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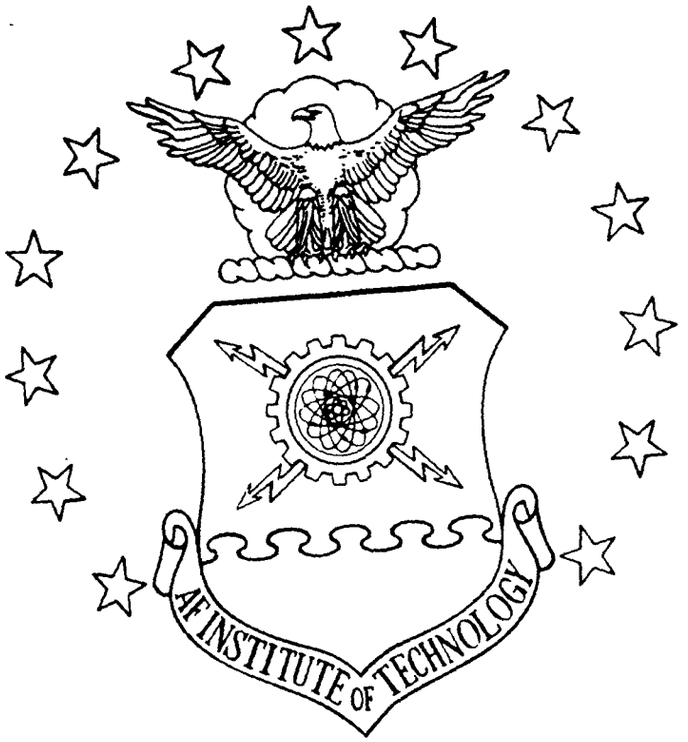

EVALUATING MANPOWER AND MANNING MEASUREMENT IN CE: DO CURRENT PRACTICES REFLECT ACTUAL CAPABILITY?

THESIS

Bryan K. Neuhaus, Captain, USAF

AFIT/GEM/LSR/90S-13

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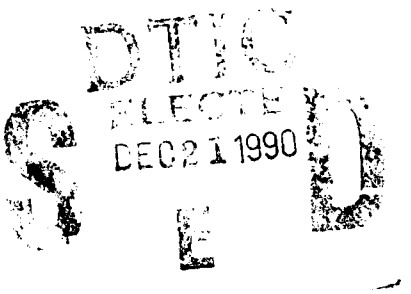

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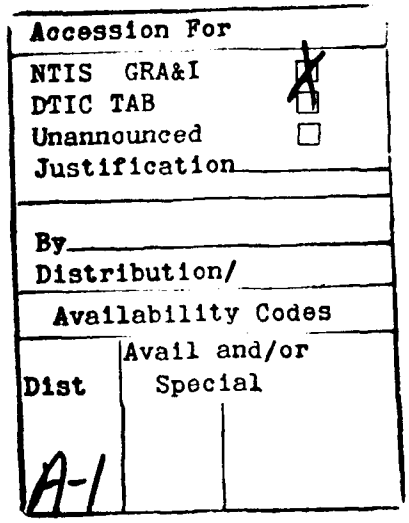

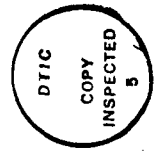

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EVALUATING MANPOWER AND MANNING MEASUREMENT IN CE: DO CURRENT PRACTICES REFLECT ACTUAL CAPABILITY?

THESIS

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the

Requirements for the Degree of

Master of Science in Engineering Management

Bryan K. Neuhaus, B.S.

Captain, USAF

September 1990

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Bryan K. Neuhaus, Capt

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Abstract

This study evaluated two methods of measuring peacetime capability for the 44XX Civil Engineering Macro Air Force Manpower Standard. The current method measures capability by comparing the quantities of assigned manning and authorized manpower. The alternative method developed by the study measures capability by comparing required manpower, authorized manpower, and assigned manning capabilities, and considers the combined qualitative and quantitative manpower factors of experience (grade), technical ability (AFSC), and quantity. Manpower authorizations are constrained by budget and other factors. Required manpower is unconstrained and represents the quantity and quality of manpower needed to accomplish a workload as measured by the Management Engineering Team. Documentation (the Unit Manpower Document and Unit Personnel Manning Roster) from five bases and the AFMS provided the database. Combined results showed small net differences (2-6 percent) between quantity and capability for authorized/required, assigned/authorized, and assigned/required levels. Individual bases varied more (as much as thirteen, twenty six, and ten percent respectively. Manpower and manning capability measures are impacted when quantity and quality factors are aggregated. The current method may produce false capability measurements because authorized and required manpower levels use different quantity bases for measuring the capability needed to accomplish measured workloads.

EVALUATING MANPOWER AND MANNING MEASUREMENT IN CE: DO CURRENT PRACTICES REFLECT ACTUAL CAPABILITY?

I. Introduction

1. Background and General Issue

> The Base Civil Engineer's image is reflected more acutely through the Operations Division than any other section within Civil Engineering. When managed effectively, it can do more to support the Air Force mission and its people than any other base resource. (15:1)

Manpower and manning issues in the Air Force Civil Engineering Squadron (AFCE) Operations and Maintenance (O&M) branch are often inadequately understood by CE personnel in managerial positions. Brigadier General D. Lynn Rans, USAF (retired) explains in part:

> It's easy to understand why supervisors/managers believe the main reason they can't do their job better is a lack of one of the three Ms [money, material, manpower]. For years we worked under the adage of do more with less and work smarter not harder; however, it's time to change our thinking...and begin to understand that the real problem is not a lack of resources but a problem of setting priorities. (23:19)

General Rans states that, as managers, we must ask the tough questions of what must be done as opposed to what we would like to do. The idea of doing less with less and ensuring we do the right things correctly with the

appropriate people equipped with the proper tools is central to understanding the problem of setting priorities.

The School of Engineering and Services (SOCES) at the Air Force Institute of Technology (AFIT) is responsible for educating civil engineering personnel in manpower through professional continuing education (PCE). In 1986 the Major Air Command Deputy Chiefs of Staff for Civil Engineering and Services (DCSs) recommended SOCES evaluate the need for including more detail and practical experience in PCE lessons addressing manning and manpower issues. As a result, the SOCES found that the existing class material inadequately addressed manning and manpower issues to the satisfaction of Air Force CE personnel. Background information on manpower, productivity, and the budget and mission can supplement and more fully explain the issue.

Manpower. The most important resource the Air Force has is its people. Manpower is a general term used to describe this resource. The Air Force regulation which addresses the Management Engineering Program (MEP), AFR 25-5, defines manpower requirements as a statement of the manpower needed to accomplish a specified workload. Manpower resources are "human resources available to the Air Force that can be applied against manpower requirements" (8:364). The Air Force's current manpower philosophy is to "provide appropriate levels of manpower authorizations to

meet the highest manpower demand of a function, in either wartime or peacetime" (8:292). There are two types of manpower requirements, funded and unfunded. Funded, or authorized, manpower requirements have been validated with appropriate funding by Congress. Unfunded requirements are validated manpower requirements that have been deferred due to budgetary or other constraints (8:364).

The term manpower requirements may carry different connotations for different people. Those who determine manpower requirements for the Air Force tend to utilize detailed data. However, those who track manpower levels are often provided or use gross data concerning manpower levels. This difference in levels of data can lead to differences in perceived manning and manpower requirements. Air Force job descriptions (commonly referred to as Air Force specialty codes (AFSCs)), skill and grade levels, and quantity determinations for manpower requirements represent the unconstrained manpower resources needed to do the job (8:367). Unconstrained requirements are not affected by external constraints or funding limitations (8:212).

The effects of cross training and other nontypical career progression influences on skill and grade relationships are generally not accounted for when manpower requirements are determined. The amount of time deemed necessary to gain the needed experience to satisfactorily

accomplish progressively higher levels of tasks and management is currently based on the assumption the individual starts and progresses through a typical technical education, on-the-job training, and career progression pattern for one specific AFSC (8:224). Requirements should adjust for manpower resources which may be limited in quality or quantity due to insufficient training, experience, or other influencing factors (25:224).

Productivity. Decreasing defense budgets and decreasing manpower are increasing the importance of effective manpower management. Major Harvey Chase states in his 1979 Air Command and Staff College study of CE productivity that "[f]unding constraints, manpower reductions, and increasing personnel costs demand that the Air Force get maximum productivity from its assigned [CE] work force" (4:ii). According to a handbook for Civil Engineering Officers produced in a 1981 AFIT thesis, success as a Civil Engineering manager "is measured by how well you organize, manage and motivate your work force to keep the productivity equation in a constant state of equilibrium" (15:11).

Any definition of productivity should include the notion of producing the intended or expected output (4:14). The required workload to accomplish the mission is the most commonly viewed and used expected output. Required manpower

standards are based upon this same required workload. However, a single meaningful measure of productivity may not be effective in large and diverse organizations (such as Civil Engineering), as a single measure in and of itself could mask problems, deficiencies, and interactions within and between specific areas within the organization (4:19-21). Productivity depends upon technical development and job performance. Job performance, in turn, depends on worker ability (4:22). It follows that accurate measures of abilities, as well as quantity, are essential for defining or measuring productivity.

Balancing the productivity equation becomes especially challenging in times of rising inflation, austere O&M funding, and reductions in force. Unfortunately, correlation between reductions in manpower resources and reductions in the required workload appears to be nonexistent. Productivity can be affected by this imbalance. Documentation of this imbalance goes back for some years. For example, the Department of Defense Manpower Requirements Report for FY 79 stated that the Air Force personnel specifically devoted to Base Operating Support had been reduced by approximately five percent over the previous two years. Base support requirements, however, had not decreased simultaneously (4:5). The trend of this imbalance appears to be continuing. The increasing emphasis to get

more bang for the buck and to improve our tooth to tail ratio has highlighted the tooth (weapons procurement and combat readiness) at the expense of the tail (labor intensive support functions such as Base Civil Engineering). Limiting expenditures for labor in periods of rising labor costs necessarily includes reductions in personnel (4:4). These actions may have a corresponding and continuing effect on productivity.

Mission and Budget. Facility support expenditure has become a significant and labor intensive portion of the Department of Defense and Air Force budget. The bulk of the Air Force's facilities support allocation is managed directly by base level civil engineering organizations (4:3). In FY 79, the Department of Defense allocated some 8.8 billion dollars, or 20 percent of our total logistics expenditure, to facilities support.

According to Paul Hogan, former Director of Manpower Planning and Analysis for the Assistant SECDEF for Force Management & Personnel, manpower costs have consumed approximately half (45-60 percent) of each dollar of DOD budgets from 1977-1987. Similarly, the combined civilian and military personnel costs account for approximately 50 percent of our routine base operating costs. These high percentages cause intense scrutiny of personnel issues, especially during p iods of austere Government spending

(18:3). The BCE will be impacted by this scrutiny, as he is responsible for approximately 40 to 60 percent of a typical base operations and maintenance budget and usually manages the largest and most visible work force on base (4:3,15:1).

AFCE typically falls under the authority and responsibility of the base commander as a resource for accomplishing the mission. Thus, the commander can significantly impact AFCE's functions and tasks. The Commander's Update Briefing enables the center, wing, or group commander "to review Civil Engineering performance and to participate in decision[s] concerning resources" and tells the BCE how effectively CE is performing (15:40). "Performance should be shown relative to some norm. Quantitative assessments, where possible, are superior to subjective measures/assessments" (15:41). A prerequisite for accomplishing work is manpower. Therefore, the Commander needs to know when manpower deficiencies exist that significantly affect one's capability to do work (15:43). The commander, to make the best decisions, must understand all pertinent factors affecting manpower. Negative factors which influence manpower and its productivity must be recognized and their impacts minimized (15:64). It is the BCE's responsibility to supply that information. It should be remembered that keeping bases physically operational during times of peace is an important

part of our mission if we are to maintain our deterrent posture.

2. Problem

Manpower, the determination of the unconstrained quantity and quality of labor positions required to do the job, is the general responsibility of the Management Engineering Team (MET) and is usually based on unconstrained manpower resources. Manning, the actual assignment of personnel to those positions, is the general responsibility of Personnel and is usually based on constrained manpower resources. Even though the requirements remain unconstrained, manning levels are currently assessed on the number of authorized or constrained positions. The MET and Personnel appear to use different manpower resource data. Individual units are manned based on data from the MET and Personnel. Unit manpower and manning documentation within the unit are the only readily available data sources for manpower and manning information, but they do not appear to reflect all information produced or used by the MET, the Personnel office, and other contributors who determine or track manpower requirements and manning levels. Misunderstanding or ignorance of the meaning of available information could bear on actual productivity based on perceived capabilities.

Goals cannot be realistically set, decisions cannot be based on accurate information, allocation of scarce resources can have no firm foundation, and productivity cannot be accurately measured if one's true or actual manpower capabilities and limitations are not known. A simplified example will further clarify the problem. If one requires 100 persons to do a job, but is constrained to hiring 95 persons, one will have enough persons (quantity) to accomplish only 95 percent of the required job. If one further considers technical ability, experience, and other factors required to do the job (quality), more or less than 95 percent of the required job will be accomplished depending on whether the hired persons are overqualified or underqualified and what compensating options (such as overtime or contract) management exercises. The measure of how successful one is depends on (1) whether one's productivity is measured against quantity, quality, or an aggregate of quantity and quality capability, and (2) whether the measure is based against the original required workload or the workload which can be expected to be done based against one's constrained capability.

3. Purpose and Objective

This study attempts to measure the differences in capability between authorized and required manpower,

assigned manning and authorized manpower, and assigned manning and required manpower levels of CE personnel during peacetime operations. More specifically, quantitative differences (in gross numbers) and qualitative differences (in skill and grade levels) between authorized and required manpower, assigned manning and authorized manpower, and assigned manning and required manpower levels in specific AFSCs will be measured to evaluate AFCE's capability to accomplish its peacetime workload requirements. The utility of the results of this research may assist AFCE managers in establishing and assessing productivity goals and levels. These assessments may enable AFCE managers to more efficiently, effectively, and responsibly make decisions utilizing available manpower resources to accomplish priorities as well as identify and concentrate efforts on weak capability factors.

Evaluative questions (which focus on product delivery and mission accomplishment), as opposed to research hypotheses (which focus on experimental methods) are used as a framework for this effort (22:2). The following evaluative questions are addressed in support of the purpose of this study. Some practical applications and implications of the results of these questions with reference to evaluation of CE's manpower performance capability to

accomplish its assigned peacetime mission are discussed in Chapter V, Conclusions and Recommendations:

1. What are the gross quantitative differences between authorized and required manpower, assigned manning and authorized manpower, and assigned manning and required manpower positions in selected CE AFSCs needed to accomplish the required workloads?

2. What are the associated qualitative differences in grade and skill level/training between authorized and required manpower, assigned manning and authorized manpower, and assigned manning and required manpower positions?

3. What are the associated aggregated quantity and quality differences between authorized and required manpower, assigned manning and authorized manpower, and assigned manning and required manpower positions?

4. Summary

The labor intensive and highly visible peacetime support function of the AFCE Operations branch significantly impacts the mission and daily operations of a base. Manpower, productivity, and budget constraints are factors which can significantly impact the capability of AFCE Operations to do its job. The capability of AFCE Operations can be more accurately assessed and evaluated by

realistically examining existing and easily accessible data bases and documents which account for AFCE manpower resources. This evaluation may assist AFCE managers, the BCE, and the commander with priority decision making regarding the use and improvement of manpower resources to accomplish AFCE's peacetime mission.

II. Literature Review

One of the major functions within the broad classification known as military logistics is facilities support. Facilities support refers to the sustainment of real property assets through maintenance and repair, operation of utilities, minor construction, and operation of base services (4:3). The mission of Air Force Civil Engineering is to maintain, repair, construct, and manage Air Force real property facilities and provide quality services to ensure USAF operations are fully supported (15:1). The primary responsibility of AFCE is its wartime mission. A secondary responsibility of AFCE is routine maintenance and repair of base facilities, airfield pavements, and utility systems to keep bases operational during peacetime in order to maintain a deterrent posture (24:4).

The literature reviewed for this study is grouped into six areas of interest; (1) previous studies related to manpower efficiency and effectiveness issues, (2) regulations associated with determining manning and manpower requirements, (3) macro standards, (4) additional current manpower and manning issues, (5) motivational theory and productivity, and (6) general methodology background literature. Each of these areas contributes directly or

indirectly to the determination and measurement of capability and/or the application of manning and manpower measurements.

1. Efficiency and Effectiveness; Related Studies

A unit should be both efficient and effective if it is to operate at its best potential. McNight & Parker initiated the development of an organizational effectiveness model in response to an Air Staff thesis proposal (21). This model defined effectiveness criteria which would allow BCEs to evaluate organization effectiveness as subjectively perceived by their contemporaries and wing and base commanders. A short timeframe reference and overall organizational effectiveness level were measured due to short rotation cycles of wing and base commanders and the commanders' perception of units under their control as whole entities respectively. Interviews found leadership to be the most important criteria in organizational effectiveness. Other criteria found to be of importance were resource availability, organizational health, and operations workforce performance. The current study addresses in part these other subjectively defined criteria of organizational effectiveness by objectively evaluating manning and manpower capability.

Fisher developed his thesis from the results of the findings and recommendations of McNight and Parker (14). Fisher's literature review "makes a distinction between efficiency, doing things right, and effectiveness, doing the right things" (14:17). Efficiency was generally defined as a ratio of inputs to outputs and effectiveness was generally defined as the ratio of outputs to performance. Fisher combines his efficiency study with McNight and Parker's effectiveness study to define productivity "as the measure of input required to produce desired measure of output", given a desired level of output, and views productivity as "the link between efficiency and effectiveness" (14:18). He concluded from his literature review that availability of resources, including manpower, is a factor in organizational effectiveness (14:4,26).

Fisher claims his results can help CE Operations branch managers efficiently use labor, vehicles, equipment, and supplies through resource allocation to accomplish their objectives of performing maintenance and repair of base facilities (14:1,60). The Constrained Facet Analysis (CFA), a computer model, identified those variables that have the greatest effect on efficient use of available resources. Pearson correlations were used to show results between inputs and outputs, with positive numerical results indicating stronger relationships. Negative correlations

were found, but not used in the conclusions. Fisher produced two groups of findings concerning efficiency. First, high correlations existed between the number of military positions with correct skill level and the number of military positions with correct grade filled (coefficient = .9384), between the number of military positions with correct skill level filled and number of military assigned (coefficient = .8531), between the number of military positions with correct grade filled and number of military assigned (coefficient = .8235), and between total available manhours and number of civilians assigned. Second, negative correlations existed between the number of military assigned and the number of military authorized and between the number of civilians assigned and the number of civilians authorized (14:77-79). Fisher did not measure authorized manpower or assigned manning information against required manpower information.

Fisher's literature review revealed that measuring and evaluating Civil Engineering effectiveness has gained increasing importance among the key issues of CE directors since Major General G. H. Goddard first addressed the issue in the early 1970s, lending credibility to the worthiness of his efforts (14:1). Fisher makes relative comparisons between like or similar organizations (14:61). The objective measure used in the analysis was authorized

manpower levels. Authorized manpower levels are normally constrained by factors external to the manpower requirements determination process, such as Congressional budget restrictions. Ratio displays of the results were found to be popular, easily calculated, but difficult to explicitly or accurately measure effects of multiple inputs (14:30,33). The current study expands on Fisher's measures by accommodating unconstrained required manpower strengths needed to accomplish objectively measured workloads.

Efficiency has also been considered from an organizational structure perspective. Taylor's 1983 thesis analyzed the organizational structure of CE units to evaluate whether a standardized or flexible organizational structure better serves the effectiveness of the BCE organization (27). Taylor's literature review concluded there is no one best way to structure an organization. The environment, the forces, and the institutions representing local constraints and requirements imposed on Civil Engineering units must be defined before a proper organizational structure can be designed.

Taylor found typical BCE organizations are highly organized and structured for two main reasons: (1) to minimize retraining of personnel moving from one organization to another, and (2) to maintain standard manpower authorizations for BCE organizations. Taylor

observed that AFR 85-10, Operations and Maintenance of Real Property, which specifies how Base Civil Engineering activities are to be organized, reflects the high level of structure and organization. Taylor's research, however, shows a contingency approach which matches the organization's structure to the environment in which it operates is more effective than the organizational structure in AFR 85-10.

Taylor utilized the USAF Integrated Computer Aided Manufacturing Definition model (IDEF) for data analysis. He concluded differences in the organization of various CE units can be attributed to their operating in unique environments. In many cases, local managers had already adopted the approach of informally modifying the structure of the organization to respond to changing mission environments. The current study may supplement Taylor's efforts by defining the environment in terms of unconstrained manpower requirements in additional to actual manpower and manning constraints.

Donovan and Faraone's 1976 thesis states one goal of Air Force Civil Engineering policy is to economically maintain all base real property at a level that prevents deterioration beyond reasonable wear and tear (12). This policy, to be successfully implemented, requires sufficient manpower (both quantity and quality) to do the job. The

objective of the study was to develop a set of qualitative and quantitative criteria which could be used in the evaluation of workload factors independent of current factors used for existing CE standards. The authors assumed current factors were relatively static and would not be sensitive to fluctuations in workload volume and other factors which might impact unit effectiveness.

The authors concluded qualitative workload factors should have a causal relationship to manpower requirements, should be predictable, should be measured in some work unit, and should be economically feasible in terms of generating or obtaining the required data. In addition, the current statistical evaluation of quantitative factors could be improved through modification of multivariate analyses. Fine tuning of workload factors, as proposed by Donovan and Faraone, would add confidence to the manpower standards. Improvements to the standards would also improve the confidence in the results of the current study because the current study uses manpower standards as a primary input.

The future efficient and effective use of CE manpower is postulated in the 1984 Air Command and Staff College study, Base-level Civil Engineering Forces of the 21st Century, which outlines proposed new basing concepts for future Air Force operations (3). These new concepts would affect, among other things, manpower and base structure.

The proposed force would rely heavily on civilians and contractors for routine tasks so as to free military personnel for wartime missions and duties. The study is based on general reasoning and logical concepts rather than statistical analyses.

Under current broad-based CE force structure, dictated by AFR 85-10, military and civilian workers are integrated. The ACSC study found inexperienced airmen are trained in their skills by experienced civilians. However, much of this training does not reflect the wartime skills the airmen will need to perform their wartime jobs.

The proposal recommends DOD civilians and contract personnel should accomplish peacetime maintenance because this work is usually not combat related. The military Base Emergency Engineering Force teams (PRIME BEEF) would become permanently configured, enhancing wartime effectiveness and unit cohesiveness and limiting military forces to combat and direct combat support tasks. This new personnel structure would be a radical change from current CE unit organizational structure and manpower requirements. The scope of the current study does not account for wartime capability and requirements. Access to classified manpower and manning data and identification of wartime manpower issues would require further research before such a combat capability analysis could be done.

An effective management information system (MIS) can greatly improve the efficiency and effectiveness (i.e. productivity potential) of a unit such as CE. Colman's 1985 thesis found MISs are generally not used to their fullest potential (6). For an organization to be more successful, the MIS must be used for more complex and sophisticated tasks. The WIMS, CE's MIS, has been installed and is operational in CE units throughout the world. One of the more positive impacts of WIMS has been the added ability to better manage work, which has increased the ability to supervise and monitor productivity.

One of the three types of tasks Colman found necessary for the improved productive use of WIMS is the analysis of data for the purposes of making management decisions, establishing policy, and performing control functions (6:5). The current study uses data which is currently or soon to be available on the WIMS and uses common spreadsheet formulas, functions, and calculations which are probably within the capability of the WIMS spreadsheet software, 20/20. As such, the current study approach may be applicable to the improved productive use of the WIMS, and thus improve unit productivity using existing computer resources.

2. Manpower Foundation, Documentation, and Implementation

Puscher and Donovan independently provided background information about current manpower practices in their theses (24,12). Current manpower standard practices, utilized by the Air Force to determine requirements, were initiated approximately three decades ago with the establishment of management engineering teams (METs) in 1959. In 1969, AFCE peacetime manpower standards were developed. "The goal of establishing AFCE manpower standards was to link manpower to actual requirements" (24:4). AFCE workload data was collected from a worldwide cross section of 43 USAF installations representing all commands. This information was then used to develop equations and formulas for determining how many people were needed to perform a particular peacetime job, thus developing engineering manpower standards to manage manpower requirements. These standards are based on workload factors (12,24:4).

According to manpower guidance in AFM 67-1, Vol II, Part II, Section H, the MEP is tasked to efficiently and effectively manage Air Force manpower by determining manpower requirements and providing related technical assistance to functional managers. Manpower needs are documented in two different formats, standards and guides. Standards are documented through formal measurement methods and are produced as Air Force Manpower Standards (AFMSs).

AFMSs represent the statistically predicted quality and quantity of required manpower needed to accomplish varying workloads. Manpower guides rely on estimates and best guesses and are applied to functions which do not lend themselves to conventional formal measurement methods. Standards and guides are developed through a functional review process. Once manpower standards are coordinated and approved through HQ USAF, regulations direct the standards be applied annually in order to keep the standards current.

The Unit Manpower Document (UMD) is a computer product maintained by Command Management Engineering Teams (CMETs). It lists manpower requirements and authorizations and is the primary document for reflecting how many people are authorized to accomplish the required mission workload. The Unit Personnel Manpower Roster (UPMR) is a computer product prepared by the Director of Personnel and matches assigned personnel with the authorized manpower positions of a unit. If a unit is fully manned, the information on the UPMR should match the authorized information on the UMD. A UMD User's Guide states information and data for the UMD can be obtained from two sources: the Command Manpower Data System (CMDS), available at MAJCOM Headquarters; and the Base Manpower Data Systems (BMDS), available from host base management engineering teams (METs) (28). UMDs are supplied to and can be obtained from individual units also.

The Management Engineering Program (MEP) contribution to the Air Force mission, as described in AFR 25-5, is the objective determination of manpower requirements and its related consultation services. HQ USAF/PRM is the primary OPR for the MEP, and MEP personnel work at almost all levels of command (8:1). MEP functional reviews establish or alter manpower grade, AFSC, or quantity standards by addressing three general but important questions: (1) what work is required, (2) how often or at what frequency is the required work accomplished, and (3) how much time is required to accomplish the work each time the work is done.

Once this quantitative data is gathered, statistical analyses are used to determine required manpower quantities which establish manpower requirements for peacetime operations, wartime operations, or a combination of peacetime and wartime operations. The required manpower quantity is then applied to AF Form 1113, Air Force Manpower Standards, to convert total manpower standard requirements into quantities of manpower with the necessary qualities (AFSCs and grades) to perform the required work for the defined work center mission. Skill and grade determinations for the standards are not affected by external constraints, funding limitations, or resource availability (8:212). Authorized manpower quantities are usually less than required manpower levels because authorized strengths are

affected by external constraints such as funding limitations and resource availability.

Functional reviews have four main objectives: (1) to develop the most efficient and effective organization possible, (2) to provide information to senior leadership for decision making, (3) to develop a manpower standard or guide, and (4) to aid functional managers at all levels to monitor their functions' performance (8:5-9). If functional reviews result in manpower savings, any vacated authorizations are retained by the MAJCOM for use against other high priority and validated but unfunded manpower requirements. Conversely, if functional reviews result in increases in manpower requirements, MAJCOMs are responsible for funding the new requirements until the new requirements are authorized and funded through the Congressional budgetary process (a multi-year action) (8:313).

Both regression and correlation statistics are used in performing MEP studies. Regression statistics determine the manpower equation and correlation statistics determine the accuracy of the manpower equation derived from regression statistics. The regression is used for manpower prediction purposes and has the underlying assumptions of linearity, independent variables, and normally distributed data with equal variances (8:189).

The Command Manpower Data System (CMDS) is the primary source for civilian and military authorizations. Local base products provide assigned data strengths. The Central Civilian Personnel Office (CCPO) determines appropriate civilian grades. Civilian occupation codes and grades are not determined during standards development, but civilian codes and grades are founded on AFSC job descriptions designated in the AFMS tables and authorized on the UMD.

Enlisted grades are based on a two grades per skill policy. In ideal environments, the following grade percentages would exist for the 9-skill level (manager), 7-skill level (technician/supervisor/trainer), and 5-skill level (specialist):

9-level	33% CMSgt	67% SMSgt
7-level	40% MSgt	60% TSgt
5-level	50% SSgt	50% Sgt

Due to rounding, fractional manpower requirements may result in more or less personnel than that required to do the task. The 3-skill level (apprentice) is assumed manned at 100 percent with the grade of A1C. The 1-skill level (helper) and grades of AB and AMN (in training) are not considered when requirements are determined because of the short time frame needed to attain a 3-skill level and the relatively rapid promotion trend through these two lower ranks (8:223-225).

3. Macro Standards

AFCE manpower standards historically have been classified into micro standards, which reflect workload factors for each individual shop within Civil Engineering. Macro standards group several related shops, or micro standards, together for establishment of workload standards (19). Two exceptions to the application of macro standards are the fire protection branch and the readiness management branch.

The need for macro standards resulted from the existence of forty AFMSs, 90 workload factors (WLF), a study or application cycle in excess of two years (instead of the desired one year cycle), and an average age of existing AFMS (in excess of six years). These factors are seen as impediments to effective manpower standards.

The macro standard study charter was approved in September, 1987, and testing of the macro standard concept was scheduled for completion by December 1989. The strategy behind macro standards is designed to give the BCE more flexibility in utilizing manpower, to reduce the time of application and updating of standards, to reduce the number of AFMSs in CE, and to provide the same degree of accuracy to ensure negligible decreases or increases in the number of manpower slots in the changeover from the micro to the macro standards.

The use of micro or macro standards in any analysis should give consistent results as long as similar groups are considered. All micro standards considered should be compared with and match the associated macro standard in manpower documents. Therefore, the current study should not be adversely affected regardless of whether one uses a group of micro standards or a corollary macro standard for data.

4. Current Manpower and Manning Issues

Three additional issues were discovered during the literature review which offer background understanding to the purpose of the current study. These three issues are (1) the relationship of peacetime and wartime manpower requirements, (2) differences between education and training with respect to CE work classification, and (3) pre-occupations with budget constraints.

First, the Air Force historically has had difficulty determining needed manpower for support units during wartime. In 1986, 41 years after the end of World War II, the General Accounting Office (GAO) reported military leaders still lacked the necessary tools to assess wartime force structure and tradeoffs (2:76). With wartime support units having difficulty establishing needed manpower requirements, one can infer similar problems exist in less visible peacetime support units. Peacetime and wartime

requirements are sometimes interrelated. The relationship between peacetime workload and manpower requirements provides a basis for extrapolation through the use of regression analysis of wartime requirements (18:4). Peacetime and wartime manpower standards can, however, oppose each other at times with peacetime operational perspectives hampering the more variable and less predictable wartime manpower forecasts (2:76).

Second, the distinction between training and education is not always clear or understood by those subject to manpower requirements. Dr John Kline discusses differences between education and training (20:94-95). Training is usually a closed system that teaches the right answers or how to do something the right way, has a definitive end, and concentrates on the psychomotor or 'doing' aspect of learning. It is usually measured by criterion objectives and predetermined levels, standards, or job requirements.

Education, in comparison, is an open system which concentrates on the cognitive or 'thinking' aspect of learning and has no definitive end. There are usually no definitive right or wrong ways, but only better or worse ways of doing things. Objectives, skill levels, and job requirements are not constraints with education, as persons are continually encouraged to develop their potential (20:94-95). These distinctions between training and

education generally classify CE Operations shop skills as training. CE AFMSs are measurable by criteria objectives and predetermined standards and requirements applicable to skills obtained through training.

Third, Chase cites Peter Drucker as stating that one of the major roadblocks to effective management of Government service institutions is misdirection by budget, where maintaining the budget becomes the primary objective of the organization. Budget cuts can result in deferral of required/requested work. Deferred work, along with manpower and funding reductions, has resulted in a rapidly expanding backlog of work (4:6).

> Air Force Civil Engineering will be facing much higher costs when deferred repairs are eventually initiated. Simple economic inflation will raise the cost of deferred repairs [and] facilities in need of repair will suffer further damage while awaiting repair. (4:8)

Budget considerations, however, should be a constraint in decision making, not an objective. The primary goal of a service organization, customer service, must remain in the forefront of management decisions (4:28). Technical effectiveness (skill level) must be weighed against economic efficiency (cost/manhour). With limited resources and constraints, tradeoffs must be made (18:5). The bottom line operational impact is most visible at the base/installation level.

5. Motivational Theory and Productivity

Any evaluation related to productivity needs to effectively integrate the results into action if the results are to serve a useful purpose. Managerial actions, based on evaluation results and implemented to improve productivity, need to consider and understand how the application will affect the performance of individuals in the system. Motivational theories address this need.

James L. Riggs, a recognized authority in production, expands the individual's ability to perform a task to include the process theories of motivation (26:286..287). Process theories focus on the individuals' conscious evaluation and selection of alternative behaviors that will yield rewards or outcomes they value. In this light, the individuals' performance depends on three variables: capacity (the ability to perform a task based on knowledge, skill, and other factors), willingness (the inclination to perform a task as affected by attitude, reward expectations, and so forth), and opportunity (factors beyond the individuals' control, such as tool and material availability, working conditions, and operating policies). These variables can be combined into a formula, expected performance = capacity x willingness x opportunity, to suggest a probable level of performance.

Wetherbe and Dickson summarize several of the most popular motivational theories in their text The Management of Information Systems (29:86-94). Maslow's hierarchy needs theory was developed in 1943 and associates individual needs with performance motivation. Skinner introduced his reinforcement theory in 1953; it attributes motivation to appropriate positive and negative reinforcement of individual performance. Herzberg's 1958 dual factor theory attributed employee concerns to two classes of factors: hygiene and motivational. Hygiene or maintenance factors are associated with issues peripheral to the work itself and are linked to the presence or absence of dissatisfaction. Motivational factors are linked to the job itself and, when present, provide motivation for the individual to perform. Vroom's expectancy theory (circa 1964) views the product of an individual's orientation toward a particular outcome (valence) and the perceived probability the task will generate the particular outcome (expectancy) as producing the drive (or force) for an individual to perform the task. Finally, in 1976, Locke hypothesized difficult (but reasonable) goals generate more effort on the part of the individual than easier goals which are well within the individual's capability.

Fisher's thesis incorporates Locke's motivational theory and states that as a unit approaches filling all of

its authorized manpower positions, the productivity of each individual may decrease because there will not be as much work for each individual compared to when the organization was undermanned (14:77). It is important to realize, however, that motivation of the individuals performing the tasks depends on factors other than adequate numbers of personnel. Incentives and disincentives, both perceived and actual, can increase and decrease productivity respectively. To effectively apply motivational theories, one must combine goals with the needs and desires of the target population.

6. Methodology Background Literature

Much information regarding the philosophy and general nature of research methodology was found during the literature review. This information lays a foundation and background for chapter III, which applies a specific research methodology to the current study.

The general purpose of research is to make contributions to mankind's knowledge (16:262). Regardless of scope or complexity, research contributes because it increases understanding, enabling one to do more of what one desires to do (16:386). Research should ultimately combine concrete science and technology with abstract philosophy & logic, because "science without philosophy is blind, while philosophy without science is empty" (16:vii).

Research can be broadly classified or divided in several ways (1:126). One division splits research into two broad areas. Pure research strives to gain knowledge for its own sake. Applied research is a deliberate investigation of a problem of practical importance. Another approach classifies research as qualitative or quantitative. A number of research methodologies span the spectrum within either of these two broad classification schemes.

There is no one best type of methodology or research, as it is relative to the environment and purpose of the investigation (16:556). No single research method will answer all the questions because each research method leaves something out. Human capacities are limited, and to compensate for this weakness we simplify or discriminate what we are interested in to make things manageable (16:349).

A question often asked concerning the descriptive methodology used in the current study asks when is the descriptive methodology a data reporting exercise and when is it research? The descriptive methodology is research when "[it] create[s] or ascertain[s] new categories that are revealing or more useful than those already in use" (16:557). The ability to identify and interpret data, however, has limited value in and of itself. It is our

ability to use the results for effective decision making and action that counts (26:264).

In any endeavor, one needs a starting point (where one is), and an end point (where one wants to go), and a path to get there. Descriptive studies can establish the initial orientation and direction in the endeavor and can situationally be broadly applied (16:256). Results from a descriptive methodology can be used as a starting frame for more complex research (16:258).

7. Conclusions

Many studies have directly or indirectly addressed manning or manpower issues, but none have directly compared the quantity and quality of required manpower, authorized manpower, and assigned manning levels. The past and current studies are not necessarily incompatible, but may in fact compliment eachother if comprehensively integrated. The use and capability of the WIMS has matured to a point where analysis of manpower and manning with the WIMS is plausible. The measurement of workloads and the determination of unconstrained manpower requirements are well documented in Air Force Regulations and other publications. Macro or micro AFMSs translate measured workloads into quantities of manpower positions with associated grades and AFSCs. Understanding the relationship between peacetime and wartime

requirements, the definition of training, and the effects of budget constraints on manpower aids in understanding the background of manpower and manning issues. Effective use of manpower includes an understanding and application of motivational theory. Reviewing different research generalities and methodologies suggests the descriptive study approach would be appropriate for the current study.

III. Methodology

1. Introduction

The current study addresses three evaluative questions, within the framework of descriptive research, which focus on the capability of required and authorized manpower and assigned manning. Evaluative questions generally focus on product delivery and mission accomplishment (22:12). Descriptive research commonly utilizes ex post facto data to describe existing conditions or situations (22:46).

The methodology described in this chapter uses ex-post-facto data from establish manpower and manning documents for a database. The data describes manpower in terms of AFSC, grade, and quantity. This descriptive data is collected and placed into one of three different classifications: unconstrained required manpower, constrained authorized manpower, and actual or assigned manning. The qualitative factors of AFSC and grade and the quantitative factor of quantity are aggregated for each classification to determine capability. The aggregates are compared in terms of three ratios: authorized/required manpower, assigned manning/authorized manpower, and assigned manning/required manpower.

Using required manpower levels as a standard measure of capability, absolute measurements between authorized and

required manpower levels and assigned manning and required manpower levels, and relative measurements between assigned manning and authorized manpower levels are recorded. These ratio measurements are numerically and graphically displayed to evaluate and assess the effectiveness of authorized manpower and assigned manning as measured against eachother (the current practice), and as measured against the requirements of the mission as represented by required manpower levels (the method developed in the current study).

2. Overview

The methodology described in this chapter was used to find answers to the evaluative questions as described and explained in chapter I. Practical applications and implications of the questions with reference to evaluation of CE's manpower performance capability to accomplish its peacetime mission, are discussed in Chapter V, conclusions and recommendations. These evaluative questions are:

1. What are the gross quantitative differences between authorized and required manpower, assigned manning and authorized manpower, and assigned manning and required manpower positions in selected CE AFSCs needed to accomplish the required workloads?

2. What are the qualitative differences in grade and skill level/training between authorized and required manpower, assigned manning and authorized manpower, and assigned manning and required manpower positions?

3. What are the aggregate quantity and quality differences between authorized and required manpower, assigned manning and authorized manpower, and assigned manning and required manpower positions?

The research methodology used for this study was descriptive research. The descriptive research approach yields knowledge about an existing situation (16:255) and is generally categorized within the applied (or practical) and quantitative classification of research. One source reports the purpose of descriptive research is "to describe systematically the facts and characteristics of a given population or area of interest, factually and accurately" (22:46). Descriptive research has the following characteristics:

> Descriptive research is used in the literal sense of describing situations or events. It is the accumulation of a data base that is solely descriptive-it does not necessarily seek or explain relationships, make predictions, or get at meanings and implications. (22:46)

Descriptive studies strive to present data, not to explain why something is or happens in such a way;

historical studies and case analyses are better methodologies to use for investigating why something happens. Description tells us what we are dealing with and hence helps us better understand reality so we can do our daily work. "Descriptive studies are of large value in providing facts on which professional judgements may be based" (16:258). One might then ask if descriptive-survey studies solve problems. The answer is that problems of a practical nature are not solved directly by data of any kind, but by the interpretation and application of that data (16:252-260).

The descriptive method can be used to collect detailed factual information that describes existing phenomena, identifies problems or justifies current conditions and practices, makes comparisons and evaluations, or determines what others are doing with similar problems or situations (22:42). It is commonly used for purposes of correlation. Examples of applied descriptive research include census studies, task analysis studies, fact-finding surveys, observation studies, questionnaire and interview studies, and normative data (measurement oriented) collection. The descriptive methodology involves four basic steps: (1) define the objectives in clear, specific terms (what facts/characteristics are to be sought), (2) design the

approach (how will the data be collected), (3) collect the data, and (4) report the results (22:46).

Advantages. Quantitative research in general can be easily used to set quantifiable standards, to monitor systems against set norms, and to predict quantitatively what the future of a given system should be. In addition, quantifiable systems are normally easier to comprehend and adjust than intangible systems. This quality makes corrective actions easier to implement at a variety of management and operational levels. The descriptive methodology is by definition quantitative in nature. As such, "quantitative studies [the descriptive method] frequently prove simpler and easier to handle" (16:264). Its quantitative character contributes to the development of normative, standardized procedures because its application searches for information that by its nature requires standardized methods for collection (16:259).

> Much of the significance and importance of descriptive-survey studies lies in the possibility of investigating the status of conditions at any given time and of repeating the survey at a later date, thus providing descriptions or cross sections at different periods of time, in order that comparisons may be made, the direction of change noted and evaluated, and future growth or development predicted. (16:550)

Cautions. Some experts disagree on the meaning of descriptive research. Mutual understandings must be

established as to the definition of descriptive research used so misunderstandings can be avoided. Michael and Isaac state: "Research authorities are not in agreement on what constitutes descriptive research and often broaden the term to include all forms of research except historical and experimental" (22:46). Often data for descriptive studies already exists and covers a discrete period or periods of time. "Certain aspects observed at a particular time may be something of an accident" and not give a true or typical description of reality in and of itself (16:327,384). Such observations could give false readings and lead to erroneous decisions and judgements if not carefully evaluated and considered. Variable effects cannot be manipulated under these circumstances, but only minimized through careful sample selection (13:60).

Much of the data collected for descriptive methodologies already exists in an historical sense and is often referred to as ex-post facto data. Under these conditions, some desired data may not be available or not exist and the ex-post facto data must be collected and used in whatever form it is found. In sum, the nature and timing of data collection can have significant effects on the final product and cannot be ignored.

The collection and assessment of descriptive measures of intangible characteristics can be demanding and difficult

when compared to more tangible factors. Job descriptions usually do not include personal qualities such as resourcefulness, tact, and judgement when the required work is described (25:348). Exceptional skill, expertise, and experience are sometimes required to meaningfully collect and interpret this kind of intangible data. The U.S. Civil Service Commission booklet, How to Write Position Descriptions, uses a factor evaluation system (which encompasses some of the qualities described above) in preparing position descriptions.

Specific to the research at hand, collecting and working with existing military personnel data may be difficult. Military personnel are dynamic, with individuals routinely reassigned and promoted, and increasing in skill levels. Collecting and evaluating data for certain civilian and military personnel qualities on an equivalent basis may be difficult to address.

Descriptive studies are commonly used to produce correlations. However, this methodology cannot establish dependence or causation as it does not in and of itself address interactions among variables.

Steps. The following steps are seen as necessary to address the problem and answer the evaluative questions stated in Chapter I and at the beginning of this chapter:

1. Determine what quantitative and qualitative variables will be considered and how they are to be processed (weighed and quantified).

2. Determine what available data sources contain desired data about the variables and how the data will be collected.

3. Determine how the processed data and results will be displayed.

4. Determine and select appropriate and available software for data collection, analyses and display.

5. Specify how the sample will be selected (which sections in CE from which squadrons).

6. Evaluate and discuss the results.

3. Data Collection

Basic to any study results is data. The data sources chosen were established, routinely reproduced and updated data bases which exist at the unit level. Using existing data bases takes advantage of economy (time), ease of accessibility, and established reliability. The three primary data sources are Air Force Manpower Standards (AFMS), unit manpower documents (UMD), and unit personnel manning rosters (UPMR). The data was requested via letter (Appendix C) from each unit in the sample.

4. Population and Sample

"There is no sampling technique universally applicable to all projects [as] each requires an individual determination of the appropriate sampling technique" (17:13). The less variability (or more accountability for variability) one has in a sample, the more confident one can be of the usefulness and validity of the results. The following criteria were used to limit possible sources of variability beyond the area of interest and collect data applicable to the problem addressed.

It is not known whether different kinds of MAJCOMs receive different emphasis concerning manpower requirements in the AFCE arena. This question is not answered in this study. The author chose, however, to limit the population to AFCE units located at bases within the CONUS and under the jurisdiction of the three active duty operational commands (TAC, SAC, and MAC) to negate possible differences between operational and support MAJCOMs with respect to the data gathered.

Units at AFRES and ANG bases were not considered because they perform different missions, have different structures, and follow different operating procedures. All HQ bases were eliminated from consideration to avoid any variation associated with such high visibility bases. Units at unusually large and small bases were also avoided because

they sometimes follow operating procedures unique to their base size. Unique and specialized missions (such as ICBM missiles) were also avoided because their CE mission requirements are more likely to differ from the maintenance requirements of an average AFCE squadron.

Finally, bases identified for major realignment or closure in the Report of the Defense Secretary's Commission on Base Realignments and Closures, dated December 1988, were not considered (25). Both the President and Congress endorsed the purpose of the Commission to recommend bases for realignment and closure for economic savings. The author felt the high visibility and interest of the Secretary's report, along with the magnitude of economic savings (estimated at approximately 5.6 billion dollars over twenty years), could contribute to excessive variation at the affected bases. Assuming no other sources of variability remain, the constraints above were imposed on the population and the bases comprising the sample were selected (Appendix B).

Within each AFCE squadron selected, data was collected with respect to selected shops, or work centers, with related tasks. Again, to help control for variability, some restrictions apply as to which shops should be considered. All AFCE squadrons have a mix of manpower resources which consist of military and civilian personnel and contracts.

This research is concerned only with civilian and military personnel. It is not concerned with the contracted workload as the AFCE manager has relatively little control over how that manpower resource is applied on a daily basis. Contract manhour equivalents are not considered in this study. Shops with relatively few personnel are not considered due to large variable effects with small changes in sample size. Groups of shops with relatively large numbers of personnel are preferred because relatively smaller amounts of variability are associated with personnel changes. Shops which historically contract out relatively large portions of their tasks are also avoided for the reason stated above.

5. Summary of Methodology Applied

The descriptive methodology, as stated at the beginning of this chapter, involves four basic steps: (1) define the objectives in clear, specific terms (what facts or characteristics are to be sought), (2) design the approach (how will the data be collected), (3) collect the data, and (4) report the results (22:46). These four basic steps have been applied to the current study.

The objective was to determine if there were differences between the quantitative, qualitative, or aggregate quantitative and qualitative capability of

selected shops to perform the required workload. The determination was done by comparing (1) authorized manpower against required manpower, (2) assigned manning against authorized manpower, and (3) assigned manning against required manpower with respect to quantitative and qualitative factors. The quantitative characteristic considered was the number of manpower positions required, the number of manpower positions authorized, and the number of personnel assigned. The qualitative characteristics considered were the required, authorized, and assigned grades and Air Force Specialty Codes (AFSCs). The qualitative data of grade and AFSC needed to be quantified so the qualitative data could be combined with the quantitative personnel data.

Data sources available at the unit level contained the desired quantitative (amount) and qualitative (grade and AFSC) data. These data sources were the Air Force Manpower Standard (AFMS), the Unit Manpower Document (UMD), and the Unit Personnel Manning Report (UPMR). The quantitative and qualitative data can be extracted and grouped by required, authorized, and assigned data respectively for each position in the selected macro standard.

These documents were requested by letter from bases in the sample. Five of the bases in the sample provided the information requested and needed for the evaluation.

AFSCs were quantified and weighted based on the two grades per skill level rule and grades were quantified and weighted based on average years of service per grade. Ratios were used to derive and present results in percentage form. Weighted grade ratios and weighted AFSC ratios were calculated for authorized and required manpower, assigned manning and authorized manpower, and assigned manning and required manpower for each position. Grade ratios, amounts, and AFSC ratios for all positions for each base were summed respectively and divided by the required amount sum for authorized and required, and assigned and required, ratios and by the authorized amount for assigned and authorized ratios.

The results gave separate quantified cumulative grade, amount, and AFSC ratios for authorized and required manpower, assigned manning and authorized manpower, and assigned manning and require manpower comparisons for each base. These resulting grade, skill level, and amount ratios were summed (each with a weight of one third) to provide aggregate ratios accounting for grade, skill level, and amount for authorized and required manpower, assigned manning and authorized manpower, and assigned manning and required manpower comparisons for each base. These quantified results were then graphed to visually display the comparison differences.

IV. Analysis and Results

1. Analysis

> The quality of a study depends on the adequacy of the research design and the appropriateness of the measuring concepts and procedures. (13:86)

Ratio scales of measurement represent the actual quantities of a variable and have the powers of order, distance, and unique origin (13:91). Population counts are an example of ratio scale measurements. The quantitative population data from the data sources described in chapter III is of a ratio scale. The grade and skill level information supplied by this data is of an ordinal scale, which is described as having order, but no distance or unique origin (13:87).

The specific quantitative information extracted from these bases is the required and authorized manpower and assigned manning quantities. Differences in quantity between required and authorized manpower, authorized manpower and assigned manning, and required manpower and assigned manning are the products of interest used to evaluate quantitative differences.

One qualitative data point extracted from these data bases is rank or grade. This characteristic is weighted, as a function of average years of service per grade, in order

to measure any meaningful differences among required, authorized, and assigned rank or grade.

A second qualitative data point is the AFSC, which describes the career field and skill level of each person. The AFMS skill level and experience (quality factors) are based on the assumption the individual has not deviated from one's initial career field throughout one's career. Cross training and other such events nullify this assumption. The AFMS also associates two grades with each skill level. Any individual deficient in or exceeding his/her assumed skill level can affect productivity. The data sources described in chapter III readily supplies AFSC data points for required and authorized manpower and assigned manning levels and supplements the quantitative data described above.

Results of the data analysis can be displayed in percentages and in graphical form, where relative differences are more easily seen and evaluated. Results for cumulative quantitative and qualitative factors are presented in addition to aggregate results to minimize distortion problems associated with viewing aggregate percentages in isolation.

Many software packages and computer systems are available for processing and evaluating the information. Three alternatives were considered. The first alternative was the use of software associated with tabletop or personal

computers. Tabletop terminals are relatively accessible throughout the Air Force by AFCE units and software is relatively inexpensive and widely available.

If the data base proves to be voluminous, use of two statistical software programs on the AFIT mainframe computer, SAS or SPSS, could be a second alternative. These software systems are already on line and available and are designed to handle large volumes of input. The ease of accessibility of these systems by AFCE units is not known.

The Work Information Management System (WIMS) is a management information system specifically designed for the AFCE community, is installed at most bases, and is familiar to and used by AFCE personnel on a daily basis in one form or another. However, WIMS is an evolving system and, as a result, documentation supplied with WIMS is poor, most training or learning is largely by trial and error, and interaction between different programs and segments within WIMS can be frustrating and time consuming if one is not intimately familiar with systems operation.

The author's preference is to use table top computers and the Quattro spreadsheet software. This software package is relatively inexpensive and widely accessible and is similar to the 20/20 Spreadsheet available on the WIMS software. A transfer of the spreadsheet model to WIMS 20/20 would make this research readily accessible, and therefore

useful, to AFCE management personnel using existing resources and skills.

Ratios, Weights, and Formulas. Ratio values were calculated in part from information contained in the AFMS, the UMD, and the UPMR. Table 1 lists these documents and the respective data fields used as data sources:

TABLE 1

INFORMATION SOURCES

DATA REQUIRED	SOURCE (and data field name)		
	AFMS	UMD	UPMR
Required Grade	GRADE	RGR	
Authorized Grd		GRD	GR (5)
Assigned Grade			GR (5)
Required AFSC	AFSC		
Authorized AFSC		AFSC	
Assigned AFSC			CAFSC/PAFSC (4)
Required Amount	Manpower Req	AMT (1)	
Authorized Amt		AMT (1)	(2)
Assigned Amount			(3)
Position Number		POS-NR	POS-NR
Manpower Type		MNT	
Effective Dates		EFF-TRU	

Notes:
(1) Required and Authorized quantity in same field in UMD.
(2) Always "1" for each line item on UPMR.
(3) Physical count of individuals assigned to a position.
(4) Primary AFSC (PAFSC) and control AFSC (CAFSC) from UPMR. PAFSC represents highest skill-level attained. CAFSC controls assignment to required or authorized positions.
(5) Authorized GR from first line, assigned GR from second line of UPMR

The AFMS details required manpower data. The UMD should list authorized manpower data and repeat the required manpower data from the AFMS. The UPMR should repeat the authorized data from the UMD and list assigned manning data.

From the UMD the RGR, GRD, EFF-TRU, MNT, and POS-NR fields can be monitored to ensure data validity. The required grade data fields are compared to ensure accuracy of data between the AFMS and the UMD. The authorized grade and POS-NR data fields are compared to ensure accuracy of data between the UMD and the UPMR. The EFF-TRU field entries can ensure currency or timeliness of the data. The MNT field entries can ensure that only personnel meeting the defined population requirements are included in the analysis. Validity checks of the fields discussed were made by inspection during data entry into the model. Qualifying MNT codes are listed in Table 2:

TABLE 2

MNT CODES

Position	1	2	3	4	5
Code(s)	X R	X W L O P	X	X	X

Source: AFR 26-1 (2 Dec 88), Vol IV, Table 7-1

Four formulas were developed to determine capability. These formulas use three weighted ratios which, when summed, give a value <= 1. The three ratios represent experience (derived from the grade), skill level or technical expertise (derived from the AFSC), and quantity (derived from the amount of positions or personnel). The values of each of the three ratios are assumed to be of equal importance, and so have equal weighting factors. Capability to do the job can be determined for each individual in the population by adding the three weighted ratios, and intermediate or overall capability for the group can be determined by aggregating individual capabilities.

The required ratio value calculated from fields in the AFMS will always equal 1, as this is the optimum or control situation.

Required Ratio Value (data from AFMS):

Experience	Skill	Quantity

$$(.33 \times \frac{RQD\ GRD}{RQD\ GRD}) + (.33 \times \frac{RQD\ AFSC}{RQD\ AFSC}) + (.33 \times \frac{RQD\ AMT}{RQD\ AMT}) = 1 \qquad (1)$$

The authorized/required ratio value calculated from fields in the UMD and the AFMS is less than or equal to 1, and represents the authorized over required capability.

Authorized/Required Ratio (data from AFMS and UMD):

Experience	Skill	Quantity
AUTH GRD / RQD GRD	AUTH AFSC / RQD AFSC	AUTH AMT / RQD AMT

$$\left(.33 \times \frac{\text{AUTH GRD}}{\text{RQD GRD}}\right) + \left(.33 \times \frac{\text{AUTH AFSC}}{\text{RQD AFSC}}\right) + \left(.33 \times \frac{\text{AUTH AMT}}{\text{RQD AMT}}\right) <= 1 \qquad (2)$$

The assigned/authorized weighted ratio value calculated from fields in the UPMR and the UMD is less than or equal to 1, and represents the assigned over authorized capability.

Assigned/Authorized Ratio (data from UMD and UPMR):

Experience	Skill	Quantity
ASGN GRD / AUTH GRD	ASGN AFSC / AUTH AFSC	ASGN AMT / AUTH AMT

$$\left(.33 \times \frac{\text{ASGN GRD}}{\text{AUTH GRD}}\right) + \left(.33 \times \frac{\text{ASGN AFSC}}{\text{AUTH AFSC}}\right) + \left(.33 \times \frac{\text{ASGN AMT}}{\text{AUTH AMT}}\right) <= 1 \qquad (3)$$

The assigned/required weighted ratio value calculated from fields in the UPMR and the AFMS is less than or equal to 1, and represents the assigned over required capability.

Assigned/Required Ratio (data from UPMR and AFMS):

Experience	Skill	Quantity
ASGN GRD / RQD GRD	ASGN AFSC / RQD AFSC	ASGN AMT / RQD AMT

$$\left(.33 \times \frac{\text{ASGN GRD}}{\text{RQD GRD}}\right) + \left(.33 \times \frac{\text{ASGN AFSC}}{\text{RQD AFSC}}\right) + \left(.33 \times \frac{\text{ASGN AMT}}{\text{RQD AMT}}\right) <= 1 \qquad (4)$$

Ratio Determinations. To determine grade ratios in the above equations, grades were weighted in terms of the average number of years of service per grade. This information is listed in tabular form in Table 3. Enlisted time is based on total active military service (TAFM). The shops selected for analysis do not have required or authorized officer positions. However, the average years of service for officers is included for general information purposes. Officer time is based on total active federal military service (TAFM), instead of total active commissioned service (TAFC), as TAFM includes and accounts for officers with prior enlisted service.

TABLE 3

DEMOGRAPHIC DATA

ENL GRD	TAFM	OFF GRD	TAFM
AB (E-1)	[.25]	2 Lt (O-1)	1.83
AMN (E-2)	1	1 Lt (O-2)	4.01
A1C (E-3)	2	Capt (O-3)	8.94
SRA (E-4)	3	Maj (O-4)	14.40
Sgt (E-4)	5	Lt Col (O-5)	19.20
SSgt (E-5)	10	Col (O-6)	23.40
TSgt (E-6)	15		
MSgt (E-7)	18		
SMSgt (E-8)	21		
CMSgt (E-9)	25		

Source: AFMPC/DPMYI

Two parts of the AFSCs, the first two digits and the fourth digit, were used to determine technical ability. The first two digits identify basic groups of positions (an Air Force career field) requiring similar types of qualifications (28:1-7). The fourth digit represents the technical skill level acquired by the individual or needed for a particular position. If the first two numbers of the primary and control AFSCs differ, the assumption was made that the individual retrained at some point in time. In the cases where the two AFSCs did differ in the collected data, the control AFSC was used for calculating values. A penalty of four years was assessed in the calculation to compensate for the active duty time the individual was not assigned to his/her current AFSC. This four year penalty arises from the fact that airmen cannot retrain until after the first enlistment (usually four years), and retraining is less common as one moves into subsequent enlistments and increases in rank. Individual personnel records would need to be examined to define exactly how much time an individual who has cross trained into a different AFSC has not been in his current AFSC. The model developed here is more general in nature and does not cover this level of detail. This information could be included at the unit level, where this information is more readily available.

Skill level ratios for enlisted grades were based on the two grades per skill level rule currently used in calculating AFMS results. If the required and authorized, and authorized and assigned AFCSs match, the number of years an individual has in his skill level over the weighted average number of years needed to attain the skill level required or authorized can determine an individual's technical capability. If the required and authorized AFSCs don't match, the authorized AFSC skill level was assumed constrained by outside factors. If authorized and assigned AFSCs don't match, a cross training is assumed to have taken place. If there was a mismatch, four years was deducted from the average number of years per grade. No changes were made for 3-level skills due to the short time needed to attain this level. This information is summarized in Table 4 and in Appendix D, Lookup Tables 2A, 2B, and 2C (fractional data is not displayed in Appendix B, but is used in calculations). Quantity or AMT ratios in all the equations were based on tallies taken directly from the AFMS, the UMD, and the UPMR.

TABLE 4

SKILL LEVEL QUANTIFICATION

YEARS PER SKILL LEVEL					
(AFSC match)					
Skill Level	(GRD #1) Avg yrs x %	+	(GRD #2) Avg yrs x %	=	Avg yrs/ Skill level
9	(CMSgt) 25 yrs x 33%	+	(SMSgt) 21 yrs x 67%	=	22.32
7	(MSgt) 18 yrs x 40%	+	(TSgt) 15 yrs x 60%	=	16.20
5	(SSgt) 10 yrs x 50%	+	((Sgt)5 yrs x 25%) + ((SRA)3 yrs x 25%)	=	7.00
3	(AlC) 2 yrs x 50%	+	((AMN)1 yr x 25%) + ((AB).25 yrs x 25%)	=	1.31
(AFSC mismatch)					
9	(CMSgt) 21 yrs x 33%	+	(SMSgt) 17 yrs x 67%	=	18.32
7	(MSgt) 14 yrs x 40%	+	(TSgt) 11 yrs x 60%	=	12.20
5	(SSgt) 6 yrs x 50%	+	((Sgt)1 yr x 25%) + ((SRA)0 yrs x 25%)	=	3.25

Data Entry, Data Collection, and Calculations. Seven TAC, seven MAC, and fourteen SAC bases were selected using the sample selection criteria. A letter explaining the current research and requesting copies of the UMD and UPMR was sent to each of the selected bases (Appendix C). The request stated the source of the data would remain anonymous. The author felt anonymity would promote

participation by minimizing any negative effects the results might show.

Some bases refused to send data because some of the information contained in these reports (social security numbers in particular) was subject to the Privacy Act. Some bases did not reply. Some bases sent incomplete or wrong data, and the data could not be used. Two MAC bases (M1 and M3) and three TAC bases (T1, T2, and T3) responded with usable data. Eight SAC bases responded with appropriate documents, but SAC has implemented a zoned maintenance organizational structure which groups different skills together for maintenance of different parts of the base. While this difference in organizational structure was not discovered in the literature review or methodology research efforts, the data documents received did reflect this change. Because SAC's data structure did not readily lend itself to the data provided on AF Form 1113 for the AFMS 44XX macro standard (Civil Engineering, Mechanical, Controls & Electronics, and Electrical) selected for the study, any results obtained from using the SAC data would provide only partial, if any, useful information to management. As a result, no data from SAC bases was used in the model. The model could, however, be expanded and modified to accommodate SAC's organizational structure and provide meaningful data for management decisions.

Demographic data from AFMPC/DPMYI (Table 3) and information from the AFMS 44XX macro standard were used in the calculations, along with previously described data from the UMD and UPMR. The AFMS 44XX AFMS macro standard supersedes and incorporates the following AFMS micro standards: 446X (Controls and Electronics), 4461 (Refrigeration and Air Conditioning), 4463 (Heating Systems), 4471 (Interior Electrical), and 4472 (Exterior Electrical). Information and data from these two sources is summarized on the Lookup Tables (Appendix D). Required manpower data from the AFMS for the five remaining bases in the sample is reproduced in Appendix E.

The Data Entry forms (Appendix F) are divided into three sections. The required manpower information (RQD) records the required grade (RGR), the required amount (RAMT), and the required AFSC (RAFSC) from the macro standard. The authorized manpower information (AUTH) records the position number (POS#), the authorized grade (TGR), the authorized AFSC (TAFSC), and the authorized amount (TAMT) from the UMD. The assigned manning information records the assigned grade (SGRD), the control AFSC (CAFSC), the primary AFSC (PAFSC), and the assigned amount (SAMT) from the UPMR.

Grade ratios are shown on the Grade Ratio sheet (Appendix G). The first, third, and fifth columns check for

grade matches between authorized and required, assigned and authorized, and assigned and required data for each position. A value of "1" indicates an exact grade match and a value of "0" indicates the grades do not match. The second, fourth, and sixth columns determine the amount of grade match based on the years per grade information on the Lookup Tables (Appendix D). Civilian grades are assumed to match the requirement or authorization they are assigned to, as the UMD lists the grade only as "CIV."

Similarly, skill ratios are shown on Skill Ratio sheets (Appendix H). The first, third, and fifth columns indicate whether the first two digits of the authorized and required, the assigned and authorized, and the assigned and required AFSCs match. A value of "1" indicates a match of the first two digits, whereas a value of "0" indicates no match and thus are considered different and assessed a four year penalty. The second, fourth, and sixth columns quantify the amount of skill match based on whether the first two AFSC digits match. If there was a match of the first and second digits, Tables 2A and 2C of the Lookup Tables were used for calculating the amount of skill match. Otherwise, Tables 2B and 2C were used to calculate the amount of skill match. The two step (match and ratio) procedure for calculations was required to accommodate equation writing limitations

inherent in the software. Calculations for ratio results are explained in detail in Appendix J.

Several inconsistencies arose during data review and data entry. First, the data included several individuals with 1-skill levels. The AFMS, however, does not account for the 1-skill level in its tables. The author interpreted this inconsistency to mean the time required to advance from a 1- to a 3-skill level is nominal or of no consequence when 1-skill levels are concerned. For those individuals with 1-skill levels, the author assigned a 3-skill level was recorded to accommodate this inconsistency in control data from the AFMS tables.

Next, base T2 listed a HVAC shop instead of separate heating and refrigeration shops. This difference was negligible, as both the heating and refrigeration shops are included in the AFMS 44XX macro standard.

Some of the bases did not supply assigned civilian personnel data. In these cases, all civilian positions were assumed filled at the authorized quantities and AFSCs.

Also, no primary AFSCs were listed on any of the documents, although it was obvious from some grade and skill mismatches that some individuals did have primary AFSCs different from the control AFSC. Unless the mismatch was obvious, all primary and control AFSCs were assumed to match.

With reference to the AFMS 446X (Controls and Electronics), many of the SSG and SGT grades were listed as having 3-level skills. According to the two grades per skill level rule, the ranks of SSG and SGT are normally associated with 5-level skills. These differences in skill levels may suggest longer training periods are required for the AFMS 446X and that this AFMS may not follow the two grades per skill level rule as consistently as other AFMSs considered in the current study.

Finally, two positions were assigned civilian personnel with officer AFSCs as opposed to the required and authorized AFSCs. Because this study does not directly account for officer AFSCs, these positions were recorded as satisfying authorized and required grades and skill levels.

2. Results

The Summary Results Table (Appendix I) for each base shows the cumulative grade (GRD), amount (AMT), and skill (SKL) capabilities of authorized/required, assigned/authorized, and assigned/required manpower and manning values for the five bases which supplied usable data for the AFMS 44XX AFMS. These tables also show the aggregate grade, amount, and skill capability ratios of authorized/required, assigned/authorized, and assigned/required manpower and manning. Cumulative and

aggregate capability values for all the bases as a whole are displayed on the All Bases Combined Summary Results Table (Appendix I, Table 10). Values on the All Bases Combined Summary Results Table are averages of all relative values shown on the individual Base Summary Results Tables. Each Summary Results Table also displays the ratio values graphically for visual comparison.

Quantitative Differences. Evaluative question 1 addressed differences in quantitative factors: What are the gross quantitative differences between authorized and required manpower, assigned manning and authorized manpower, and assigned manning and required manpower positions in selected CE AFSCs needed to accomplish the required workloads? From Table 10, the average quantity (amt) of personnel required to accomplish the required workload is 82.2, the associated quantity of authorized personnel is 69.4, and the associated quantity of assigned personnel is 64.6. While the cumulative authorized/required amount ratio is 84 percent, the cumulative assigned/authorized amount ratio is 93 percent; but the assigned/required amount ratio is 79 percent.

These cumulative results show there are differences in amounts among the required manpower, authorized manpower, and assigned manning levels, with the strongest ratio (93 percent) occurring between assigned manning and authorized

manpower and the weakest ratio (79 percent) occurring between assigned manning and required manpower. The best case was base T2 with a 91 percent ratio between authorized and required levels, a 100 percent ratio between assigned and authorized levels, and a 91 percent ratio between assigned and required levels. The weakest case, base M1, showed a 70 percent ratio between authorized and required levels, an 87 percent ratio between assigned and authorized levels, and a 60 percent ratio between assigned and required levels.

Qualitative Differences. Evaluative question 2 addresses differences in two qualitative factors: What are the associated qualitative differences in grade and skill level/training between authorized and required manpower, assigned manning and authorized manpower, and assigned manning and required manpower positions? While the All Bases Combined Summary Results (Table 10) show the overall cumulative authorized/required ratio for the quality characteristic of grade was 77 percent, the associated assigned/authorized grade ratio was 90 percent; but the associated assigned/required grade ratio was only 77 percent. While the overall cumulative authorized/required ratio for skill level was 73 percent, the associated assigned/authorized ratio was 106 percent; but the associated assigned/required ratio was only 74 percent.

These cumulative results show there are differences in quality, as measured by grade and skill, between required manpower, authorized manpower, and assigned manning levels. The strongest ratios for both grade and skill qualities occurred between assigned manning and authorized personnel (90 grade and 106 percent skill). The weakest grade ratios occurred equally between authorized and required manpower and assigned manning and required manpower (77 percent). The weakest skill ratios occurred approximately equally between authorized and required manpower and assigned manning and required manpower (73 percent and 74 percent respectively).

The best cases for grade ratios were bases T1 and T2, with authorized/required grade ratios of 82 percent and 83 percent, assigned/authorized ratios of 110 percent and 94 percent, and assigned/required grade ratios of 83 percent and 88 percent respectively. The weakest case for grade ratios was base M1 with an authorized/required grade ratio of 70 percent and an assigned/required grade ratio of 63 percent. Base T3 had the lowest assigned/authorized grade ratio of 78 percent.

The best cases for skill ratios were bases T1 and T2, with base T2 having an 83 percent authorized/required skill ratio and base T1 having an extremely high 184 percent assigned/authorized skill ratio and a 99 percent

assigned/required skill ratio. The weakest cases for skill ratios were bases M1 and M3 for authorized/required skill ratios (66 percent and 64 percent respectively), base T3 for the assigned/authorized skill ratio (81 percent), and base M1 and T3 for assigned/required ratios (59 percent and 60 percent respectively).

Aggregate Differences. Evaluative question 3 addressed differences in the aggregated quantitative and qualitative factors: What are the associated quantified and aggregated quantity and quality differences between authorized and required manpower, assigned manning and authorized manpower, and assigned manning and required manpower positions? While the overall authorized/required aggregate ratio for quantity and quality values was 78 percent, the associated assigned/authorized aggregate ratio was 96 percent; but the associated assigned/required aggregate ratio was only 77 percent. These results show there are differences between the required manpower, authorized manpower, and assigned manning levels with respect to combined and aggregated quantity and skill factors. The best cases for the aggregate ratios were bases T1 and T2. Base T1 had a high 128 percent assigned/authorized aggregate ratio and base T2 had an 86 percent authorized/required aggregate ratio and an 89 percent assigned/required aggregate ratio. The worst cases were bases M1 and T3. Base M1 had a 69 percent

authorized/required aggregate ratio and a 61 percent assigned/required aggregate ratio. Base T3 had an 84 percent assigned/authorized aggregate ratio.

The current method of evaluating manpower and manning capability using constrained authorized quantities if manpower positions produces results different from the method of measuring manpower developed in the current study. Some implications and applications of the above answers and to the three evaluative questions with respect to CE's capability to accomplish its required peacetime mission are discussed in Chapter V, Conclusions and Recommendations.

V. Conclusions and Recommendations

1. Conclusions

Manning levels are usually calculated by the Personnel office by comparing assigned over authorized quantity levels. Table 10 shows that, for the sample, when the current practice of comparing the quantity of personnel assigned to the quantity of manpower positions authorized by Congress is applied, the AFMS 44XX macro standard is being manned at 93 percent. However, when the quantity of manpower positions authorized by Congress is compared to the quantity of positions required to do the work as measured by the MET, the AFMS is manned at only 84 percent. But, most importantly from a practical or operational perspective, when the assigned (or actual) manning level is compared to the required manpower level needed to accomplish the workload as measured by the MET, the manning level decreases to 79 percent; this is a 21 percent shortfall below the required (100 percent) manpower quantity level needed to accomplish the required workload.

When total or aggregate capability is measured by combining the quantitative factor of manpower or manning with the two qualitative factors of grade (experience) and AFSC (technical ability), 96 percent of the authorized capability was assigned or filled. This aggregate capability level of 96 percent indicates a good correlation

between assigned manning capability and authorized manpower capability. However, this is a misleading indicator of capability when one considers the required workload as measured by the MET. With respect to the required and measured workload, only 78 percent of the required capability level was originally authorized, while the assigned or actual capability decreased to 77 percent of the required capability needed to accomplish the mission.

The above figures show that, for the sample, there are currently inadequate capability levels authorized or assigned for CE to perform its required and measured peacetime mission. In addition, the assigned/authorized capability level of 96 percent indicates the qualitative factors of grade and skill can compensate in part for the deficient quantity factor level alone of 93 percent. However, considering the misleading character of the assigned/authorized ratio and considering instead the more realistic aggregate assigned/required capability ratio, deficient quality factors decrease the actual capability level to 77 percent. This decrease indicates a lack of quality can actually decrease the effective capability level.

Three general conclusions can be drawn from the above results. First, the current practice of measuring only the quantitative factor when determining manning levels does not

give an accurate assessment of CE's actual capability to accomplish its required mission. Second, using constrained authorized levels as a measurement standard instead of unconstrained measured and required workload levels can produce false productivity readings because the full workload demand placed on CE is not taken into account. Third, when qualitative factors are considered in conjunction with the quantitative factor, the aggregate capability level is affected (this is particularly noticeable at bases T1 (Table 5), base M3 (Table 9), and base T3 (Table 7)). Manpower and manning assessments which take into account the above conclusions would allow management to make judgements and decisions and take subsequent action with respect to backlog, productivity, and other performance factors from a more comprehensive measure of unit or subunit capability.

The data sources (the AFMS, UMD, and UPMR) contain both the qualitative and quantitative information used in this study. Also, the tools for manipulation of this data currently exist (the WIMS and its associated software). However, the usefulness of this qualitative data and the potential of manipulating the data with available tools are not widely recognized, understood or used at any level or function for purposes of measuring and interpreting aggregate manpower and manning capability levels.

The following three approaches may help balance the required workload to accomplish the mission (as measured by the MET) with the authorized capability (as constrained and funded by Congress). These approaches would subsequently help balance the more realistic measure of assigned and required capability. First, authorized manpower capability levels can be increased by Congress to more closely match the measured workload requirements of the mission. This approach would require increased appropriations for military personnel. Increasing appropriations in times of austere budgets could be difficult politically. Second, the required workload (the mission) can be reduced in scope. This reduction in mission and defense goals lies within the responsibility of the Congress and the President as elected officials. The military by itself is a tool of national policy, not the creator of national policy, and so does not determine the mission. The third approach could be accomplished largely within the Air Force. The assumptions and procedures the MET utilizes for the measurement of work can be modified to compensate for the gap between authorized and required manpower capability levels. Or, alternatively, the current practice of using authorized levels as base measures could be deleted and required levels could be used as an alternative and more realistic standard with reference to the measured workload the mission is based upon.

There are weaknesses in aggregate assigned manning capability (77 percent) with respect to required capability. Assigned manning capability depends on recruitment (amounts), technical ability (skills), and retention and experience (grade). Assigned capability levels may be balanced in part against required capability levels at the unit level by placing more emphasis on recruitment, training, and retention and promotion. This approach, though, has its practical human limitation factors. There are limits to how fast or how well one can accomplish a trained task with definitive bounds. Motivation measures and goal congruency can also affect this balance.

The aggregate quantity and quality measurement of the assigned/required capability level is a more realistic and useful measure of a unit's ability to perform the measured and required mission than is the assigned/authorized capability level. The assigned/required factor levels of amount, grade and skill can show the weaknesses and strengths in a unit's capability to do the workload required to perform the peacetime mission. By knowing a unit's weaknesses and strengths with respect to experience (grade), technical ability (skill), and quantity (amount), the manager knows where to capitalize on excess capability resources and where to invest other limited resources for productivity improvement.

In conclusion, one additional point must be emphasized to better explain and understand the incongruencies between assigned/authorized and assigned/required measurements. Different denominators are used for determining assigned/authorized ratio levels and assigned/required ratio levels, regardless of whether one is measuring aggregate capability or just quantity. The total required amount or capability level is based on the number of positions required, whereas the total authorized amount or capability level is based on the number of positions authorized. This point indicates the Personnel office measures manning levels with one yardstick (the capability or number of positions authorized and funded by Congress) while work requirements (and possibly unit productivity) are measured against a totally different yardstick (the capability or number of positions required to accomplish the measured workload). This important conclusion explains why the assigned/required ratio levels in Appendix I are not direct products of assigned/authorized and authorized/required factors.

2. Recommendations for Further Research.

Two recommendations for further research related to the current study are proposed.

Backlog and Capability. An additional application of the current study could encompass the work backlog in AFCE

Operations. The amount of this work backlog is often used as a measure of productivity both inside and outside the unit and can be viewed as a standard measure of demand placed on CE. One way to link this productivity measure with the method of determining capability developed in the current research would be to associate aggregate assigned manning capability against the amount of workload demands associated with the work backlog. The mechanics of associating backlog with capability would require further investigation. A backlog of work is acceptable and is in fact expected. However, one needs to understand and have confidence in what the backlog really represents. This comparison of capability to backlog may correlate backlog to underperformance, demand in excess of capability, or some other specific factor which the manager may then efficiently apply his resources to correct.

Longitudinal Experiment. The current research used a single point-in-time cross-sectional reference point of one AFMS in several units. A more comprehensive study could implement and track a longitudinal study of total branch or unit capability based on the current study. The methodology could be installed and performed on the WIMS, making the results readily available to participating units as well as to the researcher. This approach could be expanded in scope to incorporate an experimental approach. An experimental

approach could include test units (to which motivational theories could be tested by managers in conjunction with backlog goals and unit capability) and control units (to which no actions would be taken in conjunction with motivational theories and capability measures) to determine statistically if capability levels and actions based on capability level measures does indeed improve productivity. The results of this research could contribute to unit productivity with a minimal investment of equipment and manpower and would cause minimal disruption to the ongoing operations of the units involved.

3. Summary

Do current practices in manpower and manning evaluation of CE units reflect the actual capabilities of the units to perform the measured workload? The results of the current research suggests the answer to this question is no.

The current practice, which measures assigned manning quantities against constrained authorized manpower positions to determine manning and manpower levels, does not produce the same results as an alternative method (the method developed in the current study), which incorporates the total quantitative and qualitative capability of the unit to perform the mission. The current method further enhances capability evaluation and guides related management

decisions by identifying deficiencies or excesses in experience (represented by grade), technical ability (represented by AFSC), and quantity.

The use of constrained authorized manpower levels as a standard for measuring manning levels, and the use of measured workloads as to determine the unconstrained required manpower resources to perform the mission results in two possible measures of capability: assigned manning/authorized manpower and assigned manning/required manpower. The former measures capability with respect to what manpower resources Congress appropriates for the task (a relative measure), and the latter measures capability with respect to what manpower resources are needed to accomplish the task (an absolute measure). Any performance measures used for evaluation or management decisions should correspond to one or the other measure of capability. Mixing relative and absolute measures is like comparing apples and oranges: the results are irrelevant to eachother.

The current study was limited to one AFSC macro standard in five different locations at a particular point in time. These limits inhibit broad or indisputable generalizations of the results outside the sample without further research. The results do indicate the alternative method may be useful, especially at the unit level.

Appendix A: Terms and Definitions

(Source: AFR 25-5 (8:360-369))

-Backlog: the accumulated workload volume not yet done, or that portion of the work that is behind schedule or beyond the immediate capability of the organization.

-Command Manpower Data System (CMDS): a system designed to provide MAJCOM and SOA OPRs for manpower the capability manage and control manpower resources through a variety of formats and levels of detail.

-Funded military grade: the grade reflected in the authorized grade column (data element GRD) of the UMD. In aggregation, this reflects statutory and budget constraints and influences assignment actions.

-Grade structure: the distribution of grades within an organization.

-Manpower authorization: a funded manpower authorization (as opposed to an unfunded position).

-Manpower utilization: the manner in which manpower resources are distributed in an organization to accomplish the assigned mission.

-Standard: an exact or fixed value, entity, or concept established and defined by authority that serves as a reference, model, or rule to measure quantities or qualities, establish practices or procedures, or evaluate results.

-Standards application: a systematic determination of required or allowed manpower authorizations for Air Force activities using manpower standards. The process consists of relating prescribed workload factor volumes to manpower models or tables resulting in a numerical identification of whole authorizations normally by Air Force specialty, skill level, and grade.

-Work center: a group of personnel that use similar machines, processes, methods, and operations to perform homogeneous work usually located in a centralized area. The term is used to identify a relatively small activity within a broad functional segment. Personnel within a work center perform work that basically contributes to the same end product or result (duties are similar or closely related).

-Work Center description (WCD): a format that shows work center responsibilities structured for easy measurement of work categories, tasks, and subtasks. Work center descriptions are the foundations on which required manpower standards are built. Manpower standards are based on the concept that work center operations are efficient and standardized.

Appendix B: List of Bases in Sample

SAC	TAC	MAC
Fairchild	Mountain Home	McChord
Beale	Davis-Monthan	Altus
Castle	Bergstrom	Little Rock
March	MacDill	Charleston
Malmstrom	Moody	Pope
Minot	Shaw	Dover
Ellsworth	Seymour Johnson	McGuire
Carswell		
Dyess		
KI Sawyer		
Wurtsmith		
Grissom		
Blytheville		
Plattsburg		

Appendix C: Data Request Letter

AFIT/LSG

Request for Manning and Manpower Information in Support of AFIT Research Project

438 CES/DE

1. I am a civil engineering officer attending the General Engineering Management (GEM) program, Air Force Institute of Technology (AFIT), Wright Patterson AFB, Ohio. My primary research project studies the differentials between required, authorized, and assigned personnel. I am currently collecting manning and manpower data from civil engineering units for this project. Items to be studied are grade, AFSC, skill level, and quantity of military and civilian personnel. This data can be extracted from two standard reports, the unit manning document (UMD) and the unit manpower personnel report/unit personnel manning document (UMPR/UPMD).

2. I request your assistance by your sending a copy of your most current UMD and UMPR/UPMD to Capt Neuhaus, AFIT/LSG, Wright Patterson AFB, Ohio 45424. Receipt of these documents by NLT 30 Mar would be extremely helpful. Anonymity of data origin will be exercised in the reporting of any findings.

3. Your cooperation in this effort is greatly appreciated. Please feel free to contact me at AV 785-4437 or Dr David Vaughan, Project Manager, at AV 785-2254 if you have any questions regarding this request. If you would like to receive a copy of the final document, please let me know when you send the requested documents. Thank you once again for your support and assistance.

BRYAN K. NEUHAUS, Capt, USAF
AFIT/LSG

Appendix D: Lookup Tables

TABLE 1 GRDS	
GRD	Yrs
AB	.25
AMN	1
A1C	2
SRA	3
SGT	5
SSG	10
TSG	15
MSG	18
SMS	21
CMS	25
NA	0.0

TABLE 2C	
AFSC	Rqd
AFSC	Yrs
54X3X	1
54X5X	7
54X7X	16
54X99	22

TABLE 2A AFSC Same		TABLE 2A (cont'd)		TABLE 2B AFSC Diff		TABLE 2B (cont'd)	
AFSC	Yrs	AFSC	Yrs	AFSC	Yrs	AFSC	Yrs
54230	1	54530	1	54230	0	54530	0
54250	7	54550	7	54250	3	54550	3
54270	16	54570	16	54270	12	54570	12
54231	1	54531	1	54231	0	54531	0
54251	7	54551	7	54251	3	54551	3
54271	16	54571	16	54271	12	54571	12
54232	1	54532	1	54232	0	54532	0
54252	7	54552	7	54252	3	54552	3
54272	16	54572	16	54272	12	54572	12
54233	1	54533	1	54233	0	54533	0
54253	7	54553	7	54253	3	54553	3
54273	16	54573	16	54273	12	54573	12
54299	22	54599	22	54299	18	54599	18
		0	0			0	0

(refer to Table 4 for unrounded Yrs figures)

Appenxix E: Air Force Manpower Standard Extracts for Sample

STANDARD MANPOWER TABLE EXTRACTS (from AFMS 44XX, 3 Jul 89)							
WORK CENTER/AFSC Mechanical/Controls & Electronics/Electrical FAC 44XX			Applicability Man-Hour Range: 4767.42 - 42847.46				
AF Specialty Title	AFSC	GRADE	Manpower Requirement				
Mechanical/ Electrical Mgr	54X00	CMS			1	1	1
Mechanical/ Electrical Supt	54X99	SMS	2	2	2	2	2
Mechanical/ Electrical Techn	54X7X	MSG	6	6	7	7	8
Mechanical/ Electrical Techn	54X7X	TSG	9	9	10	11	11
Mechanical/ Electrical Spec	54X5X	SSG	20	21	22	23	25
Mechanical/ Electrical Spec	54X5X	SGT	20	21	22	23	25
Apr Mechanical/ Electrical Spec	54X3X	A1C	16	17	19	19	21
TOTAL			73	76	83	86	93

Appendix F: Data Entry Sheets

Base M1

REQUIRED DATA (Source: AFMS)			AUTHORIZED DATA (Source: UMD)				ASSIGNED DATA (Source: UPMR)			
RGR	AMT	AFSC	POS-NR	GRD	AFSC	AMT	GRD	CAFSC	PAFSC	AMT
CMS	1	54X99	0	NA	0	0	NA	0	0	0
SMS	1	54X99	0	NA	0	0	NA	0	0	0
SMS	1	54X99	0	NA	0	0	NA	0	0	0
MSG	1	54X7X	0	NA	0	0	NA	0	0	0
TSG	1	54X7X	0	NA	0	0	NA	0	0	0
TSG	1	54X7X	0	NA	0	0	NA	0	0	0
TSG	1	54X7X	0	NA	0	0	NA	0	0	0
SGT	1	54X5X	8888	A1C	54530	1	AMN	54530	545301	1
SSG	1	54X5X	8899	CIV	54550	1	WG10	54550	545501	1
TSG	1	54X7X	10432	TSG	54570	1	TSG	54570	545701	1
A1C	1	54X3X	10441	A1C	54532	1	NA	0	0	0
SGT	1	54X5X	10442	SGT	54552	1	SRA	54552	545521	1
SSG	1	54X5X	10443	SSG	54552	1	SSG	54552	545521	1
TSG	1	54X7X	10445	TSG	54572	1	SSG	54552	545521	1
SSG	1	54X5X	10448	CIV	54552	1	NA	0	0	0
SSG	1	54X5X	10448	CIV	54552	1	WG10	54552	545521	1
SSG	1	54X5X	10448	CIV	54552	1	G10	54552	54552	1
SSG	1	54X5X	10448	CIV	54552	1	WG10	54552	54552	1
SSG	1	54X5X	10448	CIV	54552	1	WG08	54552	54552	1
MSG	1	54X7X	10449	CIV	54572	1	NA	0	0	0
SSG	1	54X5X	34959	CIV	54251	1	WG10	54251	54251	1
A1C	1	54X3X	36501	A1C	54530	1	A1C	54530	54530	1
A1C	1	54X3X	36501	A1C	54530	1	NA	0	0	0
SSG	1	54X5X	46385	SSG	54250	1	SSG	54250	54250	1
A1C	1	54X3X	46408	A1C	54231	1	AMN	54231	54231	2
SGT	1	54X5X	46410	SGT	54251	1	A1C	54231	54231	1
MSG	1	54X7X	53263	MSG	54573	1	MSG	54573	54573	1
SSG	1	54X5X	78782	SSG	54251	1	SGT	54251	54251	1
A1C	1	54X3X	92312	CIV	54533	1	WG10	54533	54533	1
MSG	1	54X7X	140436	CIV	54573	1	WG10	54573	54573	1
A1C	1	54X3X	140537	CIV	54532	1	WG08	54532	54532	1
SSG	1	54X5X	140543	CIV	54250	1	WG10	54250	54250	1
A1C	1	54X3X	206092	A1C	54530	1	A1C	54530	54530	1
A1C	1	54X3X	206093	A1C	54532	1	NA	0	0	0
SSG	1	54X5X	210144	SSG	54550	1	TSG	54570	54570	1
SGT	1	54X5X	210145	SGT	54552	1	NA	0	0	0
MSG	1	54X7X	210146	MSG	54270	1	NA	0	0	0
TSG	1	54X7X	210147	TSG	54573	1	TSG	54573	54573	1
MSG	1	54X7X	213656	MSG	54570	1	MSG	54570	54570	1
TSG	1	54X7X	215696	TSG	54271	1	SSG	54251	54251	1

Base M1 (continued)

SSG	1	54X5X	235437	CIV	54550	1	WG10	54550	54550	1
SSG	1	54X5X	235438	CIV	54552	1	WL10	54552	54552	1
SSG	1	54X5X	235439	CIV	54250	1	WG10	54250	54250	1
SGT	1	54X5X	242569	SGT	54550	1	SGT	54550	54550	1
SGT	1	54X5X	242569	SGT	54550	1	A1C	54530	54530	1
SGT	1	54X5X	242570	SGT	54552	1	NA	0	0	0
A1C	1	54X3X	242571	A1C	54532	1	AMN	54532	54532	1
A1C	1	54X3X	251802	CIV	54533	1	WG11	54533	54533	1
A1C	1	54X3X	251802	CIV	54533	1	WG11	54533	54533	1
A1C	1	54X3X	251802	CIV	54533	1	WG11	54533	54533	1
A1C	1	54X3X	257638	A1C	54230	1	SRA	54250	54250	1
SSG	1	54X5X	261167	CIV	54550	1	WG10	54550	54550	1
SSG	1	54X5X	261167	CIV	54550	1	WG10	54550	54550	1
A1C	1	54X3X	261169	CIV	54231	1	NA	0	0	0
SGT	1	54X5X	272901	SGT	54550	1	SGT	54550	54550	1
A1C	1	54X3X	299142	CIV	54230	1	NA	0	0	0
A1C	1	54X3X	307982	CIV	54530	1	NA	0	0	0
A1C	1	54X3X	326977	A1C	54530	1	AMN	54530	54530	1
SSG	1	54X5X	356839	CIV	5525F	1	GS09	5525F	5525F	1
A1C	1	54X3X	356840	CIV	54533	1	WG11	54533	54533	1
SSG	1	54X5X	356970	SSG	54533	1	SSG	54533	54533	1
SGT	1	54X5X	356971	SGT	54533	1	SSG	54533	54533	1
SGT	1	54X5X	356971	SGT	54533	1	SSG	54533	54533	1
SGT	1	54X5X	356971	SGT	54533	1	NA	0	0	0
SSG	1	54X5X	378977	SSG	54250	1	SSG	54250	54250	1
SGT	1	54X5X	400264	SGT	54552	1	SGT	54552	54552	1
A1C	1	54X3X	400265	A1C	54532	1	AMN	54532	54532	1
MSG	1	54X7X	431358	CIV	54270	0	NA	0	0	0
NA	0	0	378977	NA	0	0	SSG	54250	54250	1
NA	0	0	378977	NA	0	0	SGT	54250	54250	1
NA	0	0	206092	NA	0	0	AMN	54230	54230	1
TSG	1	54X7X	0	NA	0	0	NA	0	0	0
TSG	1	54X7X	0	NA	0	0	NA	0	0	0
TSG	1	54X7X	0	NA	0	0	NA	0	0	0
TSG	1	54X7X	0	NA	0	0	NA	0	0	0
SSG	1	54X5X	0	NA	0	0	NA	0	0	0
SSG	1	54X5X	0	NA	0	0	NA	0	0	0
SSG	1	54X5X	0	NA	0	0	NA	0	0	0
SGT	1	54X5X	0	NA	0	0	NA	0	0	0
SGT	1	54X5X	0	NA	0	0	NA	0	0	0
SGT	1	54X5X	0	NA	0	0	NA	0	0	0
SGT	1	54X5X	0	NA	0	0	NA	0	0	0
SGT	1	54X5X	0	NA	0	0	NA	0	0	0
SGT	1	54X5X	0	NA	0	0	NA	0	0	0
SGT	1	54X5X	0	NA	0	0	NA	0	0	0
SGT	1	54X5X	0	NA	0	0	NA	0	0	0
SGT	1	54X5X	0	NA	0	0	NA	0	0	0
SGT	1	54X5X	0	NA	0	0	NA	0	0	0
SGT	1	54X5X	0	NA	0	0	NA	0	0	0

Appendix F: Data Entry Sheets

Base M3

REQUIRED DATA (Source: AFMS)			AUTHORIZED DATA (Source: UMD)				ASSIGNED DATA (Source: UPMR)			
RGR	AMT	AFSC	POS-NR	GRD	AFSC	AMT	GRD	CAFSC	PAFSC	AMT
SSG	1	54X5X	927	SSG	54533	1	SSG	54533	54533	1
SSG	1	54X5X	21298	SGT	54550	1	SGT	54550	54550	1
MSG	1	54X7X	22355	CIV	54573	1	CIV	54573	54573	1
SSG	1	54X5X	24019	CIV	54550	1	CIV	54550	54550	1
SSG	1	54X5X	24019	CIV	54550	1	CIV	54550	54550	1
SSG	1	54X5X	24019	CIV	54550	1	CIV	54550	54550	1
TSG	1	54X7X	25891	TSG	54270	1	MSG	54270	54270	1
SSG	1	54X5X	25892	CIV	54250	1	CIV	54250	54250	1
SSG	1	54X5X	25892	CIV	54250	1	CIV	54250	54250	1
MSG	1	54X7X	29463	CIV	54270	1	CIV	54270	54270	1
SGT	1	54X5X	33030	A1C	54530	1	AMN	54530	54530	1
A1C	1	54X3X	33120	CIV	54231	1	CIV	54231	54231	1
A1C	1	54X3X	33120	CIV	54231	1	CIV	54231	54231	1
SGT	1	54X5X	41787	A1C	54230	1	A1C	54230	54230	1
SSG	1	54X5X	46443	SGT	54251	1	NA	0	0	0
TSG	1	54X7X	52789	TSG	54572	1	TSG	54572	54572	1
SSG	1	54X5X	52805	SSG	54250	1	SSG	54250	54250	1
SSG	1	54X5X	54017	SGT	54533	1	SSG	54533	54533	1
SSG	1	54X5X	54017	SGT	54533	1	NA	0	0	0
SGT	1	54X5X	54018	A1C	54530	1	NA	0	0	0
SGT	1	54X5X	56650	A1C	54230	1	SRA	54250	54250	1
A1C	1	54X3X	60797	CIV	54533	1	CIV	54533	54533	1
SSG	1	54X5X	63514	SGT	54533	1	SGT	54533	54533	1
SSG	1	54X5X	63514	SGT	54533	1	SSG	54533	54533	1
SSG	1	54X5X	71905	CIV	54251	1	CIV	54251	54251	1
SSG	1	54X5X	75310	SSG	54552	1	SSG	54552	54552	1
MSG	1	54X7X	75734	MSG	54570	1	MSG	54570	54570	1
MSG	1	54X7X	79686	CIV	54271	1	CIV	54271	54271	1
TSG	1	54X7X	80668	TSG	54570	1	TSG	54570	54570	1
SGT	1	54X5X	80793	A1C	54532	1	AB	54532	54532	1
SGT	1	54X5X	80793	A1C	54532	1	A1C	54532	54532	1
SSG	1	54X5X	80795	SGT	54552	1	SGT	54552	54552	1
SSG	1	54X5X	80796	SGT	54552	1	SGT	54552	54552	1
TSG	1	54X7X	80799	TSG	54573	1	TSG	54573	54573	1
TSG	1	54X7X	80971	TSG	54271	1	TSG	54271	54271	1
SGT	1	54X5X	84315	A1C	54530	1	NA	0	0	0
SGT	1	54X5X	84316	A1C	54532	1	AMN	54532	54532	1
A1C	1	54X3X	136753	CIV	54530	1	CIV	54530	54530	1

Base M3 (continued)

A1C	1	54X3X	136753	CIV	54530	1	CIV	54530	54530	1
A1C	1	54X3X	136759	CIV	54533	1	CIV	54533	54533	1
A1C	1	54X3X	136773	CIV	54230	1	CIV	54230	54230	1
SGT	1	54X5X	208230	A1C	54231	1	NA	0	0	0
SSG	1	54X5X	209477	SSG	54251	1	SGT	54251	54251	1
MSG	1	54X7X	210065	MSG	54572	1	MSG	54572	54572	1
A1C	1	54X3X	210069	CIV	54533	1	CIV	54533	54533	1
A1C	1	54X3X	210069	CIV	54533	1	CIV	54533	54533	1
A1C	1	54X3X	210069	CIV	54533	1	CIV	54533	54533	1
MSG	1	54X7X	210072	CIV	54572	1	CIV	54572	54572	1
SGT	1	54X5X	222819	A1C	54532	1	A1C	54532	54532	1
SSG	1	54X5X	233803	CIV	54552	1	CIV	54552	54552	1
SSG	1	54X5X	233803	CIV	54552	1	CIV	54552	54552	1
SSG	1	54X5X	242545	SSG	54552	1	SSG	54552	54552	1
SGT	1	54X5X	251772	SGT	54533	1	NA	0	0	0
SGT	1	54X5X	265064	SGT	54550	1	SGT	54550	54550	1
SGT	1	54X5X	265065	A1C	54532	1	A1C	54532	54532	1
SGT	1	54X5X	295180	A1C	54530	1	NA	0	0	0
SGT	1	54X5X	310011	A1C	54230	1	A1C	54230	54230	1
SGT	1	54X5X	323192	A1C	54230	1	NA	0	0	0
SGT	1	54X5X	323193	SGT	54251	1	SGT	54251	54251	1
MSG	1	54X7X	356832	CIV	54570	1	CIV	54570	54570	1
SGT	1	54X5X	356920	SGT	54550	1	NA	0	0	0
SGT	1	54X5X	356920	SGT	54550	1	NA	0	0	0
SGT	1	54X5X	356921	A1C	54530	1	NA	0	0	0
SGT	1	54X5X	361389	SGT	54533	1	SGT	54533	54533	1
SSG	1	54X5X	375527	SSG	54550	1	SSG	54550	54550	1
TSG	1	54X7X	375528	TSG	54573	1	TSG	54573	54573	1
TSG	1	54X7X	375528	TSG	54573	1	SSG	54533	54533	1
SMS	1	54X99	424529	NA	0	0	NA	0	0	0
TSG	1	54X7X	424532	TSG	54572	1	NA	0	0	0
NA	0	0	265065	NA	0	0	AMN	54530	54530	1
NA	0	0	52805	NA	0	0	SGT	54250	54250	1
NA	0	0	323193	NA	0	0	SRA	54532	54532	1
NA	0	0	52789	NA	0	0	SSG	54552	54552	1
TSG	1	54X7X	57748	MSG	54573	1	MSG	54573	54573	1
NA	0	0	80796	NA	0	0	SGT	54552	54552	1
NA	0	0	80796	NA	0	0	SGT	54552	54552	1
NA	0	0	927	NA	0	0	SSG	54533	54533	1
TSG	1	54X7X	210065	MSG	54572	1	NA	0	0	0
A1C	1	54X3X	260988	CIV	54533	1	NA	0	0	0
NA	0	0	41737	NA	0	0	A1C	54230	54230	1
NA	0	0	325527	NA	0	0	SSG	54550	54550	1
NA	0	0	265064	NA	0	0	SGT	54550	54550	1
CMS	1	54X99	0	NA	0	0	NA	0	0	0
SMS	1	54X99	0	NA	0	0	NA	0	0	0
SGT	1	54X5X	0	NA	0	0	NA	0	0	0
A1C	1	54X3X	0	NA	0	0	NA	0	0	0
A1C	1	54X3X	0	NA	0	0	NA	0	0	0
A1C	1	54X3X	0	NA	0	0	NA	0	0	0

Base M3 (continued)

AlC	1	54X3X	0	NA	0	0	NA	0	0	0
AlC	1	54X3X	0	NA	0	0	NA	0	0	0
AlC	1	54X3X	0	NA	0	0	NA	0	0	0
AlC	1	54X3X	0	NA	0	0	NA	0	0	0
AlC	1	54X3X	0	NA	0	0	NA	0	0	0
SGT	1	54X5X	0	NA	0	0	NA	0	0	0

Appendix F: Data Entry Sheets

Base T1

REQUIRED DATA (Source: AFMS)			AUTHORIZED DATA (Source: UMD)				ASSIGNED DATA (Source: UPMR)			
RGR	AMT	AFSC	POS-NR	GRD	AFSC	AMT	GRD	CAFSC	PAFSC	AMT
A1C	1	54X3X	42601	A1C	54532	1	AB	54532	54532	1
A1C	1	54X3X	42601	A1C	54532	1	A1C	54552	54552	1
A1C	1	54X3X	42601	A1C	54532	1	A1C	54532	54532	1
A1C	1	54X3X	42601	A1C	54532	1	A1C	54552	54552	1
SGT	1	54X5X	42602	SGT	54552	1	SGT	54552	54552	1
SGT	1	54X5X	42602	SGT	54552	1	SSG	54572	54572	1
SGT	1	54X5X	42631	SGT	54250	1	TSG	54270	54270	1
TSG	1	54X7X	42633	TSG	54270	1	TSG	54270	54270	1
SSG	1	54X5X	42641	CIV	54251	1	WG10	54251	54251	1
SSG	1	54X5X	42641	CIV	54251	1	WG10	54251	54251	1
MSG	1	54X7X	42642	CIV	54271	1	WS09	54271	54271	1
SSG	1	54X5X	55076	CIV	54552	1	WG10	54552	54552	1
MSG	1	54X7X	69203	CIV	54270	1	WS09	54270	54270	1
TSG	1	54X7X	77216	MSG	54570	1	TSG	54570	54570	1
MSG	1	54X7X	77218	CIV	54570	1	WS10	54570	54570	1
SSG	1	54X5X	91553	SSG	54550	1	SSG	54570	54570	1
SSG	1	54X5X	91553	SSG	54550	1	SSG	54570	54570	1
SSG	1	54X5X	91553	SSG	54550	1	SGT	54550	54550	1
SSG	1	54X5X	96731	CIV	54250	1	WG10	54250	54250	1
SSG	1	54X5X	145405	SSG	54552	1	NA	0	0	0
SSG	1	54X5X	145405	SSG	54552	1	SSG	54572	54572	1
SGT	1	54X5X	147007	A1C	54230	1	SRA	54250	54250	1
SGT	1	54X5X	147007	A1C	54230	1	NA	0	0	0
SGT	1	54X5X	173062	SGT	54251	1	SGT	54251	54251	1
A1C	1	54X3X	192867	CIV	54530	1	WL10	54530	54530	1
SGT	1	54X5X	439487	A1C	54230	1	TSG	54270	54270	1
SGT	1	54X5X	439487	A1C	54230	1	A1C	54230	54230	1
SGT	1	54X5X	482476	A1C	54231	1	A1C	54251	54251	1
SGT	1	54X5X	482946	SGT	54251	1	SSG	54271	54271	1
SSG	1	54X5X	483924	CIV	54250	1	WG10	54250	54250	1
SSG	1	54X5X	483924	CIV	54250	1	WG10	54250	54250	1
MSG	1	54X7X	492428	CIV	54572	1	WS10	54572	54572	1
SGT	1	54X5X	503119	SGT	54533	1	SGT	54553	54553	1
A1C	1	54X3X	503568	CIV	54230	1	WG10	54230	54230	1
SSG	1	54X5X	571286	CIV	54550	1	NA	0	0	0
SSG	1	54X5X	571286	CIV	54550	1	WG10	54550	54550	1
SSG	1	54X5X	571286	CIV	54550	1	WG10	54550	54550	1
SSG	1	54X5X	571286	CIV	54550	1	WL10	54550	54550	1
TSG	1	54X7X	577643	TSG	54572	1	SSG	54572	54572	1
SSG	1	54X5X	602519	SGT	54533	1	SSG	54573	54573	1

Base T1 (continued)

TSG	1	54X7X	633430	SSG	54533	1	SGT	54233	54233	1
TSG	1	54X7X	635423	TSG	54570	1	NA	0	0	0
SGT	1	54X5X	635425	SGT	54550	1	SGT	54550	54550	1
SGT	1	54X5X	635425	SGT	54550	1	SGT	54550	54550	1
TSG	1	54X7X	635429	MSG	54573	1	MSG	54573	54573	1
SGT	1	54X5X	637412	SGT	54550	1	SSG	54570	54570	1
MSG	1	54X7X	640599	CIV	54573	1	WG10	54573	54573	1
MSG	1	54X7X	640599	CIV	54573	1	WG10	54573	54573	1
SMS	1	54X99	640600	CIV	54599	1	WG10	54599	54599	1
SGT	1	54X5X	672846	SGT	54550	1	NA	0	0	0
SGT	1	54X5X	672847	A1C	54532	1	A1C	54532	54532	1
TSG	1	54X7X	684923	TSG	54573	1	TSG	54572	54572	1
TSG	1	54X7X	684924	SSG	54533	1	SGT	54553	54253	1
A1C	1	54X3X	688389	CIV	54533	1	NA	0	0	0
A1C	1	54X3X	688389	CIV	54533	1	NA	0	0	0
SGT	1	54X5X	689426	SGT	54552	1	AB	54232	54232	1
SGT	1	54X5X	689426	SGT	54552	1	NA	0	0	0
SGT	1	54X5X	689426	SGT	54552	1	NA	0	0	0
SSG	1	54X5X	888888	CIV	54552	0	WG10	54552	54552	1
SSG	1	54X5X	888888	CIV	54250	0	WG10	54250	54250	1
SSG	1	54X5X	888888	CIV	54250	0	WG10	54250	54250	1
TSG	1	54X7X	634251	TSG	54271	1	SSG	54271	54271	1
SSG	1	54X5X	55076	CIV	54552	1	WL10	54552	54552	1
NA	0	0	42633	NA	0	0	TSG	54270	45473	1
SMS	1	54X99	27678	CIV	5525F	1	GS12	5525F	5525F	1
SGT	1	54X5X	0	NA	0	0	NA	0	0	0
A1C	1	54X3X	0	NA	0	0	NA	0	0	0
A1C	1	54X3X	0	NA	0	0	NA	0	0	0
A1C	1	54X3X	0	NA	0	0	NA	0	0	0
A1C	1	54X3X	0	NA	0	0	NA	0	0	0
A1C	1	54X3X	0	NA	0	0	NA	0	0	0
A1C	1	54X3X	0	NA	0	0	NA	0	0	0
A1C	1	54X3X	0	NA	0	0	NA	0	0	0

Appendix F: Data Entry Sheets

Base T2

REQUIRED DATA (Source: AFMS)			AUTHORIZED DATA (Source: UMD)				ASSIGNED DATA (Source: UPMR)			
RGR	AMT	AFSC	POS-NR	GRD	AFSC	AMT	GRD	CAFSC	PAFSC	AMT
TSG	1	54X5X	87661	SSG	54550	1	SSG	54550	54550	1
SGT	1	54X3X	89109	A1C	54532	1	AMN	54532	54532	1
SGT	1	54X3X	89109	A1C	54532	1	A1C	54532	54532	1
SGT	1	54X3X	89109	A1C	54532	1	AB	54532	54532	1
SMS	1	54X99	112300	CIV	54570	1	WL10	54570	54570	1
SGT	1	54X3X	153735	A1C	54530	1	A1C	54530	54530	1
SGT	1	54X3X	153735	A1C	54530	1	SRA	54550	54550	1
SGT	1	54X3X	153735	A1C	54530	1	NA	0	0	0
A1C	1	54X5X	153735	A1C	54530	1	NA	0	0	0
A1C	1	54X3X	153737	A1C	54230	1	A1C	54230	54230	1
A1C	1	54X3X	153737	A1C	54230	1	AMN	54230	54230	1
A1C	1	54X3X	153737	A1C	54230	1	A1C	54230	54230	1
SSG	1	54X5X	154709	CIV	54550	1	WL10	54550	54550	1
SSG	1	54X5X	154709	CIV	54550	1	WG10	54550	54550	1
SSG	1	54X5X	154709	CIV	54550	1	WG10	54550	54550	1
SSG	1	54X5X	154709	CIV	54550	1	NA	0	0	1
SMS	1	54X99	168896	CIV	54572	1	WS12	54572	54572	1
SSG	1	54X5X	168918	CIV	54250	1	WL10	54250	54250	1
SSG	1	54X5X	168918	CIV	54250	1	WG10	54250	54250	1
MSG	1	54X7X	168927	CIV	54270	1	WS10	54270	54270	1
SGT	1	54X5X	168928	A1C	54231	1	SRA	54231	54251	1
SGT	1	54X3X	168928	A1C	54231	1	A1C	54231	54231	1
A1C	1	54X3X	168928	A1C	54231	1	SGT	54231	54251	1
TSG	1	54X5X	168931	SSG	54251	1	SSG	54251	54251	1
SGT	1	54X5X	168931	SSG	54251	1	NA	0	0	0
TSG	1	54X7X	168932	TSG	54271	1	TSG	54271	54271	1
SSG	1	54X5X	168934	CIV	54251	1	WL10	54251	54251	1
SSG	1	54X5X	168934	CIV	54251	1	WL10	54251	54251	1
A1C	1	54X3X	190759	CIV	54532	1	WG10	54532	54532	1
A1C	1	54X3X	190759	CIV	54532	1	WG10	54532	54532	1
A1C	1	54X3X	190759	CIV	54532	1	WG10	54532	54532	1
SGT	1	54X5X	365544	SGT	54533	1	SGT	54533	54533	1
TSG	1	54X7X	380525	TSG	54270	1	NA	0	0	1
TSG	1	54X7X	439539	MSG	54570	1	SSG	54550	54550	1
TSG	1	54X7X	439580	MSG	54572	1	TSG	54572	54572	1
SSG	1	54X5X	439581	SSG	54552	1	SSG	54552	54552	1
SSG	1	54X5X	439581	SSG	54552	1	NA	0	0	0
SSG	1	54X5X	439581	SSG	54552	1	SSG	54552	54552	1
SSG	1	54X5X	439581	SSG	54552	1	SGT	54552	54552	1

Base T2 (continued)

TSG	1	54X7X	441674	MSG	54271	1	MSG	54271	54271	1
SGT	1	54X5X	467145	SGT	54550	1	SSG	54550	54550	1
SGT	1	54X5X	467145	SGT	54550	1	SSG	54550	54550	1
TSG	1	54X7X	484113	TSG	54572	1	TSG	54572	54572	1
A1C	1	54X5X	503111	CIV	54530	1	NA	0	0	0
A1C	1	54X5X	503567	CIV	54230	1	WG10	54230	54230	1
MSG	1	54X7X	534750	CIV	54270	1	WS10	54270	54270	1
A1C	1	54X3X	554748	CIV	54533	1	NA	0	0	0
SSG	1	54X5X	584863	SGT	54250	1	SGT	54250	54250	1
SSG	1	54X5X	584863	SGT	54250	1	SGT	54250	54250	1
SSG	1	54X5X	601578	CIV	54250	1	WG11	54250	54250	1
SSG	1	54X5X	601578	CIV	54250	1	WG11	54250	54250	1
A1C	1	54X5X	601594	NA	0	0	NA	0	0	0
SSG	1	54X5X	601596	SSG	54250	1	SSG	54250	54250	1
MSG	1	54X7X	621647	CIV	54570	1	WS10	54570	54570	1
SGT	1	54X5X	634229	SGT	54250	1	SSG	54250	54250	1
SGT	1	54X5X	634230	SGT	54250	1	SGT	54250	54250	1
SGT	1	54X5X	635380	SGT	54552	1	SGT	54552	54552	1
TSG	1	54X7X	635384	MSG	54573	1	TSG	54573	54573	1
SSG	1	54X5X	635385	SSG	54533	1	SSG	54533	54533	1
SSG	1	54X5X	635385	SSG	54533	1	SSG	54553	54553	1
MSG	1	54X7X	640579	CIV	54573	1	WL10	54573	54573	1
MSG	1	54X7X	640580	CIV	54573	1	WG10	54573	54573	1
MSG	1	54X7X	640580	CIV	54573	1	WG10	54573	54573	1
A1C	1	54X7X	640581	NA	0	0	NA	0	0	0
A1C	1	54X7X	640581	NA	0	0	NA	0	0	0
A1C	1	54X7X	640581	NA	0	0	NA	0	0	0
SGT	1	54X5X	668529	SGT	54550	1	SRA	54550	54550	1
SGT	1	54X5X	668529	SGT	54550	1	NA	0	0	0
SGT	1	54X5X	668529	SGT	54550	1	SGT	54550	54550	1
SGT	1	54X5X	668530	SGT	54552	1	SSG	54552	54552	1
SGT	1	54X5X	668530	SGT	54552	1	SGT	54552	54552	1
SGT	1	54X5X	668530	SGT	54552	1	A1C	54532	54532	1
SGT	1	54X5X	668530	SGT	54552	1	SRA	54552	54552	1
NA	0	0	87661	NA	0	0	SGT	54550	54550	1
NA	0	0	87661	NA	0	0	SGT	54550	54550	1
NA	0	0	668530	NA	0	0	A1C	54532	54532	1
NA	0	0	153737	NA	0	0	MSG	54532	88878	1
NA	0	0	153737	NA	0	0	A1C	54532	54532	1
NA	0	0	153737	NA	0	0	SRA	54232	54232	1
NA	0	0	153737	NA	0	0	AMN	54232	54232	1
A1C	0	54X3X	0	NA	0	0	NA	0	0	0
A1C	0	54X3X	0	NA	0	0	NA	0	0	0
A1C	1	54X3X	0	NA	0	0	NA	0	0	0

Appendix F: Data Entry Sheets

Base T3

REQUIRED DATA (Source: AFMS)			AUTHORIZED DATA (Source: UMD)				ASSIGNED DATA (Source: UPMR)			
RGR	AMT	AFSC	POS-NR	GRD	AFSC	AMT	GRD	CAFSC	PAFSC	AMT
SSG	1	54X5X	69752	SSG	54550	1	SSG	54550	54550	1
SGT	1	54X5X	150250	SGT	54550	1	SRA	54550	54550	1
SGT	1	54X5X	150250	SGT	54550	1	SGT	54550	54550	1
A1C	1	54X3X	152565	A1C	54230	1	A1C	54230	54230	1
A1C	1	54X3X	152565	A1C	54230	1	AMN	54230	54230	1
A1C	1	54X3X	152565	A1C	54230	1	TSG	54230	88878	1
A1C	1	54X3X	152565	A1C	54230	1	AMN	54230	54230	1
NA	0	0	152565	NA	0	0	A1C	54230	54230	1
A1C	1	54X3X	152578	A1C	54231	1	AMN	54231	54231	1
A1C	1	54X3X	152578	A1C	54231	1	SRA	54251	54251	1
A1C	1	54X3X	152578	A1C	54231	1	NA	0	0	0
SGT	1	54X5X	152579	SGT	54251	1	SGT	54251	54251	1
NA	0	0	152579	NA	0	0	SGT	54251	54251	1
TSG	1	54X7X	152582	SSG	54251	1	SSG	54251	54251	1
SGT	1	54X5X	165853	A1C	54532	1	A1C	54532	54532	1
SGT	1	54X5X	165853	A1C	54532	1	A1C	54532	54532	1
SGT	1	54X5X	165853	A1C	54532	1	A1C	54532	54532	1
A1C	1	54X3X	165853	A1C	54532	1	AMN	54532	54532	2
SGT	1	54X5X	165853	A1C	54532	1	A1C	54532	54532	1
SGT	1	54X5X	165853	A1C	54532	1	NA	0	0	0
SGT	1	54X5X	165853	A1C	54532	1	AMN	54532	54532	1
SGT	1	54X5X	165853	A1C	54532	1	AMN	54532	54532	1
A1C	1	54X3X	165853	A1C	54532	1	AMN	54532	54532	1
SGT	1	54X5X	165856	SGT	54552	1	SGT	54552	54552	1
NA	0	0	165856	NA	0	0	SGT	54552	54552	1
SGT	1	54X5X	172059	A1C	54530	1	SRA	54552	54552	1
SGT	1	54X5X	172059	A1C	54530	1	NA	0	0	0
SGT	1	54X5X	172059	A1C	54530	1	NA	0	0	0
SGT	1	54X5X	172059	A1C	54530	1	NA	0	0	0
SGT	1	54X5X	172059	A1C	54530	1	NA	0	0	0
TSG	1	54X7X	380545	SSG	54533	1	NA	0	0	0
TSG	1	54X7X	439485	TSG	54270	1	MSG	54270	54270	1
A1C	1	54X3X	439509	A1C	54532	1	SRA	54532	54532	1
TSG	1	54X7X	439583	SSG	54552	1	SSG	54552	54552	1
TSG	1	54X7X	439583	SSG	54552	1	SSG	54552	54552	1
TSG	1	54X7X	482464	SSG	54250	1	SGT	54250	54250	1
NA	0	0	482464	NA	0	0	SGT	54250	54250	1
NA	0	0	482464	NA	0	0	SSG	54250	54250	1
MSG	1	54X7X	489521	MSG	54570	1	MSG	54570	54570	1
TSG	1	54X7X	503486	SSG	54251	1	SSG	54251	54251	1

Base T3 (continued)

NA	0	0	503486	NA	0	0	SSG	54251	54251	1
A1C	1	54X3X	508548	A1C	54230	1	A1C	54230	54230	1
A1C	1	54X3X	508548	A1C	54230	1	AMN	54230	54230	1
TSG	1	54X7X	566207	TSG	54572	1	TSG	54572	54572	1
SSG	1	54X5X	576528	SGT	54550	1	NA	0	0	0
SMS	1	54X99	598371	MSG	54271	1	NA	0	0	0
SSG	1	54X5X	601626	SGT	54533	1	SSG	54533	54533	1
SSG	1	54X5X	601626	SGT	54533	1	SSG	54533	54533	1
TSG	1	54X7X	602003	TSG	54570	1	TSG	54572	54572	1
NA	0	0	602003	NA	0	0	TSG	54572	54572	1
SSG	1	54X5X	635393	SSG	54552	1	SGT	54552	54552	1
SSG	1	54X5X	635393	SSG	54552	1	SGT	54552	54552	1
SSG	1	54X5X	635393	SSG	54552	1	SGT	54552	54552	1
SMS	1	54X99	635394	MSG	54573	1	MSG	54573	54573	1
TSG	1	54X7X	668535	MSG	54570	1	NA	0	0	0
SSG	1	54X5X	668536	SGT	54550	1	NA	0	0	0
SSG	1	54X5X	668536	SGT	54550	1	NA	0	0	0
SSG	1	54X5X	668536	SGT	54550	1	NA	0	0	0
SSG	1	54X5X	668536	SGT	54550	1	NA	0	0	0
SGT	1	54X5X	668537	SGT	54550	1	NA	0	0	0
SGT	1	54X5X	668538	SGT	54552	1	NA	0	0	0
SGT	1	54X5X	668538	SGT	54552	1	NA	0	0	0
SGT	1	54X5X	668538	SGT	54552	1	NA	0	0	0
SGT	1	54X5X	668538	SGT	54552	1	NA	0	0	0
SGT	1	54X5X	668539	SGT	54552	1	NA	0	0	0
SGT	1	54X5X	668539	SGT	54552	1	NA	0	0	0
SGT	1	54X5X	668540	SGT	54552	1	SGT	54532	54532	1
TSG	1	54X7X	684915	TSG	54573	1	NA	0	0	0
SGT	1	54X5X	684916	SGT	54533	1	NA	0	0	0
NA	0	0	69752	NA	0	0	SSG	54550	54550	1
NA	0	0	6972	NA	0	0	SSG	54550	54550	1
NA	0	0	69752	NA	0	0	SSG	54550	54550	1
NA	0	0	69752	NA	0	0	SSG	54550	54550	1
NA	0	0	439509	NA	0	0	A1C	54532	54532	1
NA	0	0	165856	NA	0	0	A1C	54532	54532	1
NA	0	0	165856	NA	0	0	SSG	54552	54552	1
NA	0	0	482464	NA	0	0	SSG	54250	54250	1
MSG	1	54X7X	13539	CIV	54571	1	CIV	54571	54571	1
SSG	1	54X5X	245747	CIV	54550	1	CIV	54550	54550	1
SSG	1	54X5X	245747	CIV	54550	1	CIV	54550	54550	1
SSG	1	54X5X	245747	CIV	54550	1	CIV	54550	54550	1
SSG	1	54X5X	245747	CIV	54550	1	CIV	54550	54550	1
SSG	1	54X5X	245747	CIV	54550	1	CIV	54550	54550	1
MSG	1	54X7X	254512	CIV	54572	1	CIV	54572	54572	1
MSG	1	54X7X	614437	CIV	54572	1	CIV	54572	54572	1
SSG	1	54X5X	254506	CIV	54552	1	CIV	54552	54552	1
SSG	1	54X5X	254506	CIV	54552	1	CIV	54552	54552	1
SSG	1	54X5X	254506	CIV	54552	1	CIV	54552	54552	1
MSG	1	54X7X	640585	CIV	54573	1	CIV	54573	54573	1
MSG	1	54X7X	640586	CIV	54573	1	CIV	54573	54573	1

Base T3 (continued)

MSG	1	54X7X	640587	CIV	54573	1	CIV	54573	54573	1
A1C	1	54X3X	484132	CIV	54533	1	CIV	54533	54533	1
A1C	1	54X3X	484132	CIV	54533	1	CIV	54533	54533	1
A1C	1	54X3X	612037	CIV	54533	1	CIV	54533	54533	1
MSG	1	54X7X	152577	CIV	54270	1	CIV	54270	54270	1
SSG	1	54X5X	576534	CIV	54250	1	CIV	54250	54250	1
SSG	1	54X5X	613966	CIV	54250	1	CIV	54250	54250	1
SSG	1	54X5X	613966	CIV	54250	1	CIV	54250	54250	1
SSG	1	54X5X	152853	CIV	54251	1	CIV	54251	54251	1
SSG	1	54X5X	493387	CIV	54251	1	CIV	54251	54251	1
A1C	1	54X3X	0	NA	0	0	NA	0	0	0
CMS	1	54X99	0	NA	0	0	NA	0	0	0
A1C	1	54X3X	0	NA	0	0	NA	0	0	0
A1C	1	54X3X	0	NA	0	0	NA	0	0	0
A1C	1	54X3X	0	NA	0	0	NA	0	0	0
A1C	1	54X3X	0	NA	0	0	NA	0	0	0
A1C	1	54X3X	0	NA	0	0	NA	0	0	0
SSG	1	54X5X	482425	CIV	54250	1	CIV	54250	54250	1

Appendix G: Grade Ratio Sheets

Base M1

Authorized/Required		Assigned/Authorized		Assigned/Required	
Match	Ratio	Match	Ratio	Match	Ratio
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.40	0	0.50	0	0.20
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.00	0	0.00
1	1.00	0	0.60	0	0.60
1	1.00	1	1.00	1	1.00
1	1.00	0	0.67	0	0.67
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.50	0	0.50
1	1.00	0	0.40	0	0.40
1	1.00	1	1.00	1	1.00
1	1.00	0	0.50	0	0.50
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.00	0	0.00
1	1.00	0	1.50	0	1.50
1	1.00	0	0.00	0	0.00
1	1.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.67	0	0.67
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00

Base M1 (continued)

1	1.00	0	0.40	0	0.40
1	1.00	0	0.00	0	0.00
1	1.00	0	0.50	0	0.50
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	1.50	0	1.50
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.50	0	0.50
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	2.00	0	2.00
1	1.00	0	2.00	0	2.00
1	1.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.50	0	0.50
1	1.00	1	1.00	1	1.00
0	0.00	0	0.00	0	1.00
0	0.00	0	0.00	0	1.00
0	0.00	0	0.00	0	1.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00

Appendix G: Grade Ratio Sheets

Base M3

Authorized/Required		Assigned/Authorized		Assigned/Required	
Match	Ratio	Match	Ratio	Match	Ratio
1	1.00	1	1.00	1	1.00
0	0.50	1	1.00	0	0.50
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	1.20	0	1.20
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
0	0.40	0	0.50	0	0.20
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
0	0.40	1	1.00	0	0.40
0	0.50	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
0	0.50	0	2.00	1	1.00
0	0.50	0	0.00	0	0.00
0	0.40	0	0.00	0	0.00
0	0.40	0	1.50	0	0.60
1	1.00	1	1.00	1	1.00
0	0.50	1	1.00	0	0.50
0	0.50	0	2.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
0	0.40	0	0.13	0	0.05
0	0.40	1	1.00	0	0.40
0	0.50	1	1.00	0	0.50
0	0.50	1	1.00	0	0.50
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
0	0.40	0	0.00	0	0.00
0	0.40	0	0.50	0	0.20
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
0	0.40	0	0.00	0	0.00
1	1.00	0	0.50	0	0.50
1	1.00	1	1.00	1	1.00

Base M3 (continued)

1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
0	0.40	1	1.00	0	0.40
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
0	0.40	1	1.00	0	0.40
0	0.40	0	0.00	0	0.00
0	0.40	1	1.00	0	0.40
0	0.40	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.00	0	0.00
1	1.00	0	0.00	0	0.00
0	0.40	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.67	0	0.67
0	0.00	0	0.00	0	0.00
1	1.00	0	0.00	0	0.00
0	0.00	0	0.00	1	1.00
0	0.00	0	0.00	1	1.00
0	0.00	0	0.00	1	1.00
0	0.00	0	0.00	1	1.00
0	1.20	1	1.00	0	1.20
0	0.00	0	0.00	1	1.00
0	0.00	0	0.00	1	1.00
0	0.00	0	0.00	1	1.00
0	1.20	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
0	0.00	0	0.00	1	1.00
0	0.00	0	0.00	1	1.00
0	0.00	0	0.00	1	1.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00

Appendix G: Grade Ratio Sheets

Base T1

Authorized/Required		Assigned/Authorized		Assigned/Required	
Match	Ratio	Match	Ratio	Match	Ratio
1	1.00	0	0.13	0	0.13
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	2.00	0	2.00
1	1.00	0	3.00	0	3.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
0	1.20	0	0.83	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	0	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.50	0	0.50
1	1.00	1	1.00	1	1.00
1	1.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
0	0.40	0	1.50	0	0.60
0	0.40	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
0	0.40	0	7.50	0	3.00
0	0.40	1	1.00	0	0.40
0	0.40	1	1.00	1	1.00
1	1.00	0	2.00	0	2.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.67	0	0.67
0	0.50	0	2.00	1	1.00
0	0.67	0	0.50	0	0.33
1	1.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00

Base T1 (continued)

0	1.20	1	1.00	0	1.20
1	1.00	0	2.00	0	2.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.00	0	0.00
0	0.40	1	1.00	0	0.40
1	1.00	1	1.00	1	1.00
0	0.67	0	0.50	0	0.33
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.05	0	0.05
1	1.00	0	0.00	0	0.00
1	1.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.67	0	0.67
1	1.00	1	1.00	1	1.00
0	0.00	0	0.00	0	1.00
1	1.00	1	1.00	1	1.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00

Appendix G: Grade Ratio Sheets

Base T2

Authorized/Required		Assigned/Authorized		Assigned/Required	
Match	Ratio	Match	Ratio	Match	Ratio
0	0.67	1	1.00	0	0.67
0	0.40	0	0.50	0	0.20
0	0.40	1	1.00	0	0.40
0	0.40	0	0.13	0	0.05
1	1.00	1	1.00	1	1.00
0	0.40	1	1.00	0	0.40
0	0.40	0	1.50	0	0.60
0	0.40	0	0.00	0	0.00
1	1.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.50	0	0.50
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
0	0.40	0	1.50	0	0.60
0	0.40	1	1.00	0	0.40
1	1.00	0	2.50	0	2.50
0	0.67	1	1.00	0	0.67
1	1.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.00	0	0.00
0	1.20	0	0.56	0	0.67
0	1.20	0	0.83	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.50	0	0.50
0	1.20	1	1.00	0	1.20
1	1.00	0	2.00	0	2.00
1	1.00	0	2.00	0	2.00

Base T2 (continued)

1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
0	0.50	1	1.00	0	0.50
0	0.50	1	1.00	0	0.50
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
0	0.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	2.00	0	2.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
0	1.20	0	0.83	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
1	1.00	0	0.60	0	0.60
1	1.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	0	2.00	0	2.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.40	0	0.40
1	1.00	0	0.60	0	0.60
0	0.00	0	0.00	0	1.00
0	0.00	0	0.00	0	1.00
0	0.00	0	0.00	0	1.00
0	0.00	0	0.00	0	1.00
0	0.00	0	0.00	0	1.00
0	0.00	0	0.00	0	1.00
0	0.00	0	0.00	0	1.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00

Appendix G: Grade Ratio Sheets

Base T3

Authorized/Required		Assigned/Authorized		Assigned/Required	
Match	Ratio	Match	Ratio	Match	Ratio
1	1.00	1	1.00	1	1.00
1	1.00	0	0.60	0	0.60
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.50	0	0.50
1	1.00	0	7.50	0	7.50
1	1.00	0	0.50	0	0.50
0	0.00	0	0.00	0	1.00
1	1.00	0	0.50	0	0.50
1	1.00	0	1.50	0	1.50
1	1.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
0	0.00	0	0.00	0	1.00
0	0.67	1	1.00	0	0.67
0	0.40	1	1.00	0	0.40
0	0.40	1	1.00	0	0.40
0	0.40	1	1.00	0	0.40
1	1.00	0	0.50	0	0.50
0	0.40	1	1.00	0	0.40
0	0.40	0	0.00	0	0.00
0	0.40	0	0.50	0	0.20
0	0.40	0	0.50	0	0.20
1	1.00	0	0.50	0	0.50
1	1.00	1	1.00	1	1.00
0	0.00	0	0.00	0	1.00
0	0.40	0	1.50	0	0.60
0	0.40	0	0.00	0	0.00
0	0.40	0	0.00	0	0.00
0	0.40	0	0.00	0	0.00
0	0.40	0	0.00	0	0.00
0	0.67	0	0.00	0	0.00
1	1.00	0	1.20	0	1.20
1	1.00	0	1.50	0	1.50
0	0.67	1	1.00	0	0.67
0	0.67	1	1.00	0	0.67
0	0.67	0	0.50	0	0.33
0	0.00	0	0.00	0	1.00
0	0.00	0	0.00	0	1.00
1	1.00	1	1.00	1	1.00
0	0.67	1	1.00	0	0.67
0	0.00	0	0.00	0	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.50	0	0.50
1	1.00	1	1.00	1	1.00

Base T3 (continued)

0	0.50	0	0.00	0	0.00
0	0.86	0	0.00	0	0.00
0	0.50	0	2.00	1	1.00
0	0.50	0	2.00	1	1.00
1	1.00	1	1.00	1	1.00
0	0.00	0	0.00	0	1.00
1	1.00	0	0.50	0	0.50
1	1.00	0	0.50	0	0.50
1	1.00	0	0.50	0	0.50
0	0.86	1	1.00	0	0.86
0	1.20	0	0.00	0	0.00
0	0.50	0	0.00	0	0.00
0	0.50	0	0.00	0	0.00
0	0.50	0	0.00	0	0.00
0	0.50	0	0.00	0	0.00
1	1.00	0	0.00	0	0.00
1	1.00	0	0.00	0	0.00
1	1.00	0	0.00	0	0.00
1	1.00	0	0.00	0	0.00
1	1.00	0	0.00	0	0.00
1	1.00	0	0.00	0	0.00
1	1.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.00	0	0.00
1	1.00	0	0.00	0	0.00
0	0.00	0	0.00	0	1.00
0	0.00	0	0.00	0	1.00
0	0.00	0	0.00	0	1.00
0	0.00	0	0.00	0	1.00
0	0.00	0	0.00	0	1.00
0	0.00	0	0.00	0	1.00
0	0.00	0	0.00	0	1.00
0	0.00	0	0.00	0	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00

Base T3 (continued)

1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00

Appendix H: Skill Ratio Sheets

Base M1

Authorized/Required		Assigned/Authorized		Assigned/Required	
Match	Ratio	Match	Ratio	Match	Ratio
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
1	0.19	1	1.00	1	0.19
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	0.43	1	0.43
1	1.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	0.19	1	0.19
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.00	0	0.00
1	1.00	1	2.31	1	2.31
1	1.00	0	0.00	0	0.00
1	1.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	0.43	1	0.43
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00

Base M1 (continued)

1	1.00	1	0.19	1	0.19
1	1.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	5.33	1	5.33
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.00	0	0.00
1	1.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
0	1.00	1	1.00	0	1.00
1	1.00	1	1.00	1	1.00
1	0.19	1	1.00	1	0.19
1	0.19	1	1.00	1	0.19
1	0.19	1	1.00	1	0.19
1	0.19	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.00	0	0.00
0	0.00	0	0.00	0	1.00
0	0.00	0	0.00	0	1.00
0	0.00	0	0.00	0	1.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00

Appendix H: Skill Ratio Sheets

Base M3

Authorized/Required		Assigned/Authorized		Assigned/Required	
Match	Ratio	Match	Ratio	Match	Ratio
1	0.19	1	1.00	1	0.19
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	0.19	1	1.00	1	0.19
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	0.19	1	1.00	1	0.19
1	1.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	0.19	1	1.00	1	0.19
1	0.19	0	0.00	0	0.00
1	0.19	0	0.00	0	0.00
1	0.19	1	5.33	1	1.00
1	1.00	1	1.00	1	1.00
1	0.19	1	1.00	1	0.19
1	0.19	1	1.00	1	0.19
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	0.19	1	1.00	1	0.19
1	0.19	1	1.00	1	0.19
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	0.19	0	0.00	0	0.00
1	0.19	1	1.00	1	0.19
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	0.19	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00

Base M3 (continued)

1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	0.19	1	1.00	1	0.19
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	0.19	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	0.19	1	1.00	1	0.19
1	0.19	0	0.00	0	0.00
1	0.19	1	1.00	1	0.19
1	0.19	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.00	0	0.00
1	1.00	0	0.00	0	0.00
1	0.19	0	0.00	0	0.00
1	0.19	1	1.00	1	0.19
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	0.08	1	0.08
0	0.00	0	0.00	0	0.00
1	1.00	0	0.00	0	0.00
0	0.00	0	0.00	0	1.00
0	0.00	0	0.00	0	1.00
0	0.00	0	0.00	0	1.00
0	0.00	0	0.00	0	1.00
1	1.00	1	1.00	1	1.00
0	0.00	0	0.00	0	1.00
0	0.00	0	0.00	0	1.00
0	0.00	0	0.00	0	1.00
1	1.00	0	0.00	0	0.00
1	1.00	0	0.00	0	0.00
0	0.00	0	0.00	0	1.00
0	0.00	0	0.00	0	1.00
0	0.00	0	0.00	0	1.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00

Appendix H: Skill Ratio Sheets

Base T1

Authorized/Required		Assigned/Authorized		Assigned/Required	
Match	Ratio	Match	Ratio	Match	Ratio
1	1.00	1	1.00	1	1.00
1	1.00	1	5.33	1	5.33
1	1.00	1	1.00	1	1.00
1	1.00	1	5.33	1	5.33
1	1.00	1	1.00	1	1.00
1	1.00	1	2.31	1	2.31
1	1.00	1	2.31	1	2.31
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	2.31	1	2.31
1	1.00	1	2.31	1	2.31
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.00	0	0.00
1	1.00	1	2.31	1	2.31
1	0.19	1	5.33	1	1.00
1	0.19	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	0.19	1	12.34	1	2.31
1	0.19	1	1.00	1	0.19
1	0.19	1	5.33	1	1.00
1	1.00	1	2.31	1	2.31
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	0.19	1	5.33	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	0.19	1	12.34	1	2.31
1	0.08	1	1.00	1	0.08
1	1.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00

Base T1 (continued)

1	1.00	1	1.00	1	1.00
1	1.00	1	2.31	1	2.31
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.00	0	0.00
1	0.19	1	1.00	1	0.19
1	1.00	1	1.00	1	1.00
1	0.08	1	5.33	1	0.43
1	1.00	0	0.00	0	0.00
1	1.00	0	0.00	0	0.00
1	1.00	1	0.19	1	0.19
1	1.00	0	0.00	0	0.00
1	1.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
0	0.00	0	0.00	0	1.00
0	1.00	1	1.00	0	1.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00

Appendix H: Skill Ratio Sheets

Base T2

Authorized/Required		Assigned/Authorized		Assigned/Required	
Match	Ratio	Match	Ratio	Match	Ratio
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	0.73	1	1.00	1	0.73
1	1.00	1	1.00	1	1.00
1	1.00	1	5.33	1	5.33
1	1.00	0	0.00	0	0.00
1	0.19	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.00	0	0.00
1	0.73	1	1.00	1	0.73
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	0.19	1	1.00	1	0.19
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	0.19	1	1.00	1	0.19
1	1.00	0	0.00	0	0.00
1	1.00	1	0.43	1	0.43
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	0.19	0	0.00	0	0.00

Base T2 (continued)

1	0.19	1	1.00	1	0.19
1	1.00	1	1.00	1	1.00
1	1.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
0	0.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	0.19	1	1.00	1	0.19
1	0.19	1	5.33	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	0.19	1	0.19
1	1.00	1	1.00	1	1.00
0	0.00	0	0.00	0	1.00
0	0.00	0	0.00	0	1.00
0	0.00	0	0.00	0	1.00
0	0.00	0	0.00	0	1.00
0	0.00	0	0.00	0	1.00
0	0.00	0	0.00	0	1.00
0	0.00	0	0.00	0	1.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00

Appendix H: Skill Ratio Sheets

Base T3

Authorized/Required		Assigned/Authorized		Assigned/Required	
Match	Ratio	Match	Ratio	Match	Ratio
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	0.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	1	5.33	1	5.33
1	1.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	0.00	0	0.00	0	0.00
1	0.43	1	1.00	1	0.43
1	0.19	1	1.00	1	0.19
1	0.19	1	1.00	1	0.19
1	0.19	1	1.00	1	0.19
1	1.00	1	1.00	1	1.00
1	0.19	1	1.00	1	0.19
1	0.19	0	0.00	0	0.00
1	0.19	1	1.00	1	0.19
1	0.19	1	1.00	1	0.19
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	0.00	0	0.00	0	0.00
1	0.19	1	5.33	1	1.00
1	0.19	0	0.00	0	0.00
1	0.19	0	0.00	0	0.00
1	0.19	0	0.00	0	0.00
1	0.19	0	0.00	0	0.00
1	0.08	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	0.43	1	1.00	1	0.43
1	0.43	1	1.00	1	0.43
1	0.43	1	1.00	1	0.43
1	0.00	0	0.00	0	0.00
1	0.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	0.43	1	1.00	1	0.43
1	0.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00

Base T3 (continued)

1	1.00	0	0.00	0	0.00
1	0.73	0	0.00	0	0.00
1	0.19	1	1.00	1	0.19
1	0.19	1	1.00	1	0.19
1	1.00	1	1.00	1	1.00
1	0.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	0.73	1	1.00	1	0.73
1	1.00	0	0.00	0	0.00
1	1.00	0	0.00	0	0.00
1	1.00	0	0.00	0	0.00
1	1.00	0	0.00	0	0.00
1	1.00	0	0.00	0	0.00
1	1.00	0	0.00	0	0.00
1	1.00	0	0.00	0	0.00
1	1.00	0	0.00	0	0.00
1	1.00	0	0.00	0	0.00
1	1.00	0	0.00	0	0.00
1	1.00	0	0.00	0	0.00
1	1.00	1	0.19	1	0.19
1	1.00	0	0.00	0	0.00
1	0.19	0	0.00	0	0.00
1	0.00	0	0.00	0	0.00
1	0.00	0	0.00	0	0.00
1	0.00	0	0.00	0	0.00
1	0.00	0	0.00	0	0.00
1	0.00	0	0.00	0	0.00
1	0.00	0	0.00	0	0.00
1	0.00	0	0.00	0	0.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00

Base T3 (continued)

1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
1	1.00	1	1.00	1	1.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00
0	0.00	0	0.00	0	0.00

Appendix I, Summary Results Tables and Graphs

TABLE 5

Base T1, Summary Results Table

AMOUNT TOTALS:	REQUIRED	AUTHORIZED	ASSIGNED
	73	61	56
CUMULATIVE RATIOS:	AUTH/RQD	ASGN/AUTH	ASGN/RQD
(GRD)	0.82	1.10	0.83
(AMT)	0.84	0.92	0.77
(SKL)	0.76	1.84	0.99
AGGREGRATE RATIOS:	AUTH/RQD	ASGN/AUTH	ASGN/RQD
	0.81	1.28	0.86

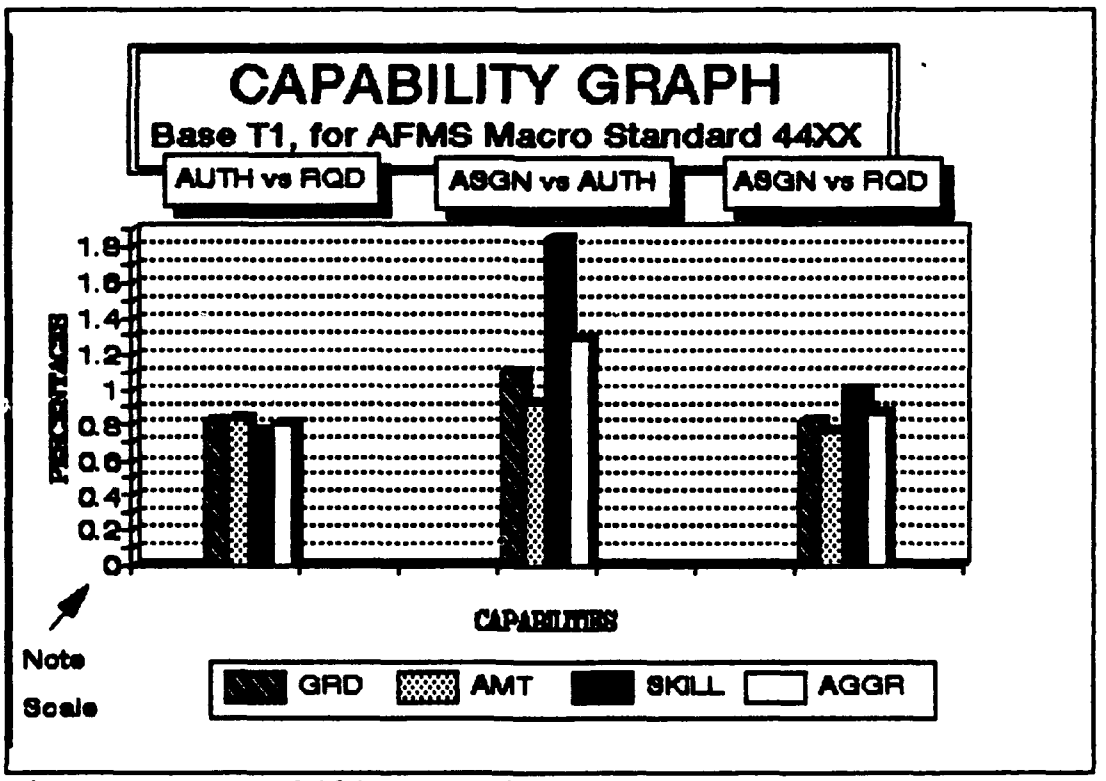

Figure 1. Capability Graph for Base T1

TABLE 6

Base T2, Summary Results Table

AMOUNT TOTALS:	REQUIRED	AUTHORIZED	ASSIGNED
	76	69	69
CUMULATIVE RATIOS:	AUTH/RQD	ASGN/AUTH	ASGN/RQD
(GRD)	0.83	0.94	0.88
(AMT)	0.91	1.00	0.91
(SKL)	0.83	0.98	0.87
AGGREGATE RATIOS:	AUTH/RQD	ASGN/AUTH	ASGN/RQD
	0.86	0.97	0.89

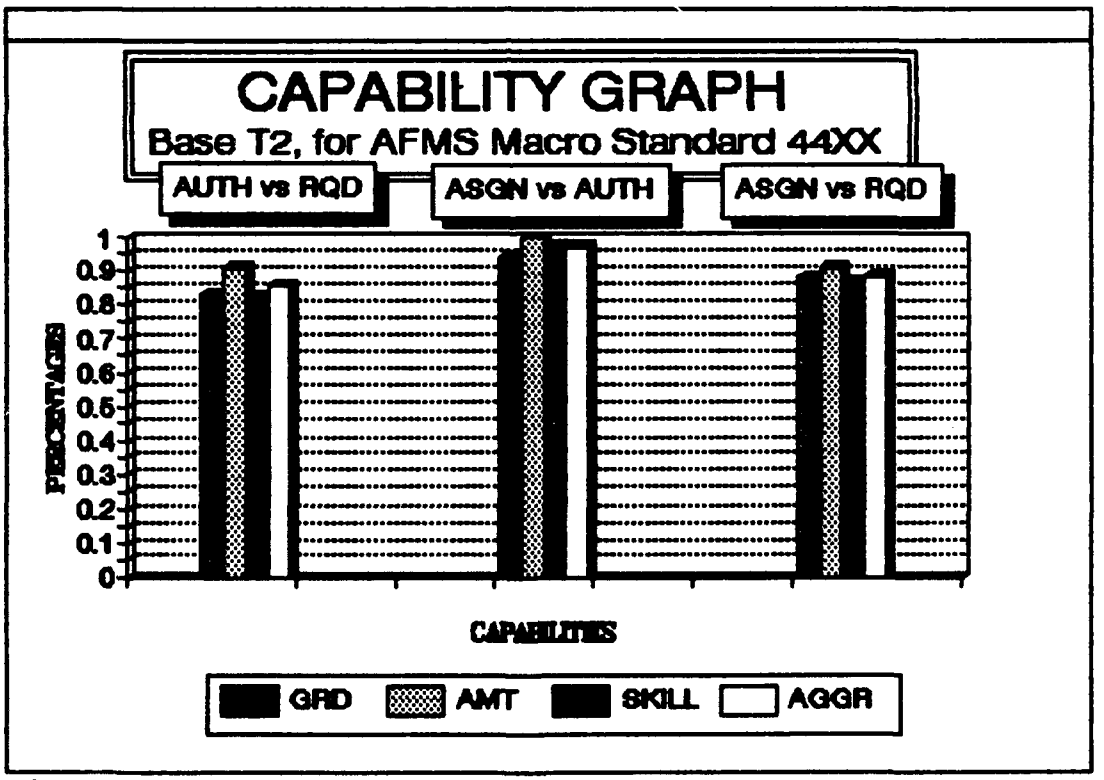

Figure 2. Capability Graph for Base T2

TABLE 7

Base T3, Summary Results Table

AMOUNT TOTALS:	REQUIRED	AUTHORIZED	ASSIGNED
	93	86	79
CUMULATIVE RATIOS:	AUTH/RQD	ASGN/AUTH	ASGN/RQD
(GRD)	0.79	0.78	0.80
(AMT)	0.92	0.92	0.85
(SKL)	0.75	0.81	0.60
AGGREGATE RATIOS:	AUTH/RQD	ASGN/AUTH	ASGN/RQD
	0.82	0.84	0.75

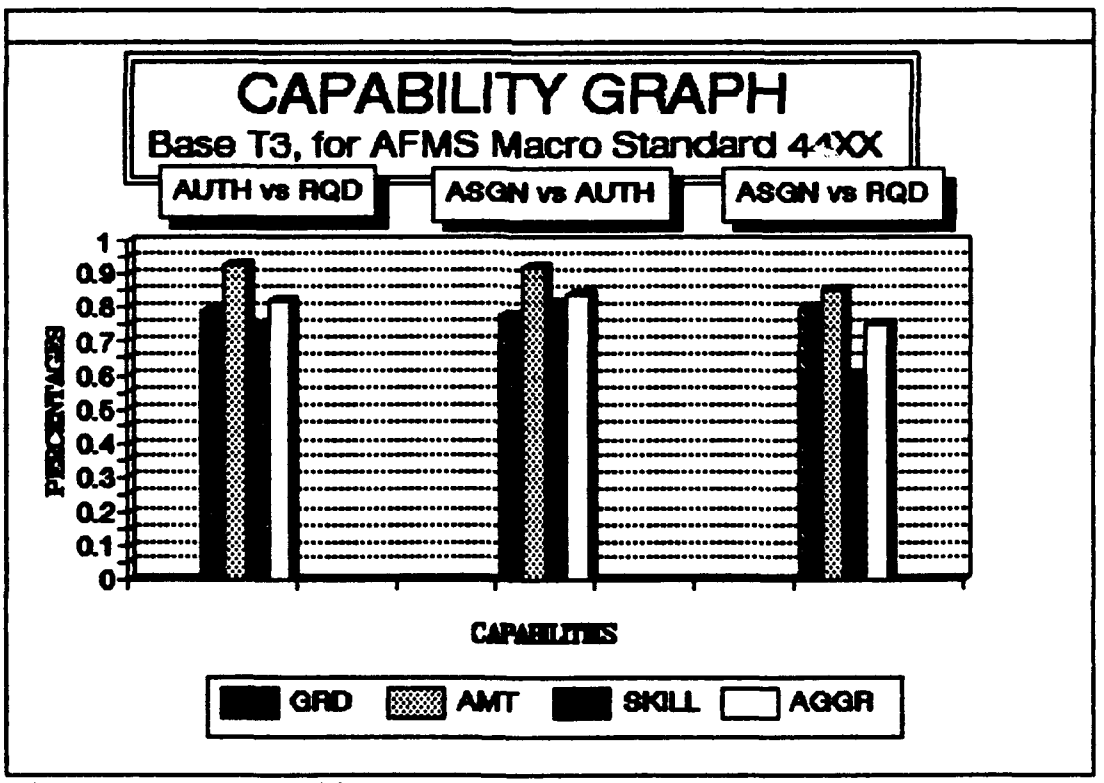

Figure 3. Capability Graph for Base T3

TABLE 8

Base M1, Summary Results Table

AMOUNT TOTALS:	REQUIRED	AUTHORIZED	ASSIGNED
	86	60	52
CUMULATIVE RATIOS:	AUTH/RQD	ASGN/AUTH	ASGN/RQD
(GRD)	0.70	0.86	0.63
(AMT)	0.70	0.87	0.60
(SKL)	0.66	0.85	0.59
AGGREGATE RATIOS:	AUTH/RQD	ASGN/AUTH	ASGN/RQD
	0.69	0.86	0.61

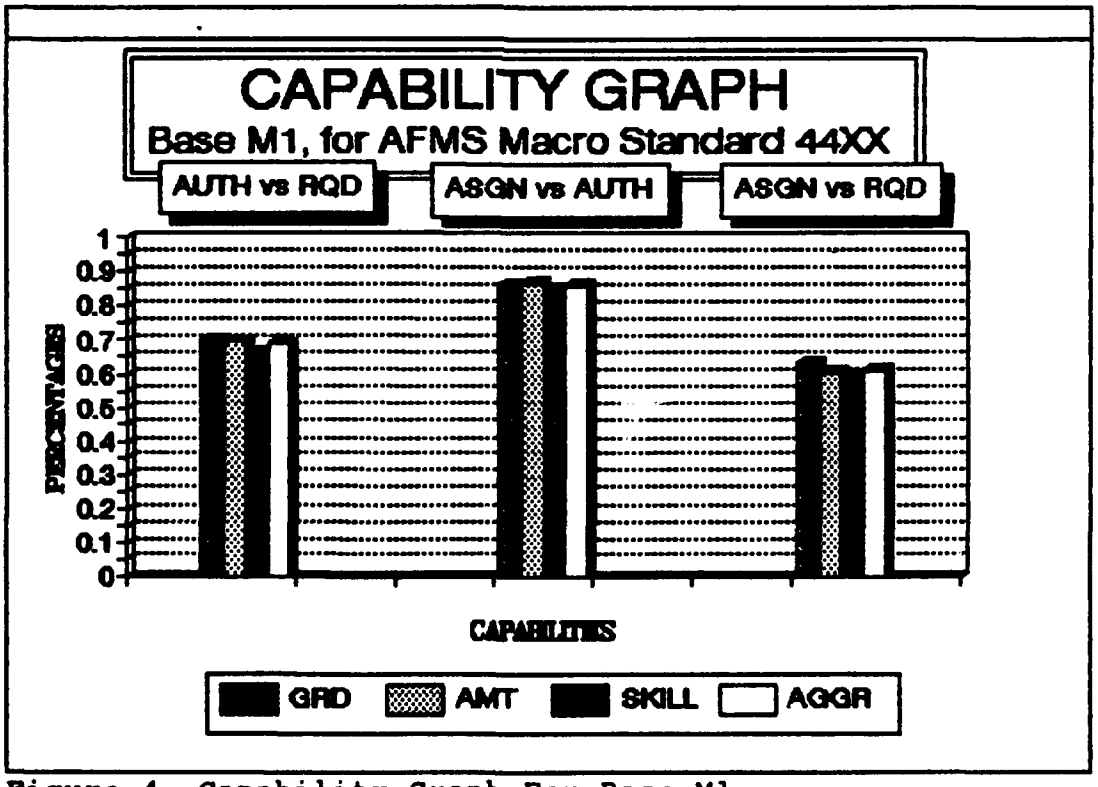

Figure 4. Capability Graph For Base M1

TABLE 9

Base M3, Summary Results Table

AMOUNT TOTALS:	REQUIRED	AUTHORIZED	ASSIGNED
	84	71	67
CUMULATIVE RATIOS:	AUTH/RQD	ASGN/AUTH	ASGN/RQD
(GRD)	0.70	0.82	0.71
(AMT)	0.85	0.94	0.80
(SKL)	0.63	0.85	0.66
AGGREGATE RATIOS:	AUTH/RQD	ASGN/AUTH	ASGN/RQD
	0.72	0.87	0.72

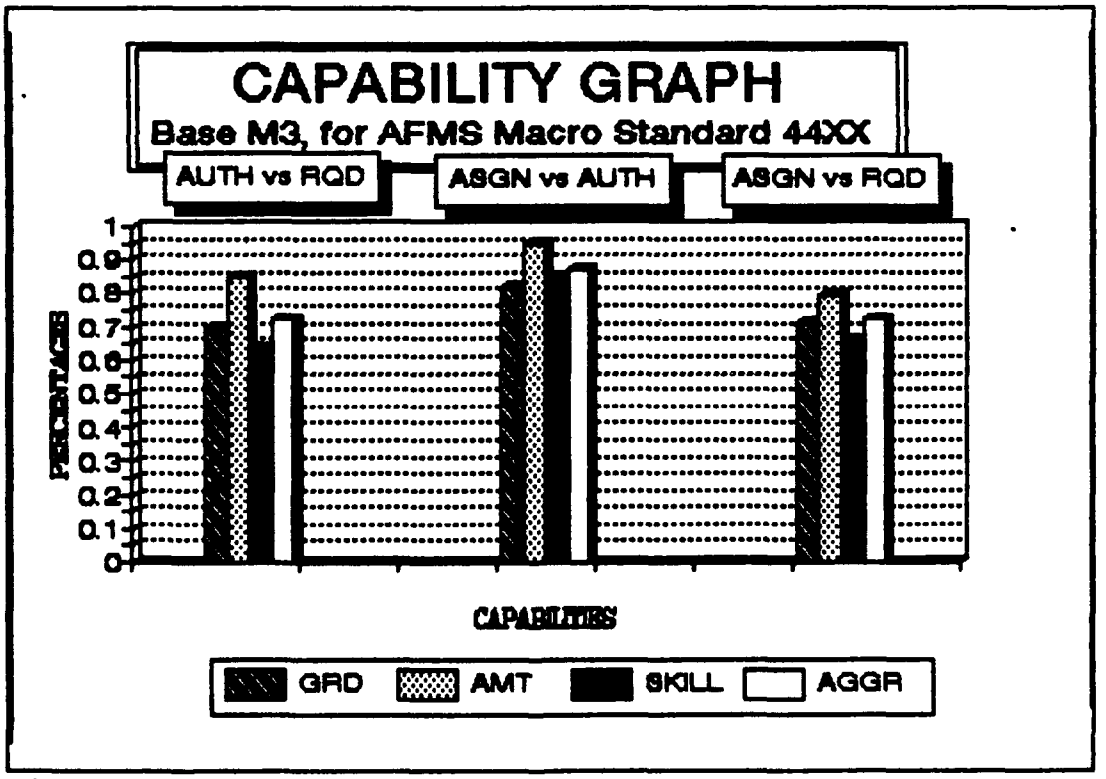

Figure 5. Capability Graph For Base M3

TABLE 10

All Bases, Combined Summary Results table

AMOUNT TOTALS:	REQUIRED	AUTHORIZED	ASSIGNED
	82.20	69.40	64.60
CUMULATIVE RATIOS:	AUTH/RQD	ASGN/AUTH	ASGN/RQD
(GRD)	.77	.90	.77
(AMT)	.84	.93	.79
(SKL)	.73	1.06	.74
AGGREGATE RATIOS:	AUTH/RQD	ASGN/AUTH	ASGN/RQD
	.78	.96	.77

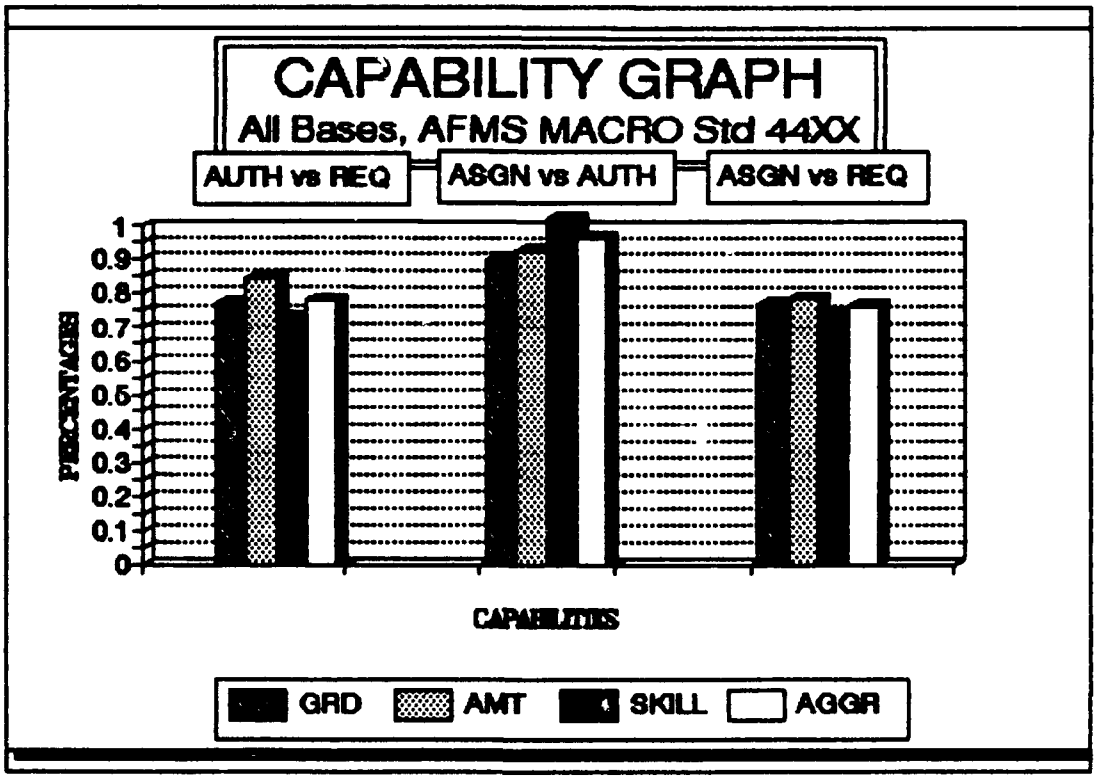

Figure 6. Combined Capability Graph for all Bases

Appendix J: Calculations Explained

The ratio results displayed in Appendix I were calculated in the following manner:

1. The Data Entry Sheet: All authorized and unfunded grade, amount, and AFSC manpower data from the UMD was recorded on the data entry sheet for each position number. All grade, amount, and AFSC assigned manning data from the UPMR was matched, by position number, with information from the UMD and was recorded accordingly on the data entry sheet. For assigned positions which were overmanned, the overmanned assigned data for each position was recorded on a separate line with "0" AFSC values and "NA" grade values recorded for the corresponding authorized and required data fields. If no assigned data was given for authorized civilian positions, the civilian positions were assumed filled at the authorized AFSC and amount.

Authorized and unfunded manpower amounts were added to obtain the number of required positions. The corresponding required manpower grade and AFSC data, based on the number of required positions, was extracted from the appropriate macro AFMS and was recorded on the data entry sheet. The required data was matched with authorized data and was recorded as follows: Required grades were recorded to match authorized civilian positions first, and then to match authorized military positions in descending order of authorized grade. Required grades were matched with authorized grades with respect to the two grades per

skill level principle, with the grades being matched in descending order (this matching grade method sometimes produced authorized/required grade ratios values greater than "1" because the higher grade within each skill level was assigned to authorized civilian positions first). Any required grades from the AFMS which were in excess of the number of authorized positions the UMD had "0" AFSC and "NA" grade entries recorded under the corresponding authorized data and assigned data fields.

2. Grade Ratio Sheets: For the "Authorized/Required" column, authorized and required grades were compared from the data sheet for each position. If the grades matched, a value of "1" was recorded under "Match." If the grades did not match, a value of "0" was recorded. Under "Ratio", a value of "1" was recorded if the "Match" value was 1. A ratio of the authorized grade over the required grade in terms of average years per grade (Appendix D, Lookup Table 1) was recorded otherwise. Similar comparisons were made and appropriate values were determined and recorded for the "Assigned/Authorized" column and for the "Assigned/Required" column.

3. Skill Ratio Sheets: Under the "Authorized/Required" column, authorized and required AFSCs were compared according to the first two digits and the fourth digit of the AFSC. Comparison was restricted to these three digits because of the format utilized in the AFMS for recording AFSCs. If the first two digits of the authorize and required AFSCs matched, a "1" was recorded under "Match." If the first two digits did not match, a

"0" was recorded under "Match." If the required AFSC was recorded as "NA," a value of "0" was recorded under "Match." If the "Match" value was "1," the average number of years for the authorized AFSCs in terms of the two grades per skill level principle (Appendix D, Lookup Table 2A) over the average number of years for the required AFSC and skill level (Appendix D, Lookup Table 2C) was recorded under "Ratio." If the "Match" value was "0," then the average number of years for the authorized AFSC and skill level (Appendix D, Lookup Table 2B) was taken over the average number of years for the required AFSC and skill level (Appendix D, Lookup Table 2C) and recorded under "Ratio." Similar steps were taken to determine and record appropriate values for the Assigned/Authorized and Assigned/Required columns.

4. Summary Results Tables: For each base, a straight count was taken from the "AMT column of the Data Entry Sheets to determine the "Amount Totals" values. For "Cumulative Totals", the recorded "Ratio" values from the Grade Ratio sheets and the Skill Ratio sheets were added. These sums were divided by the recorded "Required" value under "Amount Total" to obtain the entries under the "Authorized/Required" and "Assigned/Required" columns, or the sum was divided by the "Authorized" value under "Amount Totals" to obtain the entries under the "Assigned/Authorized" column. Similar steps were taken for all the bases as a whole for the All Bases Summary Results Table, with the exception of the "Amount Totals" values; these values

are the average required, authorized, and assigned amounts for all the bases. Summary Results tables and associated graphs for each base and for all the bases as a whole are located in Appendix I.

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13. ABSTRACT (Maximum 200 words)

Two methods of measuring peacetime manning capability levels for the 44XX macro AFMS were evaluated. The current method measures capability by comparing assigned manning quantity against authorized manpower quantity. The alternative method developed by the study measures capability by comparing the combined qualitative and quantitative required manpower factors of experience (grade), ability (AFSC), and quantity against respective authorized manpower and assigned manning capabilities. Authorized manpower is constrained by budgetary and other factors. Required manpower is unconstrained and represents the quantity and quality of manpower needed to perform a required workload as measured by the MET. The UMD and UPMR from five bases and the AFMS provided the database. Combined results showed small net differences (2-6 percent) between quantity and aggregate capability for authorized/required, assigned/authorized, and assigned/required levels. Individual bases varied as much as thirteen, twenty-six, and ten percent respectively. Aggregate quantity and quality factors affect manpower and manning capability measures. The current method may also produce false capability measurement levels because authorized levels and required levels use different quantity levels for measuring the capability needed to accomplish the measured workload.

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