYY	P	63A4	03	1CAN	P	63A3	03
1AYY	P	63A3	03	1AYY	P	63A3	03	1CAN	P	63A3	03
1AYY	P	63A3	03	1AYY	P	63A3	03	1CAN	O	63A3	03
1AYY	P	63A3	03	1AYY	P	63A3B	03	1CAN	P	63A4	03
1AYY	P	63A3	03	1AYY	P	63A3B	03	1CAN	P	63A4	03
1AYY	P	63A3	03	1AYY	P	63A1	03	1CAN	P	63A4	03

**Appendix E: Atlas 63AX Data**

<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>	<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>	<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>
1CAN	O	63A1B	03	4BYY	N	63A1	03	4IYY	N	63A3	03
2BCY	P	63A1	03	4BYY	N	63A3	03	4IYY	N	63A4	03
2BCY	P	63A3	03	4BYY	N	63A3	03	4IYY	N	63A3	03
2BCY	P	63A3B	03	4BYY	N	63A3	03	4IYY	P	63A3	03
2BYY	P	63A4	03	4BYY	N	63A3	03	4IYY	P	63A1	03
2EYY	P	63A1	03	4BYY	N	63A3	03	4IYY	N	63A1	03
2EYY	P	63A3	03	4BYY	N	63A3	03	4IYY	N	63A3	03
2FCE	P	63A3	03	4BYY	N	63A3	03	4IYY	P	63A1	03
2FYY	N	63A3	03	4BYY	N	63A3	03	4IYY	N	63A3	03
3ACY	N	63A3B	03	4BYY	N	63A3	03	4IYY	N	63A3	03
3AYY	NN	63A3W	03	4BYY	N	63A3	03	4IYY	NA	63A3	03
3AYY	N	63A3	03	4BYY	N	63A3	03	4IYY	N	63A3	03
4AEY	P	63A1	03	4BYY	N	63A3	03	4IYY	N	63A3	03
4AYY	N	63A3	03	4BYY	N	63A3	03	4IYY	N	63A3	03
4AYY	N	63A4	03	4BYY	N	63A3	03	4IYY	N	63A3	03
4AYY	N	63A1	03	4BYY	N	63A3	03	4IYY	P	63A3	03
4AYY	N	63A3	03	4DYY	P	63A3	03	4IYY	N	63A3	03
4AYY	N	63A3	03	4EEY	P	63A1	03	4IYY	N	63A3	03
4AYY	N	63A3	03	4EYY	P	63A1	03	4IYY	N	63A3	03
4AYY	N	63A3	03	4EYY	R	63A1	03	4IYY	N	63A3	03
4AYY	P	63A3	03	4EYY	N	63A1	03	4IYY	N	63A1	03
4AYY	P	63A3	03	4EYY	N	63A3	03	4IYY	N	63A3	03
4AYY	P	63A3	03	4EYY	N	63A3	03	4IYY	N	63A3	03
4AYY	P	63A3	03	4EYY	N	63A1	03	4IYY	N	63A3	03
4AYY	P	63A3	03	4EYY	N	63A1	03	4IYY	N	63A3	03
4AYY	P	63A4	03	4EYY	N	63A1	03	4IYY	N	63A3	03
4AYY	N	63A1	03	4FYY	N	63A3	03	4IYY	O	63A3	03
4AYY	P	63A1	03	4GYY	N	63A3	03	4IYY	N	63A3	03
4AYY	P	63A1	03	4GYY	N	63A3	03	4IYY	N	63A3	03
4AYY	P	63A1	03	4GYY	N	63A3	03	4IYY	N	63A1	03
4AYY	P	63A1	03	4GYY	N	63A3	03	4IYY	P	63A1	03
4BYY	N	63A3	03	4GYY	P	63A3	03	4IYY	P	63A1	03
4BYY	N	63A3	03	4HBY	P	63A4	03	4IYY	RT	63A4	03
4BYY	N	63A3	03	4HYY	N	63A3	03	4IYY	PA	63A4	03
4BYY	N	63A3	03	4HYY	N	63A3	03	4IYY	PX	63A3	03
4BYY	N	63A3	03	4HYY	N	63A3	03	4IYY	N	63A3	03
4BYY	N	63A3	03	4HYY	N	63A3	03	4IYY	N	63A1	03
4BYY	P	63A4	03	4HYY	N	63A3	03	4IYY	N	63A1	03
4BYY	N	63A3	03	4ICY	P	63A1	03	4IYY	N	63A3	03
4BYY	N	63A3	03	4IDY	P	63A1	03	4IYY	P	63A4	03
4BYY	N	63A3	03	4IDY	P	63A1	03	4IYY	N	63A1	03
4BYY	N	63A3	03	4IDY	P	63A1	03	4IYY	N	63A3	03
4BYY	N	63A3	03	4IGY	P	63A3	03	4IYY	N	63A3	03
4BYY	N	63A3	03	4IGY	P	63A3	03	4IYY	N	63A3	03
4BYY	N	63A3	03	4IHY	P	63A1	03	4IYY	N	63A3	03
4BYY	N	63A3	03	4IHY	P	63A1	03	4IYY	N	63A3	03
4BYY	P	63A3	03	4IJY	P	63A4	03	4IYY	N	63A3	03
4BYY	P	63A3	03	4IYY	N	63A3	03	4IYY	P	63A3	03
4BYY	O	63A4	03	4IYY	N	63A3	03	4IYY	P	63A3	03
4BYY	O	63A1	03	4IYY	N	63A3	03	4IYY	P	63A3	03
4BYY	N	63A1	03	4IYY	N	63A3	03	4IYY	P	63A3	03

**Appendix E: Atlas 63AX Data**

<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>	<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>	<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>
4IYY	P	63A3	03	4LYY	N	63A3	03	4MYY	O	63A3	03
4IYY	N	63A1	03	4LYY	P	63A3	03	4MYY	P	63A3	03
4IYY	N	63A3	03	4LYY	P	63A1	03	4MYY	P	63A3	03
4IYY	N	63A3	03	4LYY	P	63A1	03	4MYY	P	63A3	03
4IYY	P	63A1	03	4LYY	P	63A1B	03	4MYY	P	63A3	03
4IYY	N	63A1	03	4LYY	P	63A3	03	4MYY	P	63A3	03
4IYY	N	63A1	03	4LYY	P	63A3	03	4MYY	P	63A3	03
4IYY	N	63A1	03	4LYY	P	63A3	03	4MYY	P	63A3	03
4IYY	N	63A1	03	4LYY	P	63A3	03	4MYY	N	63A4	03
4IYY	NP	63A1P	03	4LYY	N	63A3B	03	4MYY	P	63A4	03
4IYY	N	63A3	03	4LYY	N	63A3B	03	4MYY	P	63A4	03
4IYY	N	63A3	03	4LYY	P	63A1B	03	4MYY	P	63A1	03
4IYY	P	63A1	03	4LYY	P	63A3B	03	4MYY	P	63A4	03
4IYY	N	63A3	03	4LYY	P	63A3	03	4MYY	P	63A1	03
4IYY	N	63A3	03	4LYY	P	63A3	03	4NXY	N	63A3	03
4IYY	P	63A1	03	4LYY	P	63A3	03	4NYY	P	63A3	03
4IYY	N	63A3	03	4LYY	P	63A3	03	4QYY	N	63A3	03
4IYY	O	63A3	03	4LYY	P	63A3B	03	4QYY	N	63A3	03
4IYY	P	63A3	03	4LYY	P	63A3B	03	4QYY	P	63A4	03
4IYY	P	63A3	03	4LYY	P	63A1	03	4TAY	P	63A3	03
4JYY	N	63A3	03	4LYY	P	63A3	03	4TJY	P	63A1	03
4JYY	PP	63A4W	03	4LYY	N	63A3	03	4TYY	P	63A3	03
4JYY	N	63A3	03	4LYY	P	63A1	03	4VAY	PN	63A1W	03
4JYY	N	63A3	03	4LYY	P	63A3	03	4VAY	N	63A3	03
4JYY	N	63A3	03	4MFY	P	63A3	03	4VCY	P	63A1	03
4JYY	N	63A3	03	4MFY	P	63A3	03	4VCY	PN	63A4W	03
4JYY	N	63A4	03	4MYY	P	63A3	03	4VCY	PN	63A1R	03
4JYY	N	63A4	03	4MYY	N	63A3B	03	4VCY	P	63A1	03
4JYY	N	63A4	03	4MYY	P	63A3	03	4VCY	O	63A3	03
4JYY	N	63A3	03	4MYY	N	63A3	03	4VCY	PF	63A4	03
4JYY	N	63A3	03	4MYY	N	63A3	03	4VCY	P	63A3	03
4KAB	N	63A3	03	4MYY	N	63A1	03	4VCY	P	63A3	03
4KXY	N	63A3	03	4MYY	P	63A1	03	4VCY	PF	63A1	03
4KYY	N	63A4	03	4MYY	N	63A3	03	4VCY	P	63A3B	03
4KYY	N	63A3	03	4MYY	N	63A3	03	4VCY	P	63A3	03
4KYY	N	63A3	03	4MYY	N	63A3	03	4VCY	OF	63A1	03
4KYY	N	63A3	03	4MYY	N	63A1	03	4VCY	O	63A3	03
4KYY	N	63A3	03	4MYY	N	63A3	03	4VCY	P	63A3	03
4KYY	N	63A3	03	4MYY	N	63A1	03	4VCY	PF	63A1	03
4KYY	N	63A3	03	4MYY	P	63A4	03	4VHY	N	63A1B	03
4LCY	P	63A4	03	4MYY	N	63A3	03	4VHY	N	63A3	03
4LCY	P	63A3	03	4MYY	P	63A1	03	4VKY	N	63A3	03
4LCY	P	63A4	03	4MYY	N	63A3	03	4VQY	N	63A3	03
4LDX	N	63A3	03	4MYY	N	63A1	03	4VQY	N	63A3	03
4LYY	N	63A3	03	4MYY	N	63A1	03	4VQY	N	63A1	03
4LYY	P	63A3B	03	4MYY	N	63A3	03	4VYY	N	63A3	03
4LYY	P	63A4	03	4MYY	N	63A3	03	4WYY	P	63A1	03
4LYY	P	63A3	03	4MYY	N	63A1	03	4YYY	N	63A3	03
4LYY	P	63A3	03	4MYY	N	63A3	03	4YYY	P	63A1	03
4LYY	P	63A3	03	4MYY	N	63A3	03	4YYY	P	63A3	03
4LYY	P	63A3	03	4MYY	N	63A3	03	4YYY	N	63A3	03
4LYY	P	63A3B	03	4MYY	N	63A3	03	4YYY	P	63A3	03
4LYY	P	63A3	03	4MYY	N	63A3	03	4YYY	N	63A3	03
4LYY	P	63A3	03	4MYY	N	63A3	03	5YYY	O	63A3	03
4LYY	N	63A1	03	4MYY	N	63A1	03				

**Appendix E: Atlas 63AX Data**

<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>	<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>	<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>
6EMY	PT	63A3	03	9BYY	N	63A3	03	0YKY	P	63A4	04
6EMY	P	63A1	03	9BYY	N	63A3	03	0YKY	P	63A4	04
6YYY	N	63A3	03	9BYY	N	63A3	03	0YKY	P	63A4	04
6YYY	N	63A3	03	9DJG	N	63A3	03	0YKY	P	63A4	04
6YYY	P	63A3	03	9DJG	NP	63A3W	03	0YKY	P	63A4	04
6YYY	N	63A4	03	9DYY	N	63A3B	03	0YKY	P	63A4	04
6YYY	N	63A3	03	9ECY	P	63A3	03	0YKY	P	63A3B	04
6YYY	N	63A3	03	9EYY	O	63A1	03	0YKY	P	63A3	04
6YYY	N	63A3	03	9EYY	O	63A3	03	0YKY	P	63A3	04
6YYY	P	63A1	03	9EYY	P	63A4	03	0YKY	P	63A4	04
6YYY	N	63A3	03	9EYY	PT	63A1	03	0YKY	P	63A4	04
6YYY	P	63A3	03	9EYY	O	63A4	03	0YKY	P	63A4	04
6YYY	N	63A3	03	9EYY	O	63A3	03	0YKY	P	63A4	04
6YYY	N	63A1	03	9EYY	P	63A3	03	0YKY	P	63A4	04
6YYY	N	63A3	03	9EYY	P	63A4	03	0YKY	P	63A3B	04
6YYY	N	63A3	03	9FEF	P	63A3	03	0YKY	P	63A4	04
6YYY	NC	63A3	03	9FEF	P	63A3	03	0YKY	P	63A4	04
6YYY	N	63A3	03	9FEF	O	63A3	03	0YKY	P	63A4	04
6YYY	N	63A1	03	9FFB	PN	63A1V	03	0YKY	P	63A4	04
6YYY	N	63A1	03	9FFY	N	63A3	03	0YKY	P	63A4	04
6YYY	N	63A1	03	9FYY	N	63A3	03	0YKY	P	63A4	04
6YYY	N	63A3	03	9GYY	P	63A3	03	0YKY	P	63A4	04
6YYY	N	63A3	03	9GYY	P	63A4	03	0YKY	P	63A4	04
6YYY	N	63A3	03	9GYY	P	63A4	03	0YKY	P	63A4	04
6YYY	P	63A3	03	9GYY	P	63A3	03	0YKY	P	63A4	04
7AAB	N	63A4	03	9GYY	P	63A4	03	0YKY	P	63A4	04
7AAE	N	63A3	03	0CAX	P	63A4	04	0YKY	P	63A4	04
7AAE	N	63A3	03	0CAY	P	63A3A	04	0YKY	P	63A4	04
8CYY	N	63A3	03	0CAY	P	63A4	04	0YKY	P	63A4	04
8CYY	N	63A4	03	0CAY	P	63A4	04	0YKY	P	63A4	04
8CYY	N	63A1	03	0CAY	P	63A3	04	0YKY	P	63A4	04
8DYY	N	63A3	03	0CBY	O	63A1	04	0YKY	P	63A4	04
8FDY	P	63A1	03	0CDB	P	63A4	05	0YKY	P	63A3	04
8HBY	N	63A3	03	0GYY	P	63A4	04	0YKY	P	63A3B	04
8HBY	N	63A3	03	0IYY	P	63A4	04	0YKY	P	63A1	04
8HHY	N	63A3	03	0YEY	P	63A4	04	0YKY	P	63A4	04
8HHY	N	63A1	03	0YEY	P	63A4	04	0YKY	PN	63A4W	04
8HNJ	PT	63A1	03	0YEY	P	63A4	04	0YKY	P	63A4	04
8HYY	N	63A3	03	0YEY	P	63A4	04	0YKY	P	63A3	04
8HYY	N	63A3	03	0YJY	P	63A4	04	0YKY	P	63A4	04
8HYY	N	63A3	03	0YJY	P	63A4	04	0YKY	P	63A4	04
8HYY	O	63A3	03	0YJY	P	63A4	04	0YKY	P	63A4	04
8HYY	N	63A3	03	0YKY	P	63A3	04	0YKY	P	63A4	04
8HYY	N	63A3	03	0YKY	P	63A3	04	0YKY	P	63A3	04
8HYY	N	63A4	03	0YKY	PN	63A4R	04	0YKY	P	63A4	04
8HYY	N	63A1	03	0YKY	P	63A3	04	0YKY	P	63A4	04
8HYY	N	63A3	03	0YKY	P	63A4	04	0YKY	P	63A4	04
8HYY	N	63A3	03	0YKY	P	63A4	04	0YKY	P	63A4	04
9BYY	N	63A3	03	0YKY	P	63A4	04	0YKY	P	63A4	04
9BYY	N	63A3	03	0YKY	P	63A3	04	0YKY	P	63A4	04

**Appendix E: Atlas 63AX Data**

<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>	<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>	<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>
0YKY	P	63A4	04	1AHY	P	63A3	04	1AJY	P	63A4	04
0YKY	P	63A1	04	1AHY	P	63A4	04	1AJY	P	63A4	04
0YKY	P	63A3	04	1AJB	P	63A4	04	1AJY	P	63A4	04
0YKY	P	63A4	04	1AJY	P	63A4	04	1AJY	P	63A4	04
0YKY	P	63A1B	04	1AJY	P	63A4	04	1AJY	P	63A4	04
0YKY	P	63A4	04	1AJY	O	63A4	04	1AJY	P	63A4	04
0YKY	P	63A1	04	1AJY	P	63A4	04	1AJY	P	63A4	04
0YKY	P	63A4	04	1AJY	P	63A4	04	1AJY	P	63A4	04
0YKY	P	63A4	04	1AJY	P	63A4	04	1AJY	P	63A4	04
0YKY	P	63A4	04	1AJY	P	63A4	04	1AJY	P	63A4	04
0YKY	P	63A4	04	1AJY	P	63A4	04	1AJY	P	63A4	04
0YKY	P	63A4	04	1AJY	P	63A4	04	1AJY	P	63A4	04
0YKY	P	63A4	04	1AJY	P	63A4	04	1AJY	P	63A4	04
0YKY	P	63A4	04	1AJY	P	63A4	04	1AJY	P	63A4	04
0YKY	P	63A3	04	1AJY	P	63A4	04	1AJY	P	63A4	04
0YKY	P	63A4	04	1AJY	P	63A3	04	1AJY	P	63A4	04
0YKY	P	63A4	04	1AJY	P	63A3	04	1AJY	P	63A4	04
0YRY	P	63A4	04	1AJY	P	63A4	04	1AJY	P	63A4	04
0YRY	PN	63A4P	04	1AJY	PP	63A4W	04	1AJY	P	63A4	04
0YSY	P	63A3	04	1AJY	P	63A4	04	1AJY	P	63A4	04
0YTB	P	63A4	04	1AJY	PF	63A4	04	1AJY	P	63A4	04
0YVY	P	63A4	04	1AJY	P	63A4	04	1AJY	P	63A4	04
0YVY	P	63A4	04	1AJY	PN	63A4P	04	1AJY	P	63A4	04
1AAAY	P	63A4	04	1AJY	P	63A4W	04	1AJY	P	63A4	04
1ACA	O	63A3B	04	1AJY	P	63A3	04	1AJY	P	63A4	04
1ACA	P	63A3	04	1AJY	P	63A4	04	1AJY	P	63A4	04
1ACA	P	63A1	04	1AJY	PN	63A1W	04	1AJY	O	63A4	04
1ACA	P	63A4	04	1AJY	P	63A4	04	1AJY	P	63A4	04
1ACA	PT	63A4	04	1AJY	PN	63A4U	04	1AJY	P	63A4	04
1ACB	P	63A4	04	1AJY	P	63A1	04	1AJY	PN	63A4W	04
1ACB	P	63A4	04	1AJY	P	63A1	04	1AJY	O	63A4	04
1ACB	P	63A3	04	1AJY	P	63A3	04	1AJY	PN	63A4W	04
1ACY	P	63A4	04	1AJY	P	63A3	04	1AJY	PN	63A4R	04
1ACY	P	63A4	04	1AJY	P	63A3	04	1AJY	PN	63A4W	04
1AGY	P	63A4	04	1AJY	P	63A3	04	1AJY	P	63A4	04
1AGY	P	63A4	04	1AJY	N	63A4	04	1AKY	P	63A4	04
1AGY	P	63A3	04	1AJY	R	63A4	04	1AKY	P	63A4	04
1AGY	P	63A3	04	1AJY	P	63A3B	04	1AKY	P	63A4	04
1AGY	P	63A4	04	1AJY	OP	63A3W	04	1AKY	P	63A4	04
1AGY	P	63A4	04	1AJY	P	63A4	04	1AKY	P	63A4	04
1AGY	P	63A4	04	1AJY	P	63A4	04	1AKY	P	63A4	04
1AGY	P	63A4	04	1AJY	P	63A4	04	1AKY	P	63A4	04
1AGY	P	63A4	04	1AJY	P	63A4	04	1AKY	P	63A4	04
1AGY	P	63A4	04	1AJY	P	63A4	04	1AKY	P	63A4	04
1AGY	P	63A3	04	1AJY	P	63A4	04	1AKY	P	63A4	04
1AGY	P	63A4	04	1AJY	P	63A4	04	1AKY	PN	63A4U	04
1AGY	P	63A4	04	1AJY	P	63A4	04	1AKY	P	63A1	04
1AGY	P	63A3	04	1AJY	P	63A4	04	1AKY	P	63A4	04
1AGY	P	63A4	04	1AJY	P	63A4	04	1AKY	P	63A4	04
1AHY	O	63A4	04	1AJY	P	63A4	04	1AKY	P	63A4	04
1AHY	N	63A4	04	1AJY	P	63A4	04	1AKY	P	63A4	04
1AHY	P	63A4	04	1AJY	P	63A4	04	1AKY	P	63A4	04
1AHY	P	63A4	04	1AJY	P	63A4	04	1AMH	P	63A4	04

**Appendix E: Atlas 63AX Data**

<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>	<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>	<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>
1AMH	P	63A4	04	1ARY	P	63A4	04	1AYY	P	63A4	04
1AMH	P	63A4	04	1ASM	P	63A4	04	1AYY	P	63A4	04
1AMH	P	63A4	04	1ASY	P	63A4	04	1AYY	P	63A1	04
1AMH	P	63A4	04	1ASY	P	63A4	04	1AYY	P	63A4	04
1AMI	P	63A4	04	1ASY	P	63A4	04	1AYY	P	63A4	04
1AMI	P	63A4	04	1ASY	P	63A3	04	1AYY	P	63A3	04
1AMJ	P	63A4	04	1ASY	P	63A4	04	1AYY	P	63A4	04
1AMJ	RT	63A4	04	1ASY	PA	63A4	04	1AYY	P	63A4	04
1AMJ	P	63A4	04	1ASY	P	63A4	04	1AYY	P	63A4	04
1AMJ	PN	63A4S	04	1ASY	P	63A3	04	1AYY	PN	63A4P	04
1AMJ	P	63A4	04	1ASY	P	63A4	04	1AYY	P	63A4	04
1AMJ	P	63A4	04	1ASY	P	63A4	04	1AYY	P	63A4	04
1AMJ	PN	63A4W	04	1ASY	P	63A3	04	1AYY	P	63A3B	04
1AMJ	P	63A4	04	1ASY	R	63A4	04	1AYY	P	63A1	04
1AMM	P	63A4	04	1ASY	P	63A4	04	1AYY	N	63A4	04
1AMY	P	63A4	04	1ASY	P	63A3	04	1AYY	P	63A4	04
1AMY	P	63A4	04	1ASY	P	63A4	04	1AYY	P	63A4	04
1AMY	P	63A4	04	1ASY	P	63A4	04	1AYY	P	63A4	04
1AMY	P	63A4	04	1ASY	P	63A4	04	1AYY	P	63A4	04
1AMY	P	63A3B	04	1ASY	P	63A3	04	1AYY	P	63A4	04
1AMY	P	63A4	04	1ASY	PP	63A4W	04	1AYY	P	63A4	04
1AMY	P	63A4	04	1ASY	P	63A4	04	1AYY	P	63A4	04
1AMY	P	63A4	04	1ASY	P	63A4	04	1AYY	P	63A4	04
1AMY	P	63A4	04	1ASY	P	63A4	04	1AYY	P	63A4	04
1AMY	P	63A4	04	1ASY	P	63A4	04	1AYY	P	63A4	04
1AMY	P	63A4	04	1ASY	P	63A4	04	1AYY	P	63A4	04
1ANY	P	63A4	04	1ASY	P	63A4	04	1AYY	P	63A4	04
1AOC	P	63A4	04	1ASY	P	63A4	04	1AYY	P	63A4	04
1AOY	P	63A4	04	1ASY	P	63A3	04	1AYY	P	63A4	04
1AOY	P	63A4	04	1ASY	PN	63A4W	04	1AYY	P	63A3	04
1AOY	P	63A4	04	1ASY	P	63A4	04	1AYY	P	63A4	04
1AOY	P	63A4	04	1ASY	P	63A3	04	1AYY	P	63A3	04
1AOY	P	63A4	04	1ASY	P	63A4	04	1AYY	P	63A4	04
1AOY	P	63A4	04	1ASY	P	63A4	04	1AYY	P	63A4	04
1AOY	P	63A4	04	1ASY	P	63A4	04	1AYY	P	63A4	04
1AOY	P	63A4	04	1ASY	P	63A3	04	1AYY	P	63A4	04
1AOY	P	63A4	04	1ASY	P	63A3	04	1AYY	P	63A3	04
1AOY	P	63A4	04	1ASY	P	63A4	04	1AYY	P	63A4	04
1AOY	P	63A4	04	1ASY	P	63A4	04	1AYY	P	63A4	04
1AOY	P	63A4	04	1ASY	P	63A3	04	1AYY	P	63A4	04
1APY	P	63A4	04	1ASY	P	63A3	04	1AYY	P	63A3	04
1APY	P	63A4	04	1AUY	F	63A4	04	1AYY	P	63A4	04
1APY	P	63A4	04	1AVS	P	63A4	04	1AYY	P	63A4	04
1APY	P	63A4	04	1AVY	P	63A4	04	1AYY	P	63A4	04
1APY	P	63A3	04	1AVY	P	63A3B	04	1AYY	P	63A1	04
1APY	P	63A4	04	1AVY	P	63A4	04	1AYY	P	63A4	04
1APY	P	63A4	04	1AVY	P	63A4	04	1AYY	P	63A4	04
1APY	P	63A4	04	1AVY	PN	63A4R	04	1AYY	P	63A4	04
1APY	P	63A4	04	1AVY	PN	63A4W	04	1AYY	P	63A4	04
1APY	P	63A4	04	1AVY	PN	63A4W	04	1AYY	P	63A4	04
1APY	P	63A4	04	1AVY	P	63A3	04	1AYY	P	63A4	04
1APY	P	63A3	04	1AXY	P	63A1	04	1AYY	PN	63A4P	04
1APY	P	63A4	04	1AXY	P	63A4	04	1AYY	P	63A4	04
1APY	P	63A4	04	1AYY	P	63A4	04	1AYY	O	63A3	04
1APY	P	63A4	04	1AYY	P	63A4	04	1AYY	P	63A4	04
1ARY	P	63A4	04	1AYY	P	63A4	04	1AYY	P	63A4	04

Appendix E: Atlas 63AX Data

<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>	<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>	<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>
1AYY	P	63A4	04	1AYY	NN	63A4W	04	4AFY	P	63A4	04
1AYY	P	63A4	04	1AYY	P	63A4	04	4AGY	PP	63A4W	04
1AYY	P	63A4	04	1AYY	P	63A4	04	4AGY	P	63A1	04
1AYY	P	63A4	04	1AYY	P	63A4	04	4AYY	P	63A4	04
1AYY	P	63A4	04	1AYY	P	63A4	04	4AYY	P	63A4	04
1AYY	P	63A4	04	1AYY	P	63A3	04	4AYY	P	63A4	04
1AYY	P	63A4	04	1AYY	P	63A4	04	4AYY	P	63A4	04
1AYY	P	63A3	04	1AYY	P	63A4	04	4AYY	P	63A3	04
1AYY	P	63A3	04	1AYY	P	63A4	04	4AYY	N	63A4	04
1AYY	P	63A4	04	1AYY	P	63A4	04	4AYY	PP	63A4W	04
1AYY	P	63A4	04	1AYY	P	63A4	04	4AYY	P	63A4	04
1AYY	P	63A4	04	1AYY	P	63A4	04	4AYY	P	63A4	04
1AYY	P	63A4	04	1BBA	N	63A4	04	4AYY	P	63A4	04
1AYY	P	63A4	04	1CAK	P	63A4	04	4AYY	P	63A4	04
1AYY	P	63A3B	04	1CAN	PS	63A4	04	4AYY	P	63A3	04
1AYY	P	63A4	04	1CAN	P	63A4	04	4AYY	P	63A4	04
1AYY	P	63A4	04	1CAN	PN	63A4W	04	4AYY	Q	63A4	04
1AYY	P	63A4	04	1CAN	P	63A4	04	4AYY	P	63A4	04
1AYY	P	63A4	04	1CAN	P	63A4	04	4AYY	P	63A4	04
1AYY	P	63A4	04	1CAN	P	63A4	04	4AYY	P	63A4	04
1AYY	P	63A3	04	1CAN	P	63A4	04	4AYY	P	63A4	04
1AYY	P	63A4	04	1CAN	P	63A4	04	4AYY	P	63A4	04
1AYY	P	63A4	04	1CAN	O	63A4	04	4AYY	PN	63A4W	04
1AYY	P	63A4	04	1CAN	O	63A4	04	4BYY	NP	63A4W	04
1AYY	P	63A4	04	1CAN	P	63A4	04	4BYY	PP	63A1P	04
1AYY	P	63A4	04	1CAN	PT	63A4	04	4BYY	P	63A4	04
1AYY	P	63A4	04	1CAN	PN	63A4W	04	4BYY	PP	63A4P	04
1AYY	P	63A4	04	1CAN	P	63A3B	04	4BYY	N	63A4	04
1AYY	P	63A4	04	1CAN	P	63A3	04	4ECY	P	63A4	04
1AYY	P	63A4	04	1CAN	PT	63A4	04	4IAY	P	63A4	04
1AYY	P	63A4	04	1CAN	P	63A4	04	4IAY	P	63A4	04
1AYY	P	63A4	04	1CAN	P	63A4	04	4IEY	P	63A4	04
1AYY	P	63A4	04	1CAN	O	63A4	04	4IEY	P	63A3A	04
1AYY	P	63A4	04	1CAN	P	63A1	04	4IEY	P	63A1	04
1AYY	P	63A4	04	1CAN	O	63A4	04	4IGY	P	63A1	04
1AYY	P	63A4W	04	1CBC	P	63A4	04	4IJY	P	63A4	04
1AYY	P	63A4	04	2BAA	P	63A3	04	4IJY	P	63A4	04
1AYY	P	63A4	04	2BAA	P	63A4	04	4IJY	P	63A4	04
1AYY	P	63A4	04	2BAC	P	63A4	04	4IYY	N	63A4	04
1AYY	P	63A4	04	2BAC	P	63A4	04	4IYY	P	63A4	04
1AYY	P	63A3B	04	2BAC	P	63A1	04	4IYY	N	63A4	04
1AYY	P	63A4	04	2BAF	R	63A4	04	4IYY	P	63A4	04
1AYY	O	63A4	04	2BBY	P	63A4	04	4IYY	P	63A4	04
1AYY	O	63A3	04	2BCA	P	63A3	04	4IYY	PP	63A4W	04
1AYY	P	63A1	04	2BEY	P	63A4	04	4IYY	P	63A3	04
1AYY	P	63A4	04	2BHY	N	63A4	04	4IYY	P	63A4	04
1AYY	P	63A3	04	2BIG	PN	63A4W	04	4IYY	P	63A4	04
1AYY	P	63A3	04	2FAY	NN	63A4W	04	4IYY	P	63A4	04
1AYY	P	63A4	04	3AYY	N	63A4	04	4IYY	P	63A4	04
1AYY	P	63A4	04	3AYY	NN	63A4V	04	4IYY	P	63A4	04
1AYY	P	63A4	04	3BEY	NN	63A4W	04	4IYY	PP	63A1W	04

**Appendix E: Atlas 63AX Data**

<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>	<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>	<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>
4IYY	P	63A4	04	4VCY	PN	63A4P	04	9GYY	P	63A3	04
4IYY	P	63A4	04	4VCY	PP	63A4P	04	9GYY	P	63A4	04
4IYY	P	63A4	04	4VCY	P	63A4	04	9GYY	P	63A4	04
4IYY	O	63A4	04	4VCY	P	63A4	04	9GYY	P	63A4	04
4IYY	P	63A4	04	4VHY	N	63A3A	04	9GYY	P	63A4	04
4IYY	P	63A3	04	4VIY	N	63A4	04	9GYY	P	63A4	04
4JYY	P	63A4	04	4VQY	PF	63A4	04	9GYY	P	63A4	04
4KCY	P	63A4	04	4YYY	NP	63A4P	04	9GYY	P	63A4	04
4LCY	P	63A4	04	6YYY	P	63A3	04	9GYY	P	63A3	04
4LCY	P	63A1	04	7GAL	P	63A4	04	9GYY	PN	63A4W	04
4LFB	P	63A4	04	8AAN	R	63A4	04	9GYY	P	63A4	04
4LYY	P	63A1	04	8CYY	N	63A4	04	9GYY	P	63A4	04
4LYY	P	63A4	04	8CYY	R	63A4	04	9GYY	P	63A4	04
4LYY	PN	63A3W	04	8DCY	NN	63A4W	04	9GYY	P	63A4	04
4LYY	O	63A4	04	8HLY	P	63A4	04	9GYY	P	63A4	04
4LYY	P	63A4	04	8HMJ	P	63A1	04	9GYY	P	63A3	04
4LYY	P	63A4	04	8HMJ	Q	63A1	04	9HAY	P	63A4	04
4LYY	P	63A4	04	8HYY	P	63A4	04	9HDB	P	63A3B	04
4LYY	P	63A4	04	8HYY	P	63A4	04	0CAY	P	63A4	05
4MIY	P	63A4	04	8HYY	P	63A4	04	0CAY	P	63A4	04
4MYY	P	63A4	04	8HYY	N	63A4	04	0CAY	PP	63A4W	05
4MYY	P	63A4	04	8HYY	N	63A3	04	0CAY	P	63A4	05
4MYY	N	63A4	04	8HYY	P	63A4	04	0CYY	P	63A4	05
4MYY	P	63A4	04	8HYY	R	63A4	04	0CYY	P	63A4	04
4MYY	PP	63A1P	04	8HYY	P	63A4	04	0YJY	P	63A4	05
4MYY	P	63A4	04	9AYY	N	63A3B	04	0YKY	PF	63A3	05
4MYY	P	63A4	04	9BYY	P	63A4	04	0YKY	P	63A4	05
4MYY	P	63A4	04	9BYY	P	63A4	04	0YKY	P	63A4	05
4MYY	P	63A4	04	9BYY	P	63A4	04	0YKY	P	63A4	05
4MYY	P	63A3	04	9BYY	P	63A4	04	0YKY	P	63A4	05
4MYY	NP	63A3W	04	9BYY	N	63A4	04	0YKY	P	63A4	05
4MYY	P	63A4	04	9CYY	NP	63A4R	04	0YKY	PP	63A1P	05
4QCY	P	63A4	04	9DYY	N	63A4	04	0YKY	P	63A4	05
4QYY	P	63A1	04	9ECY	P	63A4	04	0YKY	PN	63A4W	05
4QYY	P	63A4	04	9ECY	P	63A4	04	0YKY	P	63A4	05
4TJY	P	63A4	04	9ECY	O	63A3	04	0YKY	P	63A4	05
4TYY	P	63A4	04	9ECY	P	63A4	04	0YKY	P	63A4	05
4TYY	P	63A3	04	9ECY	P	63A4	04	0YKY	P	63A4	05
4TYY	P	63A4	04	9ECY	P	63A4	04	0YKY	P	63A3A	05
4VAY	N	63A4	04	9ECY	P	63A4	04	0YKY	P	63A4	05
4VAY	PN	63A4W	04	9ECY	P	63A4	04	0YKY	P	63A4	05
4VAY	NN	63A3V	04	9ECY	PN	63A4V	04	0YKY	P	63A4	05
4VCY	P	63A3B	04	9ECY	P	63A3	04	0YKY	P	63A4	05
4VCY	PP	63A4W	04	9FBY	PN	63A4W	04	0YKY	P	63A4	05
4VCY	P	63A3	04	9FBY	P	63A3B	04	0YKY	P	63A4	05
4VCY	PN	63A4U	04	9FBY	P	63A4	04	0YKY	P	63A4	05
4VCY	PN	63A4P	04	9FFY	P	63A4	04	0YKY	PP	63A4W	05
4VCY	P	63A3B	04	9FYY	N	63A4	04	0YKY	PP	63A4W	05
4VCY	OP	63A4T	04	9FYY	PN	63A4V	04	0YKY	P	63A4	05
4VCY	O	63A4	04	9FYY	P	63A4	04	0YKY	PP	63A4W	05
				9GAB	PN	63A4W	04	0YKY	P	63A4	05

**Appendix E: Atlas 63AX Data**

<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>	<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>	<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>
0YKY	P	63A4	05	1AGY	P	63A4	05	1AJY	PN	63A4W	05
0YKY	P	63A4	05	1AGY	PN	63A4W	05	1AJY	P	63A4	05
0YKY	PP	63A4W	05	1AGY	P	63A4	05	1AJY	P	63A4	05
0YKY	P	63A4	05	1AGY	P	63A4	05	1AJY	P	63A4	05
0YKY	P	63A4	05	1AGY	P	63A4	05	1AJY	P	63A4	05
0YKY	P	63A4	05	1AGY	P	63A4	05	1AJY	P	63A4	05
0YKY	P	63A4	05	1AGY	P	63A4	05	1AJY	PP	63A4W	05
0YKY	P	63A4	05	1AGY	P	63A4	05	1AJY	P	63A4	05
0YKY	P	63A4	05	1AGY	P	63A4	05	1AJY	PN	63A4W	05
0YKY	PN	63A4S	05	1AGY	R	63A4	05	1AJY	PP	63A4W	05
0YKY	PN	63A4R	05	1AGY	R	63A4	05	1AJY	P	63A4	05
0YKY	P	63A4	05	1AGY	P	63A4	05	1AJY	P	63A4	05
0YKY	PN	63A4W	05	1AGY	P	63A4	05	1AJY	PN	63A4W	05
0YKY	P	63A4	05	1AHY	P	63A4W	05	1AJY	P	63A4	05
0YKY	P	63A4	05	1AHY	P	63A4	05	1AJY	P	63A4	05
0YKY	P	63A4	05	1AHY	PN	63A4P	05	1AJY	PP	63A4W	05
0YKY	P	63A1A	05	1AJY	P	63A4	05	1AKY	P	63A4	05
0YKY	PN	63A4U	05	1AJY	P	63A4	05	1AKY	P	63A4	05
0YKY	P	63A4	05	1AJY	P	63A4	05	1AKY	P	63A4	05
0YKY	P	63A4	05	1AJY	PN	63A4W	05	1AKY	P	63A4	05
0YKY	P	63A4	05	1AJY	P	63A4	05	1AKY	P	63A4	05
0YKY	P	63A4	05	1AJY	P	63A4	05	1AKY	P	63A4	05
0YKY	P	63A4	05	1AJY	PP	63A4W	05	1AKY	P	63A4	05
0YKY	P	63A3	05	1AJY	P	63A1	05	1AKY	P	63A4	05
0YKY	P	63A4	05	1AJY	PN	63A4P	05	1AKY	P	63A4	05
0YKY	PF	63A4	05	1AJY	P	63A4	05	1AKY	P	63A4	05
0YKY	P	63A4	05	1AJY	PN	63A4W	05	1AKY	P	63A4	05
0YKY	P	63A3	05	1AJY	PN	63A4V	05	1AKY	P	63A4	05
0YKY	P	63A4	05	1AJY	P	63A4	05	1AKY	PP	63A4W	05
0YKY	P	63A4	05	1AJY	P	63A4	05	1AKY	P	63A4	05
0YKY	P	63A4	05	1AJY	P	63A4	05	1AKY	P	63A4	05
0YKY	PP	63A4T	05	1AJY	P	63A4	05	1AME	P	63A4	05
0YKY	PN	63A4W	05	1AJY	P	63A4	05	1AMH	P	63A4	05
0YKY	P	63A4	05	1AJY	P	63A4	05	1AMH	P	63A4	05
0YKY	P	63A4	05	1AJY	P	63A4	05	1AMH	P	63A4	05
0YKY	P	63A4	05	1AJY	P	63A4	05	1AMH	P	63A1	05
0YLA	P	63A4	05	1AJY	P	63A4	05	1AMH	P	63A4	05
0YSY	PN	63A4W	05	1AJY	PN	63A4U	05	1AMJ	PN	63A4W	05
0YVY	P	63A4	05	1AJY	P	63A4	05	1AMJ	P	63A4	05
0YVY	P	63A4	05	1AJY	PN	63A4W	05	1AMY	P	63A4	05
1ACA	ON	63A4W	05	1AJY	PN	63A4W	05	1AMY	P	63A4	05
1ACB	P	63A4	05	1AJY	P	63A4	05	1AMY	P	63A4	05
1ACB	P	63A4	05	1AJY	PP	63A4W	05	1AMY	P	63A4	05
1ACX	P	63A4	05	1AJY	PN	63A4P	05	1AMY	R	63A4	05
1ACX	P	63A4	05	1AJY	PN	63A4R	05	1AMY	P	63A4	05
1ACY	P	63A3A	05	1AJY	P	63A4	05	1AOC	P	63A4	05
1ACY	P	63A4	05	1AJY	P	63A1	05	1AOY	PC	63A4	05
1ADY	P	63A4	05	1AJY	P	63A4	05	1AOY	PP	63A4W	05
1AFY	P	63A4	05	1AJY	P	63A4	05	1AOY	PN	63A4W	05
1AGY	P	63A4	05	1AJY	P	63A4	05	1AOY	PF	63A3	05

**Appendix E: Atlas 63AX Data**

<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>	<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>	<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>
1AOY	P	63A4	05	1AYY	P	63A4	05	1AYY	P	63A4R	05
1AOY	P	63A4P	05	1AYY	P	63A4	05	1AYY	P	63A4	05
1AOY	PP	63A4P	05	1AYY	P	63A4	05	1AYY	P	63A4	05
1AOY	P	63A4	05	1AYY	P	63A4	05	1AYY	PP	63A4W	05
1AOY	P	63A4	05	1AYY	P	63A4	05	1AYY	P	63A4	05
1AOY	P	63A4	05	1AYY	P	63A4	05	1AYY	P	63A4	05
1AOY	P	63A4	05	1AYY	P	63A4	05	1AYY	P	63A4	05
1AOY	P	63A4	05	1AYY	PP	63A4T	05	1AYY	P	63A4	05
1APY	P	63A4	05	1AYY	P	63A4	05	1AYY	PP	63A4P	05
1APY	P	63A4	05	1AYY	P	63A4	05	1AYY	P	63A4	05
1APY	P	63A4	05	1AYY	P	63A4	05	1AYY	PN	63A4W	05
1APY	P	63A4	05	1AYY	P	63A4	05	1AYY	P	63A4	05
1APY	PF	63A4	05	1AYY	P	63A3	05	1AYY	P	63A4	05
1APY	P	63A4	05	1AYY	P	63A4	05	1AYY	P	63A4	05
1APY	P	63A4	05	1AYY	P	63A4	05	1AYY	P	63A4	05
1APY	P	63A4	05	1AYY	N	63A4	05	1AYY	P	63A4	05
1APY	P	63A4	05	1AYY	O	63A4	05	1AYY	P	63A4	05
1APY	P	63A4	05	1AYY	P	63A4	05	1AYY	P	63A4	05
1APY	P	63A4	05	1AYY	P	63A4	05	1AYY	P	63A3	05
1APY	P	63A4	05	1AYY	P	63A4	05	1AYY	P	63A4	05
1APY	P	63A3	05	1AYY	P	63A4	05	1AYY	P	63A1	05
1ARY	P	63A4	05	1AYY	P	63A4	05	1AYY	P	63A4	05
1ASA	PN	63A4W	05	1AYY	P	63A4	05	1AYY	P	63A4	05
1ASY	P	63A4	05	1AYY	P	63A4	05	1AYY	PP	63A4W	05
1ASY	P	63A4	05	1AYY	P	63A4	05	1AYY	P	63A4	05
1ASY	PP	63A4W	05	1AYY	P	63A4	05	1AYY	P	63A4	05
1ASY	P	63A4	05	1AYY	P	63A4	05	1AYY	P	63A4	05
1ASY	P	63A4	05	1AYY	P	63A4	05	1AYY	P	63A4	05
1ASY	P	63A4	05	1AYY	P	63A4	05	1AYY	P	63A4	05
1ASY	P	63A4	05	1AYY	P	63A4	05	1AYY	P	63A4	05
1ASY	QT	63A4	05	1AYY	P	63A4	05	1AYY	P	63A4	05
1ASY	P	63A4	05	1AYY	P	63A4	05	1AYY	P	63A4	05
1ASY	P	63A4	05	1AYY	P	63A4	05	1AYY	P	63A4	05
1ASY	P	63A4	05	1AYY	PP	63A4W	05	1AYY	P	63A4	05
1ASY	PN	63A4W	05	1AYY	P	63A4	05	1CAN	P	63A4	05
1ASY	PN	63A4W	05	1AYY	P	63A4	05	1CAN	P	63A4	05
1ASY	P	63A4	05	1AYY	P	63A4	05	1CAN	P	63A1	05
1ASY	P	63A4	05	1AYY	P	63A4	05	2BAC	P	63A4W	05
1ASY	P	63A4	05	1AYY	P	63A4	05	2BAC	R	63A4	05
1ASY	P	63A4	05	1AYY	P	63A4	05	2BCA	P	63A3A	05
1ASY	P	63A4	05	1AYY	P	63A4	05	2BDC	PC	63A4	05
1AUU	PP	63A4W	05	1AYY	P	63A4	05	2BDY	PN	63A4W	05
1AUU	P	63A3	05	1AYY	P	63A4	05	2BYY	P	63A4	05
1AVY	P	63A4	05	1AYY	P	63A4	05	2BYY	P	63A4	05
1AVY	P	63A4	05	1AYY	P	63A4	05	3AVY	Q	63A4	05
1AVY	P	63A4	05	1AYY	P	63A4	05	4AAY	R	63A1	05
1AVY	P	63A4	05	1AYY	P	63A4	05	4AEY	P	63A4	05
1AVY	PT	63A4	05	1AYY	PN	63A4W	05	4AEY	P	63A4	05
1AVY	P	63A4	05	1AYY	P	63A4	05	4AFY	P	63A4	05
1AVY	PF	63A4	05	1AYY	P	63A4	05	4AFY	PP	63A4T	05
1AYY	P	63A4	05	1AYY	P	63A4	05	4AFY	P	63A4	05
1AYY	P	63A4	05	1AYY	P	63A4	05	4AFY	P	63A4	05
1AYY	P	63A4	05	1AYY	P	63A4	05	4AFY	P	63A4	05
1AYY	P	63A4	05	1AYY	P	63A4	05	4AGY	P	63A1	05

**Appendix E: Atlas 63AX Data**

<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>	<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>	<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>
4AYY	NF	63A4	05	4IJY	P	63A4	05	4VJY	P	63A4	05
4AYY	P	63A4	05	4IYY	P	63A4	05	4WYY	P	63A4	05
4AYY	RC	63A4	05	4IYY	P	63A4	05	4WYY	P	63A4	05
4AYY	P	63A4	05	4IYY	P	63A4	05	6EMY	P	63A4	05
4AYY	P	63A4	05	4IYY	P	63A4	05	8CGL	R	63A4	05
4AYY	P	63A4	05	4IYY	PF	63A4	05	8CHY	R	63A4	05
4AYY	P	63A4	05	4IYY	P	63A4	05	8CYY	P	63A4	05
4AYY	P	63A4	05	4IYY	P	63A4	05	8CYY	P	63A4	05
4AYY	P	63A4	05	4IYY	P	63A4	05	8HAJ	P	63A4	05
4AYY	R	63A4	05	4IYY	P	63A4	05	8HMJ	P	63A4	05
4AYY	Q	63A4	05	4IYY	P	63A4	05	8HMJ	P	63A4	05
4BAY	P	63A4	05	4IYY	P	63A4	05	8HNY	R	63A4	05
4BAY	R	63A4	05	4IYY	PP	63A4W	05	8HNY	PP	63A4U	05
4BYY	P	63A4	05	4IYY	PP	63A4P	05	8HYY	P	63A4	05
4BYY	P	63A4	05	4IYY	P	63A4	05	8HYY	RF	63A1	05
4BYY	PP	63A4W	05	4IYY	P	63A4	05	9BYY	P	63A4	05
4BYY	P	63A4	05	4IYY	Q	63A4	05	9DYY	P	63A4	05
4BYY	R	63A4	05	4IYY	P	63A4	05	9ECY	PN	63A4V	05
4BYY	PP	63A4U	05	4IYY	P	63A4	05	9EFY	P	63A4	05
4BYY	R	63A4	05	4IYY	PP	63A3P	05	9FAY	P	63A4	05
4BYY	PP	63A4W	05	4LCY	P	63A4	05	9FBY	P	63A4	05
4ECY	P	63A4	05	4LFB	P	63A4	05	9FBY	P	63A4	05
4EEY	P	63A4	05	4LFB	P	63A4	05	9FFB	PC	63A4	05
4EYY	P	63A4	05	4LYY	PN	63A4W	05	9FFB	PC	63A4	05
4EYY	P	63A4	05	4LYY	NP	63A4W	05	9FFB	P	63A4	05
4EYY	PP	63A3W	05	4MBY	P	63A4	05	9FFY	P	63A4	05
4EYY	PP	63A4P	05	4MYY	P	63A4	05	9FYY	P	63A4	05
4GCV	P	63A4	05	4MYY	PP	63A4P	05	9GDY	PN	63A4W	05
4GYY	PF	63A4	05	4MYY	PN	63A4R	05	9GFB	P	63A4W	05
4GYY	NN	63A4W	05	4MYY	P	63A4	05	9GYY	PP	63A4P	05
4HYY	NP	63A4W	05	4MYY	PN	63A4W	05	9GYY	Q	63A4	05
4HYY	P	63A4	05	4MYY	PP	63A4P	05	9GYY	P	63A4	05
4ICY	P	63A4	05	4MYY	PP	63A4P	05	9GYY	P	63A4	05
4ICY	PP	63A4U	05	4MYY	P	63A4	05	9GYY	P	63A4	05
4ICY	P	63A4	05	4QCY	P	63A1	05	9GYY	P	63A4	05
4ICY	P	63A4	05	4QYY	R	63A4	05	9GYY	P	63A4	05
4IDY	P	63A4	05	4SYY	P	63A4	05	9GYY	P	63A4	05
4IDY	P	63A4	05	4THY	P	63A4	05	9GYY	P	63A4	05
4IDY	P	63A4	05	4THY	PA	63A4	05	9GYY	P	63A4	05
4IGY	O	63A4	05	4TJY	P	63A4	05	9GYY	P	63A4	05
4IGY	P	63A4	05	4TJY	P	63A4	05	9GYY	P	63A4	05
4IGY	P	63A4	05	4TJY	P	63A4	05	9GYY	P	63A4	05
4IGY	P	63A4	05	4TJY	P	63A4	05	9GYY	P	63A4	05
4IGY	P	63A4	05	4TYY	PP	63A4W	05	9GYY	PN	63A4W	05
4IHC	P	63A1	05	4VAY	P	63A4	05	9GYY	P	63A4	05
4IHC	P	63A4	05	4VCY	PP	63A4W	05	9GYY	P	63A4	05
4IHY	P	63A4	05	4VCY	PN	63A4P	05	9GYY	P	63A4	05
4IJY	PN	63A4R	05	4VCY	P	63A4	05	9GYY	P	63A4	05
4IJY	P	63A4	05	4VCY	PP	63A4T	05	9GYY	P	63A4	05
4IJY	P	63A4	05	4VCY	PN	63A4W	05	9GYY	PN	63A4U	05



Appendix E: Atlas 63AX Data

<u>Code</u>	<u>Deg</u>	<u>AFSC</u>	<u>Rank</u>
6YYY	P	63A4	06
8AYY	P	63A4	06
8CBY	R	63A4	06
8CYY	R	63A1	06
8DDY	PP	63A4W	06
8FAY	P	63A4	06
8FFC	R	63A4	06
8HEY	R	63A4	06
8HHY	P	63A4	06
9BYY	P	63A1	06
9DHI	P	63A4	06
9ECY	PP	63A4W	06
9ECY	P	63A4	06
9EFY	P	63A3	06
9EYY	P	63A3	06
9EYY	P	63A4	06
9FBY	P	63A4	06
9FFB	P	63A4	06
9GYY	P	63A4	06
9GYY	P	63A4	06
4LYY	N	63A1	03

Code Deg AFSC Rank

Code Deg AFSC Rank

*Appendix F: Graduate Degree and Market Sector Codes for PMP's*

**Type**

- 00 None given
- 01 MS
- 02 MA
- 03 MBA
- 04 Other Masters level
- 05 Ph D
- 06 Other Doctorate level
- 07 Professional degree (e.g. J. D., LL. B.)

**Major**

- 20 None given
- 21 Management
- 22 Systems Management
- 23 Project Management
- 24 Program Management
- 25 Operations Management
- 26 Engineering Management
- 27 Construction Management
- 28 Facilities Management
- 29 Technology Management
- 30 Energy Management
- 31 Project Finance Management
- 32 Risk & Decision Analysis in Projects
- 33 Other Management
- 34 Operations Research
- 35 Engineering (including specialties; Mechanical, Aeronautical, etc.)
- 36 Business (including Business Administration, Finance, etc.)
- 37 Science (Physics, Chemistry, etc.)
- 38 Mathematics/Computer Science
- 39 Humanities (English, Sociology, etc.)
- 40 Other (enter major in "Other" field)

**Market Sector (based on Specific Interest Groups defined by PMI)**

- 01 Automotive
- 02 Construction
- 03 Defense/Aerospace
- 04 Education
- 05 Environmental Restoration
- 06 Financial Services
- 07 Government
- 08 Independent Businesspersons
- 09 Information Management and Movement (formerly telecommunications)
- 10 Information Systems
- 11 New Product Development
- 12 Pharmaceutical
- 13 Project Earth
- 14 Utilities (including energy, oil, gas, etc.)
- 15 Women in Project Management
- 16 (not used)
- 17 Manufacturing/Production
- 18 Other (market sector entered in data field)

Appendix G: Program Management Professional (PMP) Data

ID	MAS DEG	TYPE	MAJ	MARKET SECTOR	ID	MAS DEG	TYPE	MAJ	MARKET SECTOR
1	T	5	36	11	49	T	1	35	2
2	T	2	36	3	50	T	4	40	ARCHITECTURE
3	F	0	20	2	51	T	3	20	2
4	F	0	20	11	52	T	3	20	2
5	F	0	20	ENERGY	53	T	2	21	3
6	T	1	35	3	54	T	0	20	10
7	F	0	20	17	55	F	0	20	2
8	T	3	36	17	56	F	0	20	14
9	T	1	21	11	57	F	0	20	17
10	T	3	20	17	58	F	0	20	3
11	T	3	20	5	59	T	1	26	PM
12	F	0	20	14	60	F	0	20	5
13	T	3	20	3	61	T	3	20	10
14	F	0	20	9	62	T	3	40	STRTMGNT
15	F	0	20	12	63	T	1	38	3
16	T	1	35	2	64	F	0	20	9
17	T	3	20	CHEMICALS	65	T	5	35	7
18	F	0	20	9	66	T	3	20	2
19	T	3	20	2	67	F	0	20	9
20	T	3	20	10	68	F	0	20	14
21	T	0	20	3	69	F	0	20	14
22	T	3	20	3	70	F	0	20	9
23	F	0	20	7	71	T	12	0	3
24	F	0	20	2	72	F	0	20	2
25	T	1	27	2	73	F	0	20	17
26	T	3	20	14	74	F	3	20	10
27	F	0	20	17	75	T	1	38	10
28	T	3	20	TRANSPORT	76	F	0	20	CHEMICALS
29	T	1	35	14	77	F	0	20	14
30	F	0	20	2	78	T	3	20	14
31	F	0	20	3	79	F	0	20	14
32	T	1	36	3	80	T	0	20	3
33	F	0	20	14	81	T	5	39	7
34	T	1	33	FIN MGT	82	T	1	21	9
35	F	0	20	CHEMICALS	83	T	1	35	14
36	F	0	20	2	84	F	0	20	2
37	T	1	26	3	85	T	1	35	2
38	F	0	20	14	86	T	3	20	3
39	F	0	20	10	87	F	0	20	2
40	T	1	20	17	88	T	3	20	2
41	T	3	20	14	89	F	0	20	9
42	F	0	20	2	90	F	0	20	10
43	T	1	40	ADMIN	91	T	1	40	ADMIN
44	T	0	20	CHEMICALS	92	T	0	20	11
45	F	0	20	17	93	T	1	35	2
46	T	0	20	3	94	T	3	36	2
47	T	1	35	5	95	T	5	35	4
48	F	0	20	10	96	T	0	20	9

Appendix G: Program Management Professional (PMP) Data

ID	MAS	TYPE	MAJ	MARKET	ID	MAS	TYPE	MAJ	MARKET
DEG				SECTOR	DEG				SECTOR
97	F	0	20	2	145	T	1	35	3
98	F	0	20	PM	146	T	1	21	3
99	F	0	20	ARCHITECTURE	147	F	0	20	ARCHITECTURE
100	T	1	35	ARCHITECTURE	148	F	0	20	ARCHITECTURE
101	F	0	20	2	149	T	1	23	3
102	T	5	35	MINING	150	T	5	40	PUB POLICY PM
103	F	0	20	2	151	T	3	36	10
104	F	0	20	PM	152	T	3	20	7
105	F	0	20	9	153	T	3	20	10
106	F	0	20	2	154	T	0	20	14
107	F	0	20	2	155	F	0	20	14
108	T	3	36	PM	156	T	3	20	14
109	F	0	20	12	157	F	0	20	9
110	T	2	35	2	158	F	0	20	7
111	T	4	35	17	159	F	0	20	CHEMICALS
112	T	1	35	3	160	T	3	20	2
113	T	3	20	3	161	T	3	20	2
114	T	4	40	MSTRENG	162	T	3	21	3
115	F	0	20	2	163	T	0	20	10
116	T	3	20	3	164	F	0	20	PM
117	F	0	20	CHEMICALS	165	T	0	20	PM
118	F	0	20	9	166	T	1	33	3
119	F	0	20	14	167	T	0	20	10
120	F	0	20	10	168	F	0	20	3
121	T	3	20	17	169	F	0	20	14
122	F	0	20	9	170	F	0	20	2
123	T	0	20	10	171	T	0	20	3
124	F	0	20	2	172	T	0	20	3
125	F	0	20	14	173	F	0	20	2
126	F	0	20	2	174	T	1	27	2
127	F	0	20	5	175	F	0	20	PM
128	F	0	20	14	176	T	2	39	9
129	F	0	20	14	177	T	3	20	10
130	T	0	20	10	178	F	0	20	10
131	F	0	20	10	179	T	3	20	5
132	T	7	40	LAW	180	F	0	20	2
133	F	0	20	2	181	F	0	20	2
134	F	0	20	14	182	T	1	35	14
135	T	1	35	5	183	F	0	20	10
136	T	3	20	2	184	T	1	21	3
137	F	0	20	2	185	T	0	20	10
138	T	3	20	17	186	F	0	20	14
139	F	0	20	9	187	T	3	20	2
140	F	0	20	9	188	T	4	35	2
141	T	2	35	2	189	F	0	20	PM
142	F	0	20	9	190	T	4	36	9
143	F	0	20	PM	191	F	0	20	14
144	F	0	20	14	192	F	0	20	3

Appendix G: Program Management Professional (PMP) Data

ID	MAS	TYPE	MAJ	MARKET	ID	MAS	TYPE	MAJ	MARKET
	DEG			SECTOR		DEG			SECTOR
193	F	0	20	2	241	T	0	20	3
194	T	0	20	10	242	T	1	35	3
195	F	0	20	2	243	F	0	20	14
196	F	0	20	10	244	F	0	20	9
197	F	0	20	2	245	T	5	35	5
198	T	1	35	3	246	F	0	20	2
199	T	3	20	14	247	T	0	20	3
200	F	0	20	2	248	T	3	20	6
201	F	0	20	PM	249	F	0	20	9
202	T	0	20	2	250	T	1	35	14
203	F	0	20	10	251	F	0	20	9
204	T	1	38	10	252	T	5	20	4
205	F	0	20	11	253	F	0	20	14
206	F	0	20	2	254	F	0	20	10
207	F	0	20	9	255	T	3	20	2
208	T	1	20	14	256	T	1	22	3
209	F	0	20	3	257	T	2	39	6
210	T	4	35	14	258	F	0	20	14
211	T	3	20	14	259	T	1	31	3
212	F	0	20	14	260	F	0	20	CHEMICALS
213	T	1	33	14	261	T	0	20	14
214	T	3	20	4	262	T	1	35	10
215	F	0	20	10	263	F	0	20	CHEMICALS
216	T	0	20	3	264	T	0	20	3
217	T	1	27	2	265	T	3	20	2
218	T	3	20	5	266	F	0	20	10
219	T	0	20	10	267	F	0	20	14
220	T	0	20	3	268	F	0	20	3
221	T	3	20	3	269	T	0	20	2
222	T	1	25	PM	270	T	3	36	5
223	T	0	20	CHEMICALS	271	F	0	20	10
224	T	3	36	10	272	F	0	20	2
225	T	4	36	3	273	F	0	20	2
226	F	0	20	14	274	F	0	20	2
227	F	0	20	7	275	F	0	20	14
228	T	0	20	3	276	T	0	20	5
229	F	0	20	9	277	T	0	20	2
230	F	0	20	2	278	T	0	20	2
231	T	1	35	17	279	F	0	20	14
232	T	1	20	10	280	T	3	20	14
233	T	3	21	6	281	F	0	20	10
234	F	0	20	9	282	F	0	20	2
235	T	1	35	9	283	F	0	20	14
236	T	1	35	2	284	T	0	20	3
237	T	0	20	10	285	T	1	20	3
238	T	3	20	PM	286	T	3	35	2
239	T	1	35	5	287	F	0	20	11
240	F	0	20	17	288	F	0	20	14

Appendix G: Program Management Professional (PMP) Data

ID	MAS	TYPE	MAJ	MARKET	ID	MAS	TYPE	MAJ	MARKET
DEG				SECTOR	DEG				SECTOR
289	F	0	20	3	337	F	0	20	2
290	T	1	35	17	338	T	1	22	4
291	F	0	20	14	339	F	0	20	14
292	F	0	20	2	340	F	0	20	10
293	T	4	23	2	341	T	3	20	3
294	T	3	20	14	342	T	0	20	14
295	T	4	35	2	343	T	0	20	14
296	T	0	20	PM	344	F	0	20	17
297	F	0	20	2	345	F	0	20	3
298	T	3	20	3	346	F	0	20	17
299	T	4	23	3	347	F	0	20	17
300	F	0	20	3	348	T	1	35	7
301	F	0	20	9	349	T	1	22	3
302	T	2	40	URBAN PLANNING	350	F	0	20	14
303	T	3	20	9	351	F	0	20	2
304	F	0	20	10	352	T	3	22	2
305	T	5	20	4	353	F	0	20	2
306	F	0	20	3	354	T	1	35	2
307	F	0	20	9	355	T	1	35	17
308	F	0	20	14	356	F	0	20	10
309	T	0	20	2	357	T	3	36	3
310	T	4	40	MIL SCIENCE	358	F	0	20	2
311	F	0	20	PM	359	T	3	20	PM
312	T	3	20	9	360	F	0	20	2
313	F	0	20	17	361	T	3	21	3
314	F	0	20	10	362	T	3	40	INFO SYST PM
315	T	1	22	7	363	T	1	38	10
316	T	3	20	10	364	F	0	20	14
317	F	0	20	10	365	F	0	20	7
318	F	0	20	9	366	T	0	20	10
319	F	0	20	2	367	F	0	20	17
320	T	5	20	PM	368	F	0	20	14
321	T	1	35	3	369	T	2	21	7
322	T	4	40	ADMIN	370	F	0	20	9
323	T	6	40	ENG ADMN	371	T	1	35	5
324	F	0	20	3	372	F	0	20	3
325	F	0	20	2	373	F	0	20	10
326	T	4	40	ADMIN	374	T	4	35	10
327	T	3	40	ADMIN	375	T	1	35	10
328	F	0	20	2	376	F	0	20	7
329	T	3	20	14	377	F	0	20	9
330	T	3	20	14	378	F	0	20	17
331	T	2	20	10	379	T	4	26	14
332	T	1	40	HEALTH MGT	380	F	0	20	5
333	F	0	20	PM	381	T	3	20	9
334	F	0	20	10	382	T	4	38	14
335	F	0	20	10	383	F	0	20	14
336	T	0	20	2	384	F	0	20	10

Appendix G: Program Management Professional (PMP) Data

ID	MAS	TYPE	MAJ	MARKET	ID	MAS	TYPE	MAJ	MARKET
DEG				SECTOR	DEG				SECTOR
385	T	4	40	CONSTRUCTION	433	F	0	20	3
386	T	1	21	10	434	T	1	27	2
387	F	0	20	2	435	F	0	20	5
388	F	0	20	17	436	F	0	20	PM
389	F	0	20	9	437	T	0	20	3
390	F	0	20	2	438	F	0	20	9
391	T	0	20	10	439	F	0	20	2
392	T	0	20	9	440	F	0	20	3
393	T	3	20	CHEMICALS	441	F	0	20	HEALTH CARE
394	T	2	39	3	442	F	0	20	2
395	T	3	20	12	443	T	4	21	9
396	T	0	20	3	444	T	1	23	17
397	T	3	20	2	445	T	1	40	ENG ADMN
398	T	5	20	4	446	F	0	20	9
399	T	0	20	17	447	F	0	20	3
400	T	4	38	9	448	F	0	20	14
401	F	0	20	9	449	F	0	20	10
402	T	3	20	PM	450	F	0	20	14
403	F	0	20	2	451	F	0	20	17
404	T	0	20	3	452	F	0	20	2
405	F	0	20	2	453	T	3	36	9
406	F	0	20	2	454	T	3	20	14
407	F	0	20	9	455	T	1	35	5
408	F	0	20	1	456	F	0	20	9
409	F	0	20	PM	457	T	3	20	3
410	F	0	20	2	458	T	0	20	1
411	T	1	38	17	459	T	1	35	2
412	F	0	20	2	460	F	0	20	2
413	F	0	20	9	461	T	1	35	3
414	T	5	40	ENVION DESIGN	462	F	0	20	9
415	F	0	20	2	463	F	0	20	3
416	T	3	20	10	464	T	1	22	3
417	T	1	36	9	465	F	0	20	9
418	T	1	22	3	466	F	0	20	3
419	T	3	36	11	467	T	1	26	3
420	T	0	20	3	468	F	0	20	17
421	F	0	20	14	469	T	0	20	14
422	F	0	20	5	470	F	0	20	14
423	F	0	20	TRANSPORTATN	471	F	0	20	14
424	F	0	20	17	472	T	1	35	2
425	T	1	27	2	473	T	0	20	7
426	T	3	20	3	474	T	3	20	9
427	T	0	20	9	475	F	0	20	3
428	T	3	40	INFO TECH PM	476	T	3	36	3
429	T	3	20	7	477	F	0	20	3
430	T	4	35	3	478	F	0	20	2
431	T	3	20	17	479	T	1	22	7
432	T	0	20	3	480	F	0	20	17

Appendix G: Program Management Professional (PMP) Data

ID	MAS	TYPE	MAJ	MARKET	ID	MAS	TYPE	MAJ	MARKET
DEG				SECTOR	DEG				SECTOR
481	F	0	20	2	529	T	0	20	9
482	T	1	20	3	530	T	0	20	4
483	F	0	20	3	531	T	0	20	17
484	F	0	20	2	532	F	0	20	2
485	F	0	20	17	533	T	0	20	9
486	F	0	20	3	534	T	3	36	14
487	F	0	20	2	535	T	3	20	2
488	T	0	20	PM	536	F	0	20	10
489	F	0	20	2	537	T	3	20	PM
490	F	0	20	9	538	T	3	21	3
491	T	0	20	14	539	T	4	40	ADMIN
492	T	4	35	3	540	T	1	20	2
493	T	3	20	14	541	T	0	20	10
494	F	0	20	PM	542	T	3	20	2
495	F	0	20	17	543	T	1	40	INFO_MGT9
496	F	0	20	PM	544	F	0	20	14
497	F	0	20	14	545	T	3	20	3
498	F	0	20	2	546	F	0	20	MINING
499	T	3	20	PM	547	T	1	35	10
500	T	1	20	14	548	F	0	20	3
501	T	1	21	10	549	T	0	20	9
502	T	3	20	14	550	T	1	27	2
503	T	4	35	17	551	T	0	20	2
504	F	0	20	17	552	T	1	22	3
505	F	0	20	3	553	F	0	20	2
506	F	0	20	2	554	T	3	36	2
507	T	0	20	3	555	T	1	35	PM
508	T	5	39	7	556	F	0	20	14
509	T	0	20	9	557	F	0	20	9
510	F	0	20	2	558	T	3	36	2
511	F	0	20	17	559	F	0	20	2
512	T	1	35	10	560	T	0	20	9
513	F	0	20	PM	561	T	4	27	2
514	F	0	20	14	562	T	1	20	9
515	F	0	20	14	563	F	0	20	2
516	F	0	20	PM	564	F	0	20	9
517	T	4	35	14	565	F	0	20	2
518	F	0	20	9	566	T	3	20	9
519	T	4	27	2	567	F	0	20	14
520	F	0	20	2	568	T	1	40	PRSNNEL17
521	F	0	20	2	569	T	3	36	1
522	T	1	27	2	570	F	0	20	10
523	T	0	20	3	571	T	1	35	3
524	F	0	20	2	572	F	0	20	3
525	F	0	20	5	573	F	0	20	14
526	T	3	36	9	574	T	1	20	3
527	T	1	27	2	575	T	3	36	3
528	F	0	20	2	576	T	7	40	LAWPM

Appendix G: Program Management Professional (PMP) Data

ID	MAS	TYPE	MAJ	MARKET	ID	MAS	TYPE	MAJ	MARKET
DEG				SECTOR	DEG				SECTOR
577	T	1	22	3	625	F	0	20	17
578	T	3	40	MRKTING9	626	F	0	20	5
579	T	0	20	14	627	T	3	20	14
580	F	0	20	9	628	T	3	20	PM
581	T	0	20	7	629	T	0	20	3
582	T	0	20	3	630	F	0	20	3
583	F	0	20	9	631	F	0	20	14
584	T	2	36	3	632	F	0	20	2
585	T	1	38	10	633	F	0	20	2
586	T	1	20	3	634	F	0	20	14
587	F	0	20	2	635	F	0	20	6
588	T	1	35	3	636	F	0	20	14
589	T	3	20	10	637	T	2	40	EDCATIONPM
590	F	0	20	3	638	T	3	20	14
591	T	0	20	14	639	T	1	35	10
592	T	4	35	2	640	T	5	38	10
593	T	0	20	9	641	F	0	20	9
594	T	5	40	INFO_SYS3	642	T	3	20	3
595	F	0	20	17	643	T	0	20	17
596	F	0	20	9	644	T	4	40	ARCHTCTR17
597	F	0	20	14	645	F	0	20	PM
598	F	0	20	PM	646	F	0	20	5
599	F	0	20	14	647	T	0	20	14
600	F	0	20	9	648	T	3	20	3
601	T	0	20	3	649	F	0	20	9
602	F	0	20	17	650	F	0	20	14
603	T	3	20	2	651	T	3	20	5
604	T	3	40	IND_MGNT5	652	F	0	20	TRNSPRTATN
605	T	3	20	9	653	F	0	20	17
606	T	3	36	9	654	T	3	20	2
607	T	4	26	14	655	F	0	20	17
608	F	0	20	9	656	F	0	20	14
609	F	0	20	2	657	T	2	38	14
610	F	0	20	2	658	T	3	36	9
611	T	0	20	2	659	T	3	20	14
612	F	0	20	9	660	T	0	20	3
613	T	1	35	PM	661	T	0	20	2
614	F	0	20	2	662	T	4	23	14
615	T	1	35	14	663	F	0	20	9
616	F	0	20	14	664	T	4	35	3
617	F	0	20	14	665	F	0	20	17
618	F	0	20	2	666	F	0	20	9
619	F	0	20	9	667	F	0	20	CHEMICALS
620	T	0	20	3	668	T	0	20	17
621	F	0	20	9	669	F	0	20	9
622	F	0	20	PM	670	F	0	20	3
623	T	1	22	3	671	T	3	20	2
624	T	1	26	14	672	T	3	20	14

Appendix G: Program Management Professional (PMP) Data

ID	MAS	TYPE	MAJ	MARKET	ID	MAS	TYPE	MAJ	MARKET
DEG				SECTOR	DEG				SECTOR
673	F	0	20	14	721	T	1	39	2
674	F	0	20	2	722	T	3	02	
675	F	0	20	17	723	F	0		14
676	F	0	20	3	724	T	1	20	PM
677	T	1	27	2	725	T	1	35	PM
678	F	0	20	14	726	F	0		9
679	F	0	20	9	727	T	1	35	2
680	T	0	20	17	728	F	0		14
681	F	0		2	729	T	1	27	2
682	F	0		3	730	F	0		3
683	F	0		9	731	T	0	20	3
684	T	1	20	17	732	F	0		2
685	T	4	20	16	733	T	1	35	3
686	F	0		10	734	F	0		3
687	T	3	20	17	735	T	4	40	ADMIN
688	F	0		9	736	F	0		3
689	T	4	40	ELEC ENGINEER	737	T	3	0	3
690	F	0		3	738	F	0		PM
691	T	1	27	2	739	T	4	21	INT'L MGT
692	F	0		3	740	F	0		9
693	F	0		3	741	F	0		14
694	F	0		18	742	F	0		3
695	T	3	20	17	743	F	0		PM
696	T	1	40	MECH ENGINEER	744	F	0		2
697	T	3	20	2	745	F	0		5
698	F	0		MINING	746	T	3	36	3
699	F	0		10	747	F	0		2
700	T	1	21	PM	748	F	0		17
701	F	0		2	749	F	0		2
702	F	0		10	750	T	4	40	ARCHITECTURE
703	F	0		4	751	F	0		PM
704	T	14	0	FRENCH	752	T	1	35	17
705	T	4	21	10	753	T	1	27	14
706	T	4	20	2	754	T	0	20	10
707	F	0		2	755	T	3	0	3
708	F	0		2	756	F	0		9
709	T	3	20	14	757	F	0		14
710	F	0		9	758	T	0	20	11
711	F	0		10	759	F	0		14
712	F	0		10	760	T	0	20	3
713	F	0		9	761	T	1	35	2
714	T	30	17		762	T	1	35	10
715	F	0		PM	763	T	1	35	14
716	F	0		2	764	T	3	36	PM
717	F	0		PM	765	T	1	35	10
718	F	0		14	766	F	0		17
719	T	3	01	4	767	T	1	38	17
720	F	0		14	768	T	3	0	14

Appendix G: Program Management Professional (PMP) Data

ID	MAS	TYPE	MAJ	MARKET	ID	MAS	TYPE	MAJ	MARKET
DEG				SECTOR	DEG				SECTOR
769	T	3	0	3	817	T	3	0	3
770	F	0		PM	818	T	0	20	PM
771	T	0	20	14	819	F	0		PM
772	T	3	0	14	820	T	0	20	3
773	T	3	0	2	821	F	0		3
774	F	0		PM	822	F	0		17
775	F	0		2	823	F	0		2
776	T	3	0	2	824	F	0		PM
777	F	0		17	825	T	1	22	3
778	F	0		17	826	F	0		2
779	F	0		9	827	F	0		2
780	F	0		3	828	F	0		12
781	F	0		14	829	T	1	35	OCEAN PM
782	F	0		17	830	T	3	0	2
783	T	1	35	3	831	T	3	0	3
784	T	0	20	9	832	T	3	0	2
785	F	0		2	833	F	0		2
786	F	0		5	834	T	1	35	2
787	T	1	31	3	835	F	0		6
788	T	1	26	7	836	F	0		PM
789	T	1	35	MINING	837	T	0	20	3
790	T	3	0	9	838	T	3	0	14
791	F	0		1	839	T	0	20	10
792	F	0		PM	840	T	1	35	STRUCT ENG
793	T	0	20	10	841	F	0		DRAFTER
794	F	0		10	842	F	0		14
795	T	1	35	14	843	F	0		2
796	T	0	20	3	844	T	0	20	6
797	T	0	20	14	845	F	0		14
798	T	1	36	3	846	T	3	0	6
799	T	3	0	PM	847	T	1	35	3
800	F	0		3	848	F	0		17
801	T	1	40	TELECOM	849	T	1	35	3
802	F	0		PM	850	F	0		14
803	T	1	35	3	851	T	1	22	3
804	F	0		14	852	T	1	35	10
805	F	0		17	853	T	3	0	2
806	T	0	20	3	854	F	0		3
807	T	1	40	ADMIN	855	T	3	0	14
808	T	1	38	3	856	F	0		3
809	F	0		2	857	F	0		10
810	T	0	20	MINING	858	F	0		PM
811	T	1	37	3	859	T	1	33	3
812	T	1	21	10	860	F	0		9
813	T	0	20	PM	861	F	0		3
814	T	3	0	14	862	T	3	0	9
815	F	0		9	863	T	4	40	COMPINF
816	F	0		INSUR	864	F	0		2

Appendix G: Program Management Professional (PMP) Data

ID	MAS	TYPE	MAJ	MARKET	ID	MAS	TYPE	MAJ	MARKET
	DEG			SECTOR		DEG			SECTOR
865	F	0		17	913	F	0		14
866	F	0		10	914	T	1	26	17
867	F	0		2	915	T	4	40	EXEC
868	T	3	0	PM	916	F	0		2
869	F	0		17	917	F	0		10
870	F	0		17	918	F	0		9
871	T	1	38	10	919	T	0	20	14
872	F	0		2	920	F	0		2
873	F	0		9	921	F	0		2
874	T	1	22	2	922	F	0		10
875	F	C		17	923	T	1	22	10
876	F	0		10	924	F	0		14
877	T	0	20	3	925	T	2	21	17
878	F	0		14	926	T	1	26	PM
879	T	4	35	17	927	T	0	20	8
880	T	0	20	PM	928	F	0		2
881	F	0		14	929	F	0		2
882	T	0	20	10	930	F	0		3
883	F	0		2	931	T	3	0	PM
884	T	3	0	3	932	T	0	20	3
885	F	0		11	933	F	0		2
886	T	0	20	2	934	F	0		3
887	F	0		14	935	T	1	38	10
888	T	0	20	9	936	F	0		2
889	T	3	0	10	937	F	0		10
890	T	1	38	3	938	F	0		3
891	T	1	33	14	939	T	1	21	10
892	F	J		PM	940	F	0		PM
893	T	0	20	10	941	T	4	35	MASTER ENG
894	F	0		9	942	F	0		17
895	F	0		2	943	T	4	39	9
896	F	0		9	944	F	0		14
897	T	1	40	ADMIN	945	F	0		10
898	T	1	21	14	946	T	1	35	3
899	T	0	20	PM	947	F	0		9
900	T	4	40	PUBLIC ADMIN	948	F	0		9
901	T	1	35	14	949	T	1	35	8
902	F	0		9	950	F	0		9
903	F	0		6	951	F	0		5
904	T	1	22	3	952	F	0		10
905	F	0		10	953	F	0		PM
906	T	0	20	PM	954	T	0	20	17
907	T	2	20	9	955	F	0		14
908	F	0		1	956	T	0	20	14
909	F	0		7	957	T	0	20	3
910	T	3	0	PM	958	F	0		14
911	T	1	35	5	959	F	0		10
912	T	0	20	9	960	F	0		PM

Appendix G: Program Management Professional (PMP) Data

ID	MAS	TYPE	MAJ	MARKET	ID	MAS	TYPE	MAJ	MARKET
DEG				SECTOR	DEG				SECTOR
961	F	0		9	1009	T	1	35	2
962	T	0	20	9	1010	T	1	35	PM
963	F	0		10	1011	T	3	0	3
964	T	1	35	3	1012	T	1	37	17
965	F	0		3	1013	F	0		9
966	F	0		2	1014	T	4	35	3
967	F	0		3	1015	T	1	21	PM
968	T	3	0	2	1016	F	0		17
969	T	3	0	PM	1017	F	0		14
970	T	1	22	PM	1018	F	0		3
971	T	3	0	10	1019	F	0		9
972	F	0		10	1020	T	0	20	5
973	T	4	39	PM	1021	F	0		3
974	T	1	35	8	1022	T	4	21	3
975	T	1	35	3	1023	T	0	20	17
976	F	0		PM	1024	F	0		PM
977	F	0		10	1025	F	0		17
978	F	0		2	1026	T	4	40	CONST MGT
979	F	0		17	1027	T	3	0	2
980	T	1	40	ADMIN	1028	F	0		14
981	T	1	35	10	1029	T	3	0	14
982	F	0		PM	1030	F	0		7
983	F	0		2	1031	F	0		14
984	T	1	35	3	1032	F	0		2
985	F	0		7	1033	F	0		2
986	T	1	20	14	1034	T	3	0	10
987	F	0		2	1035	F	0		2
988	T	0	20	9	1036	F	0		2
989	F	0		9	1037	F	0		14
990	T	3	0	5	1038	F	0		14
991	F	0		2	1039	F	0		2
992	T	3	0	9	1040	F	0		14
993	F	0		2	1041	F	0		2
994	T	0	20	18	1042	F	0		2
995	F	0		14	1043	T	1	35	9
996	T	1	33	LOGISTICS	1044	T	1	35	10
997	T	1	22	3	1045	T	3	0	2
998	F	0		10	1046	F	0		2
999	T	1	35	2	1047	T	0	20	18
1000	T	3	0	3	1048	F	0		2
1001	T	0	20	14	1049	F	0		2
1002	F	0		17	1050	F	0		5
1003	T	4	40	PUBLIC ADMIN	1051	F	0		9
1004	T	1	35	3	1052	F	0		2
1005	T	3	0	5	1053	F	0		2
1006	F	0		10	1054	T	3	0	2
1007	T	0	20	2	1055	F	0		PM
1008	T	1	35	3	1056	F	0		2

Appendix G: Program Management Professional (PMP) Data

ID	MAS	TYPE	MAJ	MARKET	ID	MAS	TYPE	MAJ	MARKET
DEG				SECTOR	DEG				SECTOR
1057	T	4	40	TECHNOLOGY PM	1105	F	0		9
1058	T	1	38	3	1106	F	0		5
1059	T	4	40	TELECOMM	1107	F	0		2
1060	T	1	22	PM	1108	T	0	20	17
1061	T	0	20	10	1109	F	0		9
1062	T	1	35	3	1110	F	0		3
1063	T	1	38	9	1111	F	0		9
1064	F	0		5	1112	F	0		PM
1065	F	0		2	1113	T	0	20	9
1066	T	0	20	2	1114	F	0		PM
1067	T	3	0	PM	1115	T	4	37	ENVIRN SCIENCE
1068	T	4	40	ENGIN ADMIN	1116	T	1	22	PM
1069	T	3	0	9	1117	F	0		9
1070	F	0		PM	1118	F	0		9
1071	F	0		9	1119	T	2	39	9
1072	F	0		14	1120	T	2	36	BUS MGT
1073	F	0		PM	1121	F	0		2
1074	T	0	20	10	1122	T	1	35	3
1075	F	0		17	1123	T	2	21	3
1076	F	0		2	1124	T	1	35	9
1077	F	0		4	1125	T	0	20	4
1078	F	0		10	1126	T	4	40	CONST MGT
1079	F	0		17	1127	F	0		3
1080	F	0		17	1128	F	0		PM
1081	F	0		14	1129	F	0		9
1082	T	0	20	17	1130	F	0		17
1083	T	3	0	2	1131	F	0		PM
1084	T	0	20	PM	1132	T	0	20	7
1085	F	0		10	1133	F	0		17
1086	T	0	20	2	1134	F	0		2
1087	F	0		PM	1135	F	0		6
1088	T	4	36	LEADERSHIP MGT	1136	F	0		2
1089	T	1	35	3	1137	T	0	20	2
1090	T	1	35	14	1138	T	0	20	2
1091	T	3	0	4	1139	T	1	22	PM
1092	F	0		PM	1140	F	0		2
1093	F	0		7	1141	T	3	0	10
1094	T	0	20	2	1142	F	0		9
1095	F	0		14	1143	F	0		2
1096	F	0		PM	1144	F	0		3
1097	F	0		2	1145	T	1	22	3
1098	F	0		2	1146	T	3	0	3
1099	F	0		17	1147	F	0		2
1100	T	3	0	3	1148	T	3	0	2
1101	T	1	35	3	1149	F	0		14
1102	T	1	40	ADMIN PM	1150	F	0		14
1103	F	0		PM	1151	F	0		17
1104	F	0		2	1152	T	4	34	10

Appendix G: Program Management Professional (PMP) Data

ID	MAS	TYPE	MAJ	MARKET	ID	MAS	TYPE	MAJ	MARKET
DEG				SECTOR	DEG				SECTOR
1153	F	0		3	1201	T	0	20	PM
1154	F	0		10	1202	F	0		14
1155	F	0		14	1203	F	0		9
1156	T	3	0	PM	1204	T	1	21	18
1157	T	2	39	PM	1205	F	0		PM
1158	F	0		17	1206	F	0		10
1159	T	3	0	18	1207	F	0		14
1160	T	0	20	PM	1208	T	3	0	4
1161	F	0		PM	1209	F	0		14
1162	T	3	0	14	1210	F	0		PM
1163	T	0	20	17	1211	T	1	35	3
1164	T	4	37	2	1212	F	0		10
1165	F	0		17	1213	T	3	0	10
1166	T	3	40	FINANCE	1214	T	4	35	2
1167	F	0		5	1215	T	4	23	1
1168	F	0		7	1216	F	0		2
1169	F	0		2	1217	T	1	37	14
1170	F	0		9	1218	F	0		5
1174	F	0		3	1219	F	0		2
1172	T	3	0	10	1220	T	0	20	17
1173	F	0		7	1221	T	1	35	17
1174	T	4	40	COMMERCE	1222	F	0		14
1175	F	0		10	1223	F	0		PM
1176	F	0		10	1224	T	0	35	2
1177	T	0	20	14	1225	T	2	36	PM
1178	F	0		PM	1226	T	0	20	10
1179	F	0		14	1227	T	0	20	14
1180	F	0		PM	1228	T	1	39	PSYCOLOGY
1181	T	1	40	GEOLOGY	1229	F	0		PM
1182	T	0	20	2	1230	T	1	27	17
1183	T	1	20	PM	1231	F	0		17
1184	F	0		10	1232	T	4	35	14
1185	F	0		PM	1233	T	0	20	10
1186	F	0		17	1234	F	0		9
1187	T	3	0	5	1235	T	4	39	EDUCATION
1188	F	0		3	1236	F	0		3
1189	F	0		2	1237	T	1	35	14
1190	F	0		10	1238	T	0	20	3
1191	F	0		PM	1239	T	1	26	14
1192	F	0		14	1240	T	2	20	17
1193	F	0		PM	1241	F	0		2
1194	F	0		10	1242	F	0		2
1195	F	0		10	1243	F	0		14
1196	T	1	35	3	1244	T	1	36	2
1197	T	0	20	3	1245	F	0		3
1198	T	0	20	14	1246	F	0		PM
1199	T	3	0	3	1247	F	0		9
1200	F	0		10	1248	F	0		2

Appendix G: Program Management Professional (PMP) Data

ID	MAS	TYPE	MAJ	MARKET	ID	MAS	TYPE	MAJ	MARKET
DEG				SECTOR	DEG				SECTOR
1249	T	3	0	7	1297	F	0		9
1250	F	0		2	1298	F	0		PM
1251	T	3	0	9	1299	F	0		PM
1252	T	1	35	3	1300	T	1	22	3
1253	F	0		2	1301	T	3	0	2
1254	F	0		PM	1302	F	0		2
1255	F	0		PM	1303	T	4	40	ADMIN
1256	T	0	20	PM	1304	T	2	23	PM
1257	T	0	20	17	1305	T	1	38	10
1258	T	0	20	PM	1306	F	0		PM
1259	T	3	0	14	1307	T	0	40	INFO SCIENCE
1260	T	1	34	PM	1308	F	0		PM
1261	F	0		14	1309	T	3	0	2
1262	F	0		17	1310	F	0		PM
1263	F	0		9	1311	F	0		2
1264	F	0		PM	1312	F	0		14
1265	T	3	0	PM	1313	T	3	0	17
1266	T	1	35	PM	1314	F	0		10
1267	F	0		10	1315	T	1	35	PM
1268	F	0		9	1316	T	3	0	3
1269	T	1	35	2	1317	T	1	27	4
1270	F	0		10	1318	T	1	33	MGT SCIENCE
1271	T	4	35	3	1319	T	3	0	3
1272	F	0		2	1320	F	0		PM
1273	F	0		2	1321	T	0	20	9
1274	T	1	35	7	1322	F	0		17
1275	T	3	0	2	1323	T	0	20	17
1276	T	1	40	BUILDING	1324	F	0		10
1277	T	3	0	10	1325	T	3	0	17
1278	F	0		14	1326	T	3	0	10
1279	F	0		2	1327	F	0		2
1280	F	0		9	1328	T	3	0	10
1281	T	1	22	3	1329	F	0		PM
1282	T	1	40	R&D	1330	T	3	0	3
1283	F	0		7	1331	T	3	0	3
1284	T	0	20	3	1332	F	0		14
1285	T	3	0	2	1333	T	4	35	ENVIRON
1286	T	1	21	3	1334	T	4	23	2
1287	T	1	40	ENGADMI	1335	F	0		PM
1288	F	0		9	1336	T	1	39	ORG DEV
1289	F	0		2	1337	T	0	20	14
1290	F	0		7	1338	F	0		5
1291	T	3	0	17	1339	F	0		PM
1292	T	1	40	URB&REG	1340	F	0		9
1293	F	0		14	1341	T	1	35	17
1294	T	1	35	PM	1342	F	0		2
1295	T	3	40	MARKETNG	1343	T	1	35	3
1296	F	0		2	1344	F	0		17

Appendix G: Program Management Professional (PMP) Data

ID	MAS	TYPE	MAJ	MARKET	ID	MAS	TYPE	MAJ	MARKET
DEG				SECTOR	DEG				SECTOR
1345	F	0		PM	1393	F	0		PM
1346	T	1	26	14	1394	T	3	0	14
1347	T	0	20	3	1395	F	0		PM
1348	F	0		2	1396	F	0		14
1349	T	0	20	11	1397	T	1	39	9
1350	T	4	35	14	1398	F	0		14
1351	F	0		3	1399	T	1	35	17
1352	T	1	35	17	1400	T	1	35	3
1353	T	2	40	COMM PM	1401	T	3	0	14
1354	T	4	40	ENG SCIENCE	1402	F	0		10
1355	T	0	20	PM	1403	F	0		10
1356	T	0	20	PM	1404	F	0		3
1357	F	0		10	1405	F	0		9
1358	F	0		PM	1406	F	0		17
1359	F	0		1	1407	F	0		9
1360	F	0		9	1408	F	0		PM
1361	F	0		PM	1409	T	3	0	PM
1362	F	0		14	1410	T	1	35	17
1363	F	0		3	1411	F	0		PM
1364	T	1	20	PM	1412	T	1	35	PM
1365	F	0		PM	1413	F	0		17
1366	F	0		14	1414	T	1	35	4
1367	F	0		PM	1415	F	0		2
1368	F	0		14	1416	F	0		2
1369	F	0		14	1417	T	0	20	9
1370	F	0		PM	1418	T	3	0	9
1371	T	0	20	17	1419	T	3	0	FINANCE
1372	F	0		7	1420	T	1	35	10
1373	T	3	0	PM	1421	F	0		10
1374	T	0	20	2	1422	F	0		17
1375	F	0		2	1423	F	0		PM
1376	F	0		PM	1424	F	0		7
1377	F	0		PM	1425	F	0		17
1378	F	0		9	1426	T	0	20	3
1379	T	0	20	PM	1427	F	0		14
1380	F	0		PM	1428	T	1	35	14
1381	F	0		14	1429	F	0		9
1382	T	1	22	3	1430	T	7	33	CANADA
1383	F	0		PM	1431	F	0		10
1384	F	0		9	1432	F	0		
1385	T	1	21	LOGISTIC	1433	F	0		17
1386	T	0	20	PM	1434	F	0		3
1387	T	4	35	PM	1435	T	1	35	3
1388	F	0		3	1436	T	3	0	3
1389	T	3	0	PM	1437	F	0		PM
1390	F	0		2	1438	T	0	20	3
1391	T	1	36	14	1439	T	1	36	PM
1392	T	3	0	14	1440	T	0	20	PM

Appendix G: Program Management Professional (PMP) Data

ID	MAS	TYPE	MAJ	MARKET	ID	MAS	TYPE	MAJ	MARKET
	DEG			SECTOR		DEG			SECTOR
1441	F	0		14					
1442	F	0		17					
1443	F	0		3					
1444	F	0		3					
1445	F	0		2					
1446	F	0		14					
1447	T	3	0	17					
1448	T	3	0	14					
1449	F	0		PM					
1450	F	0		PM					

## Appendix H: Confidence Interval Calculations for Project Management Institute Data

The proportion of Project Management Professionals (PMP's) with graduate degrees is desired. A success is measured as having a graduate degree.

Population size = 2,015

Sample size = 1,450

Number of PMP's with graduate degrees = 717

Number of PMP's with relevant gradu. degrees = 89

Number of PMP's in Defense/Aerospace industry = 230

Number of PMP's in Defense/Aerospace industry with graduate degrees = 166

Number of PMP's in Defense/Aerospace industry with relevant graduate degrees = 31

$p$  = proportion of successes

$n$  = sample size

$X$  = the number of successes in the sample

If  $n$  is large,  $X$  has approximately a normal distribution. In this case  $n$  is large so the assumption can be made that  $X$  is approximately normally distributed.  $\hat{p}$  is the estimator for  $p$  and  $\hat{p} = X/n$ .

$\hat{p}$  is also approximated normally distributed because  $\hat{p}$  is simply  $X$  multiplied by the constant  $1/n$ .

The expected value of  $\hat{p}$  is  $p$ .  $E \hat{p} = p$  and  $\sigma_{\hat{p}} = \frac{\sqrt{\hat{p}(1-\hat{p})}}{n}$

A large sample  $100(1-\alpha)\%$  confidence interval for a population proportion  $p$  is  $\hat{p} \pm Z_{\alpha/2} \frac{\sqrt{\hat{p}q_{\hat{p}}}}{n}$  where  $\hat{p} = x/n$ ,  $x$  = the number of observed successes, and  $q_{\hat{p}} = 1-\hat{p}$ .

This confidence interval can be used whenever  $n\hat{p} \geq 5$  and  $nq_{\hat{p}} \geq 5$ .

### a) Confidence Interval for PMP's with Graduate Degrees

Observed proportion: 49.45%

$$x = 717 \quad n = 1450 \quad \hat{p} = \frac{x}{n} \quad \sigma_{\hat{p}} = \frac{\sqrt{\hat{p}(1-\hat{p})}}{n} \quad q_{\hat{p}} = 1-\hat{p}$$

$$n \cdot \hat{p} = 717$$

Both are  $\geq 5$  so this confidence interval can be used.

$$n \cdot q_{\hat{p}} = 733$$

A 99% confidence interval for p is:  $\hat{p} - Z_{.005} \sqrt{\frac{\hat{p}\hat{q}}{n}}$ ,  $\hat{p} + Z_{.005} \sqrt{\frac{\hat{p}\hat{q}}{n}}$

$$\sigma_{\hat{p}} = 0.013 \quad Z_{.005} = 2.575 \quad \hat{p} = 0.494 \quad \hat{q} = 0.506$$

$$\begin{aligned} \text{CI lower} &= \hat{p} - Z_{.005} \sqrt{\frac{\hat{p}\hat{q}}{n}} & \text{CI upper} &= \hat{p} + Z_{.005} \sqrt{\frac{\hat{p}\hat{q}}{n}} \\ \text{CI lower} &= 0.461 & \text{CI upper} &= 0.528 \end{aligned}$$

Thus, there is a 99% confidence that between 46.1% and 52.8% of all PMP's have graduate degrees. The observed proportion of 49.45% falls into this confidence interval.

### b) Confidence Interval for PMP's with Relevant Graduate Degrees

Observed proportion: 12.41%

$$x = 89 \quad n = 717 \quad \hat{p} = \frac{x}{n} \quad \sigma_{\hat{p}} = \sqrt{\frac{\hat{p}(1 - \hat{p})}{n}}$$

$$n \cdot \hat{p} = 89$$

Both are  $\geq 5$  so this confidence interval can be used.

$$n \cdot \hat{q} = 362.456$$

A 99% confidence interval for p is:  $\hat{p} - Z_{.005} \sqrt{\frac{\hat{p}\hat{q}}{n}}$

$$\sigma_{\hat{p}} = 0.012 \quad Z_{.005} = 2.575 \quad \hat{p} = 0.124$$

$$CI_{lower} = \hat{p} - Z_{.005} \sqrt{\frac{\hat{p}\hat{q}}{n}}$$

$$CI_{lower} = 0.1$$

$$CI_{upper} = \hat{p} + Z_{.005} \sqrt{\frac{\hat{p}\hat{q}}{n}}$$

$$CI_{upper} = 0.148$$

Thus, there is a 99% confidence that between 10% and 14.8% of all PMP's with graduate degrees have relevant graduate degrees. The observed proportion of 12.41% falls into this confidence interval.

### c) Confidence Interval for PMP's in the Defense/Aerospace Industry with Graduate Degrees

Observed proportion: 72.18%

$$x = 166 \quad n = 230 \quad \hat{p} = \frac{x}{n} \quad \sigma_{\hat{p}} = \sqrt{\frac{\hat{p}(1 - \hat{p})}{n}}$$

$$n \cdot \hat{p} = 166$$

Both are  $\geq 5$  so this confidence interval can be used.

$$n \cdot \hat{q} = 116.269$$

A 99% confidence interval for  $p$  is:  $\hat{p} \pm Z_{.005} \sqrt{\frac{\hat{p}\hat{q}}{n}}$

$$\sigma_{\hat{p}} = 0.03 \quad Z_{.005} = 2.575 \quad \hat{p} = 0.722$$

$$CI_{lower} = \hat{p} - Z_{.005} \sqrt{\frac{\hat{p}\hat{q}}{n}}$$

$$CI_{lower} = 0.619$$

$$CI_{upper} = \hat{p} + Z_{.005} \sqrt{\frac{\hat{p}\hat{q}}{n}}$$

$$CI_{upper} = 0.824$$

Thus, there is a 99% confidence that between 61.9% and 82.4% of all PMP's in the Defense/Aerospace industry have graduate degrees. The observed proportion of 72.18% falls into this confidence interval.

**d) Confidence Interval for PMP's in the Defense/Aerospace Industry with Relevant Graduate Degrees**

Observed proportion: 18.67%

$$x = 31 \quad n = 166 \quad \hat{p} = \frac{x}{n} \quad \sigma_{\hat{p}} = \sqrt{\frac{\hat{p}(1 - \hat{p})}{n}}$$

$$n \cdot \hat{p} = 31$$

Both are  $\geq 5$  so this confidence interval can be used.

$$n \cdot \hat{q} = 83.916$$

A 99% confidence interval for  $p$  is:  $\hat{p} \pm Z_{.005} \sqrt{\frac{\hat{p} \hat{q}}{n}}$

$$\sigma_{\hat{p}} = 0.03 \quad Z_{.005} = 2.575 \quad \hat{p} = 0.187$$

$$CI_{\text{lower}} = \hat{p} - Z_{.005} \sqrt{\frac{\hat{p} \hat{q}}{n}}$$

$$CI_{\text{lower}} = 0.125$$

$$CI_{\text{upper}} = \hat{p} + Z_{.005} \sqrt{\frac{\hat{p} \hat{q}}{n}}$$

$$CI_{\text{upper}} = 0.248$$

Thus, there is a 99% confidence that between 12.5% and 24.8% of the PMP's in the Defense/Aerospace industry with graduate degrees have relevant graduate degrees. The observed proportion of 18.67% falls into this confidence interval.

## Bibliography

1. Air Force Institute of Technology (AFIT). "Air Force Graduate Educational Requirements for Officers." Background paper. AFIT, Wright-Patterson AFB OH, 15 November 1993.
2. ——. "A Strategy-to-Task (Top-Down) Model for Determining Air Force Graduate Education Requirements." Briefing. AFIT, Wright-Patterson AFB OH, 1993.
3. ——. "Encode/Decode Table for Academic Specializations." Reference table. AFIT, Wright-Patterson AFB OH, 8 April 1994.
4. Biesada, Alexandra. "Strategic Benchmarking," *International Journal of Production Research*, 19: 30-36 (Fall 1992).
5. ——. "Strategic Benchmarking. Tired Of Getting Blindsided? Study How The Competition Plans For Tomorrow," *Financial World*, 30-36 (September 1992).
6. Bono, Peter. "The Benchmarking Boom," *Journal of the American Management Association*, 12: 5-7 (April 1993).
7. Byrne, John A. "Rethinking Graduate Education," *Proceedings*, 11: 69, 70 (November 1993).
8. Camp, Robert C. *Benchmarking: The Search for Industry Best Practices That Lead to Superior Performance*. Milwaukee WI: American Society for Quality Control (ASQC) Press, 1989.
9. ——. "A Bible for Benchmarking, by Xerox," *Financial Executive*, 22: 23-27 (July/August 1993).
10. Chase, David L. Colonel, USAF, and Chief, Education and Training Division, Directorate of Personnel Programs, Education and Training (HQ USAF/DPPE), HQ USAF. Action memorandum for Fiscal Year 1995 graduate education quota requests. 4 March 1994.
11. Cooper, Donald R. and C. William Emory. *Business Research Methods*. Homewood IL: Irwin, 1991.
12. Crow, Stephen M. and Pamela D. Van Epps. "An Exercise in Benchmarking," *Human Resources Management Journal*, 16: 3-14 (November 1992).
13. Department of the Air Force. *AFIT Graduate Catalog 1993-1995*. Washington: GPO, 1993.

14. —. *Educational Classification and Coding Procedures*. AFI 36-2305. Washington: HQ USAF, 31 May 1994.
15. —. *Graduate Education Management System (GEMS)*. AFR 36-19. Washington: HQ USAF, 1988.
16. —. *Officer Assignments*. AFR 36-1. Washington: HQ USAF, 1 January 1989.
17. —. *Officer Professional Development*. AFR 36-23. Washington: HQ USAF, 1990.
18. —. *Promotion of Active Duty List Officers*. AFR 36-89. Washington: HQ USAF, 17 April 1992.
19. —. *Report of Audit, Management of Education and Training Programs*. Project 92051002. Washington: HQ USAF, 1993.
20. Department of Defense. *Policy on Graduate Education for Military Officers*. DOD Directive 1322.10. Washington: GPO, 31 August 1990.
21. —. *U.S. National Military Strategy*. Washington: Pentagon, 1992.
22. Department of the Navy. *Naval Postgraduate School Catalog, Academic Year 1990*. Washington: GPO, 1990.
23. Devore, Jay L. *Probability and Statistics for Engineering and the Sciences*. Pacific Grove CA: Brooks/Cole Publishing Company, 1991.
24. Donnelly, James H. Jr., James L. Gibson and John M. Ivancevich. *Organizations: Behavior, Structure, Processes*. Homewood IL: Irwin, 1991.
25. Dorr, Robert F. "Smarter Troops for a Smaller Force," *Air Force Magazine*, 77: 38-43 (July 1994).
26. Evans, James R. and William M. Lindsay. *The Management and Control of Quality* (Second Edition). St. Paul MN: West Publishing Co., 1993.
27. Ford, Donald J. "Benchmarking HRD," *Training and Development*, 17: 36-41 (June 1993).
28. Hackett, R. Dempsey. Captain, USAF, and Personnel Resource Manager, Air Force Manpower and Personnel Center (HQ AFMPC/DPMRS), Randolph AFB TX. Information package regarding assignments for AFIT graduates. 14 May 1994.
29. —. Assignment list for AFIT graduates. 29 July 1994.

30. Harmon, Marion. "Benchmarking," *Quality Digest*, 12: 20-31 (July 1992).
31. Hiebeler, Robert. "A Roadmap For Success, Avoid Pitfalls In The Quest For Quality," *Industry Week*: 53 (July 1993).
32. HQ AFMPC/DPMR. "Process Action Team (PAT) - USAF Graduate Education." *Electronic Message*. 1926Z, 18 January 1994.
33. Hunt, V. Daniel. *Quality in America*. Homewood IL: Irwin, 1992.
34. Karlof, Bengt and Svante Ostblom. *Benchmarking: A Signpost To Excellence In Quality And Productivity*. Chichester, West Sussex, England: John Wiley and Sons Ltd., 1993.
35. Kinni, Theodore B. "Benchmarking: One Measurement In The Continuous Improvement Process," *Quality Digest*, 13: 24-29 (November 1993).
36. Kondos, Karen. Director of Membership and Marketing, Project Management Institute, Upper Darby PA. Telephone interview. 14 April 1994.
37. Micklewright, Michael J. "Competitive Benchmarking: Large Gains For Small Companies," *Quality Progress*, 26: 67-68 (June 1993).
38. McMullan, William J., and Ralph E. Smythe. *An Evaluation of the Major Qualifications Desired of Air Force System Program Managers*. MS thesis, LSR 31-75A. School of Systems and Logistics, Air Force Institute of Technology (AU), Wright-Patterson AFB OH, January 1975 (AD-A006360).
39. McPeak, Merrill A. "Today's Air Force: Ready for Tomorrow's Challenges," *Airman Magazine*, 38: 3-7 (September 1993).
40. O'Reilly, Brian. "How Execs Learn Now," *Fortune*: 52-58 (5 April 1993).
41. Parnell, Gregory S. Colonel, USAF and Head, Department of Operational Sciences (AFIT/ENS), School of Engineering, Air Force Institute of Technology, Wright-Patterson AFB OH. Cover letter requesting benchmarking data. 28 April 1994.
42. Port, Otis, and Geoffrey Smith. "Beg, Borrow, and Benchmark," *Business Week*, 32: 74, 75 (30 November 1992).
43. Project Management Institute. *PM Network*, 7: 9-16 (January 1993).
44. ——. *PM Network*, 7: 45-55 (December 1993).
45. ——. *PM Network*, 8: 42 (July 1994).

46. —. *Project Management Body of Knowledge (PMBOK)*. Drexel Hill PA: Project Management Institute, 1987.
47. Randall, Terri. Technical Sergeant, USAF, and Education Administration Officer, Office of Registration and Records (AFIT/RR), Air Force Institute of Technology, Wright-Patterson AFB OH. Personal interview. 21 June 1994.
48. Sillyman, Steve. "Guide to Benchmarking Resources," *Quality Management Journal*, 8: 17, 18 (March 1992).
49. Simons, Jacob V. Lt Colonel, USAF and Assistant Dean for Research and Consulting (AFIT/LAC), AFIT Graduate School of Logistics and Acquisition Management, Wright-Patterson AFB OH. Personal interview. 31 January 1994.
50. Swanson, Roger. "Quality Benchmark Deployment," *Quality Progress*, 26: 81-84 (December 1993).
51. Vaziri, Kevin H. "Using Competitive Benchmarking To Set Goals," *Quality Progress*, 25: 81-85 (October 1992).
52. Watson, Gregory H. *The Benchmarking Book: Adapting Best Practices For Performance Improvement*. Cambridge MA: Productivity Press, 1992.

## Vita

Captain William D. Beatty was born on 20 December 1955 in Alexandria, Virginia where he graduated from Hayfield High School in 1974. He joined the United States Marine Corps in 1974 and received an honorable discharge in 1978. After returning to Alexandria, Virginia, he attended The George Washington University in Washington DC and received a Bachelor of Arts in Economics in May 1980. Captain Beatty received a reserve commission in the USAF through Officer Training School and reported for his first tour of duty at Arnold Engineering and Development Center (AEDC), Arnold AFB, Tennessee on 14 July 1985. He began as a Financial Manager for all propulsion testing at AEDC. In January 1988 he was made Chief of the Advanced Planning Division for the Deputy for Operations, AEDC, where he developed all schedules for future testing at AEDC. In September 1989 he was transferred to the Maverick Missile System Directorate of the Systems Program Office, Aeronautical Systems Center, Wright-Patterson AFB, Ohio where he served as the Assistant Program Manager of the Raytheon contract for the production of Maverick Missiles for the USAF. In April 1991 he became the International Project Manager for all Maverick Missile Foreign Military Sales to the Middle East including Bahrain, Kuwait, and Egypt. In June 1992 he was transferred to the F-22 System Program Office where he served as a Project Manager in the Acquisition Strategies Branch. In January 1993 he was made Chief of the Acquisition Strategies Branch. He entered the Graduate School of Logistics and Acquisition Management, Air Force Institute of Technology, in May 1993.

Permanent Address: Rt. 1, Box 434  
Afton, VA 22920

### *Vita*

Captain David H. Kelley was born on 23 February 1963 in Groton, Massachusetts where he graduated from Groton-Dunstable Regional Secondary School in 1981. He attended Embry-Riddle Aeronautical University in Daytona Beach, Florida where he graduated with a Bachelor of Science in Aeronautical Engineering and received a reserve commission through the Reserve Officer Training Corps program in April 1985. Captain Kelley reported for his first tour of duty at Los Angeles AFB, California in June 1985. He served in the Space Transportation System Program Office managing several programs including the United Kingdom SKYNET 4 Foreign Military Sales case and the first space shuttle flight of the Communications Interface Equipment payload. In June 1989 he was assigned to the Secretary of the Air Force, Office of Special Projects where he served until entering the Graduate School of Logistics and Acquisition Management, Air Force Institute of Technology, in May 1993.

Permanent Address: 430 Old Ayer Rd  
Groton, MA 01450

# REPORT DOCUMENTATION PAGE

Form Approved  
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE <b>September 1994</b>	3. REPORT TYPE AND DATES COVERED <b>Master's Thesis</b>	
4. TITLE AND SUBTITLE <b>A DEMONSTRATION OF A BENCHMARKING TECHNIQUE TO COMPARE GRADUATE EDUCATION LEVELS OF AIR FORCE PROJECT MANAGERS AND SELECTED BENCHMARKING PARTNERS</b>		5. FUNDING NUMBERS	
6. AUTHOR(S)  <b>William D. Beatty, Capt, USAF David H. Kelley, Capt, USAF</b>		8. PERFORMING ORGANIZATION REPORT NUMBER  <b>AFIT/GSM/LAS/94S-3</b>	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)  <b>Air Force Institute of Technology, WPAFB OH 45433-6583</b>		10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)  <b>HQ USAF/DPPE Pentagon, Washington DC</b>		10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES			
12a. DISTRIBUTION / AVAILABILITY STATEMENT  <b>Approved for public release; distribution unlimited</b>		12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words)  <b>This thesis demonstrated a benchmarking technique to support determining graduate education requirements for officers in the Acquisition Program Management utilization field. The technique is also applicable to other Air Force career fields. The USAF currently uses the Graduate Education Management System (GEMS) to quantify officer graduate education requirements. Weaknesses in the GEMS-based process include the inability to address future technologies, vulnerability to inconsistency and change, and confusion of training with education. AFIT developed and recommended an alternative requirements determination approach that relies on benchmarking. This thesis reviewed literature on benchmarking principles. The research methodology developed and implemented benchmarking procedures to include identifying attributes to benchmark, determining measures, identifying suitable benchmark subjects, collecting benchmark data, and analyzing the data. Primary benchmark partners were project managers from the Project Management Institute (PMI), a non-profit professional organization. Percentages of Air Force, PMI, and PMI Defense/Aerospace sector project managers holding relevant graduate degrees were 53.21%, 12.41% and 18.67% respectively. Six limitations identified in the thesis prevented the determination of firm education requirements based solely on these results. Securing senior USAF support, developing rigorous best practices criteria, using trend data and developing numerical bridging factors were recommended to improve the benchmarking technique.</b>			
14. SUBJECT TERMS  <b>Benchmarking, Graduate Education, Education Requirements, Project Management, Program Management</b>		15. NUMBER OF PAGES <b>131</b>	16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT <b>Unclassified</b>	18. SECURITY CLASSIFICATION OF THIS PAGE <b>Unclassified</b>	19. SECURITY CLASSIFICATION OF ABSTRACT <b>Unclassified</b>	20. LIMITATION OF ABSTRACT <b>UL</b>