AIR COMMAND
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---- STUDENT REPORT ----

HANDBOOK FOR STRATEGIC AIR COMMAND (SAC)

MANAGEMENT ENGINEERING OFFICERS (MEOs)

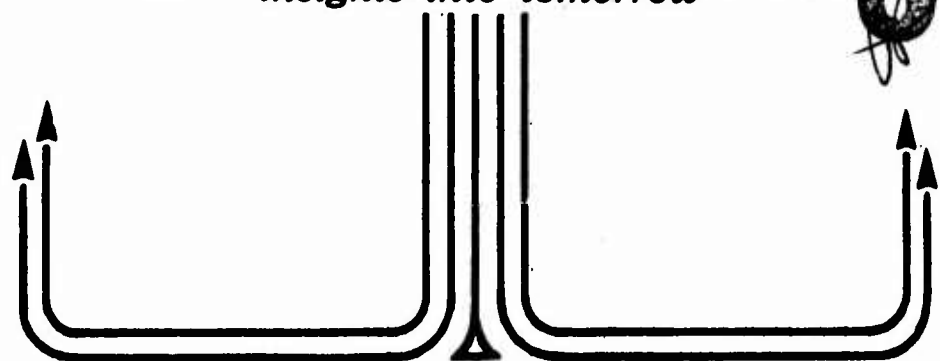MAJOR JACK D. MARTIN   REPORT #85-1735

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TITLE: HANDBOOK FOR STRATEGIC AIR COMMAND (SAC)
MANAGEMENT ENGINEERING OFFICERS (MEOs)

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requirements for graduation.

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This study establishes and evaluates reasons for the unsatisfactory performance of Strategic Air Command (SAC) management engineering officers (MEOs) during the analysis and computations phase of a manpower standard development study. Results of the evaluation are then used to define the scope and content of a handbook for SAC MEOs. The handbook addresses three major areas of deficiency in sufficient detail to guide the MEO in the successful development of a manpower standard.

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PREFACE

Assessment of Need

Need for Information

In a letter to commanders of all major commands and separate operating agencies on 10 November 1982, General Jerome F. O'Malley, then Vice Chief of Staff of the Air Force, described the need for more efficient and effective management of Air Force resources.

In an atmosphere of constrained national
resources, we have been enjoined by the Secretary of
Defense to attain maximum efficiency at minimum
cost. We are being asked to rethink work practices,
to increase productivity, and to improve the utili-
zation of limited manpower and dollar resources.

Pressure to reduce the DOD budget during a
period of force modernization/expansion presents a
tremendous challenge to the Air Force. If we work
. . . together smartly and aggressively, we can en-
hance our combat capability. Otherwise, we will be
forced to live with arbitrary reductions and un-
funded programs--we cannot let this happen.

The Air Force Management Engineering Program (AFMEP) is the
ultimate vehicle for ensuring the efficient and economical alloca-
tion and use of Air Force manpower resources. Less than two
months after General O'Malley's letter, the Air Training Command
(ATC), with the concurrence of the Air Force Director of Manpower
and Organization (HQ USAF/MPM) combined the officer and enlisted
courses for manpower management personnel. The thesis of this
study is that the combining of those two courses exacerbated the
situation referred to by General O'Malley. At a time when better
trained manpower management personnel were needed ". . . to
rethink work practices, to increase productivity, and to improve
the utilization of limited manpower, . . ." the scope and depth of
training for manpower management officers was reduced to the same
level as for manpower management technicians. This situation
leads to the hypothesis: Providing information to manpower man-
agement officers which is more detailed and broader in scope with
respect to management engineering principles and procedures will
result in better manpower standards. In turn, better manpower
standards will help improve the efficient and economical use of
manpower resources.

Background. In January 1982 ATC took a step toward the anti-
thesis by combining course E3OBR7421, Manpower Management Officer,
with course E3ALR73331, Manpower Management Specialist. The con-
tent of the new course for manpower management personnel was
changed significantly. Less emphasis was given to the more finite
work measurement methods such as time study, queuing analysis, and
simulation techniques. The level of instruction also had to be
maintained at a level commensurate with the educational level of
enlisted personnel versus that of officers. In addition, more
emphasis and curriculum time was given to skills and tasks which
are used by a minority of manpower management personnel.

Manpower Management vs Management Engineering. At this point
it is necessary to understand the distinction between manpower
management and management engineering. The term manpower manage-
ment was developed to accommodate the combination of two Air Force
Specialty Codes (AFSC): AFSC 733X0, Manpower Management Techni-

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cian and AFSC 733X1, Management Engineering Technician. The new '
combined AFSC 733X1 was then retitled Manpower Management
Technician. The term manpower management was chosen because it
was more descriptive of the entire range of duties and responsi-
bilities listed in AFM 39-1, Airman Classification Regulation. In
reality, at least 70 percent of a technician's time in the career
field is spent performing management engineering tasks. AFM 25-5,
Volume I, AFMEP Policies, Responsibilities, and Requirements,
defines management engineering as the combination of the exactness
of science with the art of judgement to develop managerial tools,
techniques, procedures, and methods, which when applied by a
manager, will help achieve more effective operations. The primary
role of a management engineer is to develop manpower standards. A
manpower standard is a quantitative expression of a work center's
man-hour requirements in relation to varying levels of workload.
A standard also includes a description of tasks the work center is
required by regulation to perform and associated conditions on
which the standard is built. The standard development process
requires the application of finite industrial engineering princi-
ples and procedures in combination with managerial expertise and
judgement. In addition, management engineering officers are ex-
pected to manage the development process, as well as be able to
perform the duties and responsibilities of a technician--a role
they are not now being prepared for by ATC. The remaining 30
percent of the workload is referred to as manpower management.
This term covers a myriad of interrelated, but unique tasks in-
volving the management of manpower resources and requirements. No
commonly accepted definition exists. To attempt to enumerate
those tasks here is beyond the scope and intent of this study.
Suffice it to say, manpower management refers to all tasks not
specifically involved with the development and maintenance of
manpower standards. In summary then, the general Air Force spe-
cialty title for all personnel is "manpower management"; however,
the majority of manpower management personnel work as management
engineering officers and technicians.

AFMS versus SACMS. A second distinction must be made to
enhance the reader's comprehension of the scope of this study--the
difference between an Air Force Manpower Standard (AFMS) and a
Strategic Air Command Manpower Standard (SACMS). An AFMS is a
manpower standard that applies to a particular function in two or
more major commands (MAJCOMs) and/or separate operating agencies
(SOAs). For instance, the manpower standard for Manpower and
Organization (AFMS 1080/81) applies to all commands in the Air
Force. A SACMS, however, applies only to a particular function
within the Strategic Air Command. For instance SACMS 1210, Logis-
tics Plans, applies only to the Logistics Plans function at SAC
locations. It does not apply to the Logistics Plans function in
Tactical Air Command, Military Airlift Command, or any other
MAJCOM or SOA. In addition the development, publication, and
maintenance of an AFMS is the responsibility of the Air Force
Management Engineering Agency (AFMEA) and its subordinate Func-
tional Management Engineering Teams (FMETs). Each FMET focuses

its efforts on the manpower management needs of a single, broad Air Force function such as civil engineering, base supply, security police, etc. A SACMS, on the other hand, is developed, published, and maintained by the SAC Directorate of Manpower and Organization and its subordinate Strategic Air Command Management Engineering Teams (SACMETs).

LEAD TEAM RESPONSIBILITIES. Although SACMET management engineering personnel participate in the development of both AFMSs and SACMSs, the level of responsibility and skill knowledge required by SACMET personnel to develop a SACMS is quite different than that required to participate in the development of an AFMS. As a participant or "input team" in the development of an AFMS, SACMET personnel only have to apply measurement techniques as directed by the appropriate FMET or "lead team." The development of a SACMS, however, requires one of the SACMETs to perform the lead team duties. The lead team for a manpower standard development study is responsible for developing the measurement plan, giving technical guidance and assistance to the input teams during the measurement of workload, analyzing the data provided by the input teams, and computing the manpower standard. In addition the lead team must document the results of the standard development study and publish a report of their findings and conclusions. Performance of these duties and responsibilities requires lead team personnel to gain a working knowledge of the function for which a manpower standard is being developed. More importantly, lead team personnel need to have extensive knowledge of management engineering principles and procedures and study management techniques. In fact the success of the study and the quality of the resultant SACMS is usually directly proportional to the expertise of lead team personnel.

NOT ENOUGH INFORMATION. According to HQ SAC/XPME, the declining quality of SACMSs being developed by SACMET personnel is directly attributable to the change in course content for ATC Course E30BR7421. The change by ATC eliminated a unique manpower management officer course. The change also deemphasized the more technical aspects of management engineering and study management previously taught to officers. This was caused by the integration of officer and enlisted personnel in the same class. Once the graduates of the new course were assigned to SAC, the quality of the SACMSs being produced and directed by these people began to decline. An increasing effort on the part of HQ SAC/XPME personnel has been required to manage the development of the standards. In addition, the length of time required to develop and publish a standard increased because of the extra time needed to correct mistakes in measurement methodology, data analysis, and/or computation of the standard—an unacceptable situation at best.

WHAT INFORMATION IS NEEDED?

While graduates of the new integrated Manpower Management Course have performed adequately as members of an input team

during most phases of the manpower standard development process, HQ SAC/XPME has found the graduates are not adequately prepared to perform as members of a lead team.

SACMS Development Process. To determine what information the course graduates are not getting or what information needs to be expanded or emphasized, an understanding of lead team responsibilities in the SACMS development process is helpful. The process is divided into five distinct, but related phases: Prestudy Preparation, Feasibility, Measurement Design, Measurement, and Data Analysis and Computation.

Prestudy Preparation Phase. The purpose of the Prestudy Preparation Phase is to get ready to perform the study. The most important aspects of this phase are to coordinate with the appropriate commander, to analyze wartime guidance, and to gather data. The first step of any study is to brief the responsible commander and/or manager of the function to be studied. The briefing consists of a detailed description of the manpower standard development process and pertinent milestone dates for the study. The second step is to identify and analyze any wartime guidance that levys workload requirements on the function under study. SACMET technicians also attempt to validate any wartime tasking with the appropriate higher-headquarters plans. The last step is to identify, gather, and analyze all functional directives (regulations, operating instructions, etc.) that levy peacetime workload requirements on the function under study. Technicians also obtain and review all pertinent reports of inspection, staff-assistance visits, and audit for possible problem areas.

Feasibility Phase. The purpose of the Feasibility Phase is to determine the feasibility of developing a manpower standard for the function under study. There are three major steps in this phase: Functional Familiarization, Work Center Description, and Memorandum of Understanding. Functional familiarization involves the in-depth study of work being performed in the function under study. The work is separated into homogeneous tasks then grouped into major categories of work for ease of measurement. SACMET technicians are particularly interested in determining whether or not the work can be measured accurately and what measurement methodology should be used. The next step is to prepare a work center description (WCD). Simply stated the WCD is a word description of each major category of work being performed. Each category is further segregated into distinct identifiable tasks. The WCD then becomes the one document all SACMETs use to measure work by. The last step of this phase is the development and coordination of the Memorandum of Understanding (MOU). The MOU is a contract between the Director of Manpower and Organization and the HQ SAC function manager. The MOU specifies what each party's responsibilities are during the remainder of the standard development study. The WCD is attached to the MOU and coordinated with the functional commander/manager. Of course, if for some reason the SACMET Commander determined it was not feasible to develop a

manpower standard at that time, the MOU would reflect the commander's decision and the pertinent rationale upon which the decision was based. Upon concurrence of HQ SAC/XPM, all study efforts would cease.

Measurement Design Phase. The purpose of the measurement design phase is to produce a Measurement Plan (MEAS-PLAN) for use in measuring the work described in the WCD. First a draft MEAS-PLAN is developed. The plan contains the' draft WCD which was prepared during the feasibility phase, specific instructions on how to measure each item of work described in the WCD, and any peculiarities that the input team SACMETs need to watch for. The draft MEAS-PLAN is then sent to each SACMET, one of which is located on every SAC-owned base. Copies of the plan are also sent to HQ SAC/XPME for review and approval. Each SACMET then reviews the plan with the functional commander/manager at that base. The plan is either approved as written or suggested changes are returned to the lead team SACMET. The same coordination process takes place at HQ SAC. The lead team SACMET then investigates each suggested change and includes it in the plan or declines to make the change and provides rationale for the decision. Once all changes have been incorporated, the Final MEAS-PLAN is sent to selected input team SACMETs for use in performing the measurement.

Measurement Phase. The objective of this phase is to measure the workload in accordance with the Final MEAS-PLAN instructions. Once the input team SACMETs have measured the work-load and collected the required production data, a measurement report (MEAS-REP) is developed and sent to the lead team SACMET.

Data Analysis and Computation Phase. The purpose of this phase is to review and analyze the data provided by the input teams, resolve any discrepancies, compute a manpower standard, and document the results of the study. When all MEAS-REPs have been received, the lead team performs a complete audit of each piece of data and resolves any obvious discrepancies or input team failures to follow measurement instructions. The team then performs a comparative analysis of the data from all locations. Any discrepancies identified during the comparative analysis are resolved through coordination with the input teams and HQ SAC. The refined data then forms the basis for statistical correlation and regression analysis. The result is a quantitative algebraic equation which is the standard man-hour equation. The equation, the WCD, and manpower tables showing the Air Force Specialty Codes and ranks allowed at varying levels of workload form the content of the standard. The lead team produces a Final Report (FIN-REP) which contains the proposed manpower standard and documents the analytical findings and conclusions and a statement of conditions the manpower standard was developed to accommodate. The FIN-REP

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is then sent to HQ SAC/XPME for a quality assurance review and approval and subsequent publication of the manpower standard.

Quality Assurance Program. HQ SAC/XPME is responsible for management of the Quality Assurance Program (QAP). The primary purpose of the program is to review all management engineering products produced by the SACMETs, provide feedback on the results, and resolve substantive discrepancies identified during the review. The secondary, but equally important, purpose of the QAP is to provide data XPME uses to assess trends in management engineering personnel performance and to identify areas requiring emphasis during proficiency training. While the Technical Services Branch (HQ SAC/XPMET) is the office of primary responsibility (OPR) for the QAP, the Studies Supervision Branch (HQ SAC/XPMED) has collateral responsibility.

Technical Services Branch. HQ SAC/XPMET personnel are responsible for ensuring the technical accuracy of all management engineering products. They perform a 100 percent audit of all manpower standard development study products to ensure SACMET technicians have complied with technical and administrative requirements in AFR 25-5, Air Force Management Engineering Program, and pertinent HQ SAC/XPM Operating Instructions. They document any discrepancies found during the review and classify each discrepancy as a "major or minor error." A major error is assessed if the discrepancy materially affects the accuracy of the manpower standard. An example of a major error would be an incorrect mathematical computation or logic error. Each major error results in an assessment of 10 penalty points. Minor errors do not materially affect the accuracy of the manpower standard, but do detract from the professional quality of the product. An example of a minor error is a typographical error or incorrect word usage. Each minor error is assessed 1 penalty point. The penalty points are then added together and compared to a rating scale to determine the overall quality rating to be assigned to the product being reviewed. The quality ratings cover a range from 1 through 10, with 10 being the highest possible rating. The review process is not complete, however. While XPMET personnel are the "technical experts," XPMED personnel are the "functional experts" and must review the product for functional accuracy.

Studies Supervision Branch. HQ SAC/XPMED is responsible for managing the development and maintenance of all SACMSs and supervising the participation of SACMETs in the development of AFMSs. Each individual in the branch is assigned duty as a "Project Manager" for all studies within a particular functional area such as civil engineering, aircraft maintenance, etc. Each Project Manager reviews and rates the product from a functional point of view. The Project Manager also coordinates the product with the appropriate functional manager on the SAC staff. The primary objective for this review and coordination process is to ensure all required workload has been documented, measured, and included in the proposed manpower standard. It also serves as a check on

the XPMET review. Once the review is complete, the Project Manager sends the product back to the originating SACMET with the documented discrepancies and the overall quality assurance rating. If the discrepancies are substantive, the Project Manager also provides instructions on how to correct the errors; otherwise, the Project Manager makes the necessary corrections and publishes the standard upon approval by HQ SAC/XPM.

Trend Analysis. In the latter part of 1983, Project Managers began to notice an increase in the number of substantive discrepancies that needed to be corrected before the newly developed and updated manpower standards could pass the quality assurance audit. Analysis of the quality ratings for each major phase of a manpower standard development study disclosed some problem areas.

Analysis by Study Phase. Since the Prestudy Preparation Phase does not result in a document of any type, no particular problems could be isolated. Quality ratings for the draft WCD and Memorandum of Understanding had decreased somewhat for the Feasibility Phase. Ratings for the draft and final Measurement Plans had also decreased for the Measurement Design Phase. Quality ratings for the Measurement Reports, however, had remained consistently high with only a slight decrease. By far, the largest decline in quality ratings was found in the Data Analysis and Computation Phase with respect to the Final Report.

Conclusions. The results of the analysis of quality assurance ratings together with flow process appraisals by the Project Managers resulted in an overall conclusion and pinpointed three major areas of concern. The overall conclusion was that graduates of the new manpower management course had performed adequately during most phases of the manpower standard development process, but were inadequately prepared to produce an acceptable Final Report during the Data Analysis and Computation Phase. The corollary to this conclusion is that the new graduates are being adequately prepared to perform "input team" duties, but are not being prepared to perform "lead team" duties which are concentrated in the Measurement Design and Data Analysis and Computation Phases. The flow process appraisals performed by the Project Managers identified three major areas that require extensive, supplemental proficiency training for graduates and lead team SACMET personnel. The first major area of performance found to be inadequate involved use of the Manpower Standards Development System (MSDS). Use of MSDS to perform computerized mathematical analyses historically produced accuracy ratings better than 99 percent and reduced the man-hours required to produce the analyses by 60 percent. In fairness to ATC, the computer resources with which to provide instruction on MSDS were still not operational within the school as of December 1984. SACMETs, however, have had the capability since 1982. The second area of concern was a demonstrated lack of knowledge about input data analysis techniques and procedures. The third major area of deficient performance involved the overall management of the manpower

standard development process by lead team personnel. Such items as inadequate technician availability, poor communication, low productivity, and inadequate proficiency training were especially evident. These three major areas of inadequate performance form the basis for the information SACMET personnel need to enhance the quality of manpower standards they are tasked to develop.

WHO NEEDS THE INFORMATION?

The majority of Air Force manpower management officers are captains and lieutenants. Their level of experience in the manpower management career field is low. The level of experience for SAC manpower management officers is less than the Air Force average. This situation is made worse when the duties and responsibilities of a manpower management officer at a lead team SACMET are taken into consideration.

Air Force Experience Level. A review of personnel files at the Air Force Manpower and Personnel Center (AFMPC) disclosed that 379 out of 565 manpower management officers are captains and lieutenants. This equates to 67.1 percent of the manpower management force. The average experience level for those 379 officers is 4.12 years. The experience level for the lieutenant colonels and majors is 11.93 years. The gap in experience levels between company and field grade officers was created by the reduction of the rated supplement in the late 1970s and early 1980s. As a result, the experience levels will remain low or get even lower with the majority of new manpower management officers coming through direct accession of second lieutenants.

SAC Experience Level. While the Air Force experience level is low, the experience level of SAC manpower management officers is even lower. The average experience level for captains and lieutenants in SAC is 3.11 years versus the Air Force average of 4.12 years. To make matters worse, there are no field grade officers assigned to any of the SACMETs. In addition, 55 percent of the company grade officers assigned to the SACMETs are lieutenants with an average of only 1.85 years of experience.

Management Engineering Officers. Lack of experience is handicap enough for any lieutenant, but that's only a small portion of the obstacles a manpower management officer faces when assigned to a SACMET. The average SACMET is authorized 2 officers and 8-10 enlisted personnel. The highest ranking of the 2 officers, usually a captain, is the SACMET commander. The other officer is a lieutenant and is assigned duty as the Management Engineering Officer (MEO). The majority of the commander's time is spent attending meetings and attending to peripheral manpower management activities and personnel matters. This leaves the majority of workload, management engineering, to be managed by the MEO. Not only must the MEO manage the lengthy manpower standard development process and provide technical guidance to input teams with like or less experience, but the MEO must train and supervise subordinate

their time training rather than developing training materials. It also ensures that each SACMET is receiving the same training. In this vein, the SAC Director of Manpower and Organization has directed increased use of computer-assisted training modules, sound-on-slide presentations, and handbooks. While development of a computer-assisted training module is the preferred mode of instruction, there are not enough computer resources within SAC at this time to accomplish the objective. The 4235th Strategic Training Squadron Manpower Training Branch (4235 STS/XPMT) will eventually prepare the modules, but not before all SACMETs have received the necessary computer hardware which is scheduled to be 1986. In addition the 4235 STS/XPMT is operating under scheduling constraints which prevent the development of a sound-on-slide presentation until late 1985. Considering the unlikely prospects for timely development of a computer-assisted training module or a sound-on-slide presentation, the next best solution is to prepare a handbook. The use of handbooks was prevalent in SAC during the years before widespread computer usage and sophisticated audio-visual techniques. The handbook approach will meet the timeliness and standardized training objectives. It will also serve as a basis for developing the more sophisticated training materials when resources become available.

SUMMARY

The Air Force Management Engineering Program (AFMEP) is the ultimate vehicle for ensuring the most efficient and economical allocation and use of manpower--the Air Force's most important and costliest resource. Yet even as General O'Malley, then Vice Chief of Staff of the Air Force, was emphasizing the necessity for an even stronger more aggressive AFMEP, ATC combined the formal training courses for manpower management officers and enlisted personnel. That action, combined with the reduction in the rated supplement made the AFMEP weaker, not stronger. The need for information was graphically demonstrated by the declining quality of manpower standard development products produced by SACMET personnel. Analysis of quality assurance evaluations and flow process results established that SACMET personnel lacked adequate training in the use of Manpower Standard Development System (MSDS) products, in the performance of input data analysis, and in the management of the manpower standard development process. The fact that SAC Management Engineering Officers (MEO) have less than 1.85 years of experience and are not getting the training they need to perform adequately makes the MEOs the target audience for further training. Although HQ USAF/MPMI, AFMEA, and the MAJCOM Directors of Manpower and Organization requested ATC to provide further training for officers, no new or expanded courses have been approved. The ATC answer to AFMEP training needs for manpower management personnel is OJT. Unfortunately, unit OJT is a long-term solution that requires trainers who have been trained and are experienced--a rare commodity in a SACMET. To help train the MEOs to become trainers and to supplement their lack of experience with knowledge not given to them in formal training, a handbook is

required to meet the short-term requirement until a computer-
assisted training module or sound-on-slide presentation can be
prepared.

VALIDATION

This study will be considered valid when the Management
Engineering Division (HQ SAC/XPME) can conclude from quality
assurance evaluations conducted in accordance with HQ SAC/XPM
Operating Instruction 25-14, Quality Assurance Program, and from
flow process analysis results that: SAC MEOs have improved their
overall management of the manpower standard development process;
average quality ratings for Final Reports have increased; and
SACMET personnel are using MSDS products to reduce the time re-
quired to perform input data analysis and to increase the accuracy
of resultant products.

Handbook for . . .

STRATEGIC AIR COMMAND MANAGEMENT ENGINEERING OFFICERS

Slay Ignorance.

SURELY THEY JEST...

MEO

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PURPOSE

The purpose of this handbook is to impart previously unpub-
lished knowledge of the management engineering discipline to man-
power management personnel within Strategic Air Command (SAC).
This handbook is a compilation of "lessons learned" by the author
and other contributors in the "school of hard knocks." Hopefully,
it will help the reader avoid having to learn those lessons the
same way. While the title of the handbook indicates it was
written primarily for management engineering officers (MEOs), it
should prove to be useful to anyone who wants to know more about
the manpower standard development process.

SCOPE

This handbook is confined to a discussion of the Manpower
Standards Development System (MSDS), input data analysis and com-
putation procedures, and management tools and techniques for use
in improving the manpower standard development process. The
information presented is intended to supplement and/or enhance the
reader's understanding and application of policies, principles,
and procedures contained in Air Force Regulation (AFR) 25-5, Air
Force Management Engineering Program (AFMEP), and Air Force Manual
25-511, Manpower Standards Development System (MSDS) Users Manual.

The three subject areas addressed in this handbook were deter-
mined through a formal assessment process to be the major areas of
information needed most by SAC manpower management personnel. The
assessment process involved an analysis of quality assurance rat-
ings, a flow process analysis of manpower standard development
procedures, and interviews with personnel assigned to the HQ USAF
and SAC Directorates of Manpower and Organization and Air Training
Command (ATC) Manpower Management Course instructors. While other
areas of concern were identified, these three areas were assessed
as being the most critical to the successful development of a
quality manpower standard.

AUDIENCE

As the title of the handbook indicates, it was written
primarily for use by SAC management engineering officers (MEOs).
However, that doesn't mean one must be a MEO to understand or use
the handbook. The MEO was selected as the primary audience for

two reasons. First, because the formal assessment process
identified this individual as the one who was least prepared
through ATC formal training to perform the duties and responsi-
bilities of a lead team. Secondarily, the MEO is the pivotal

member of a SAC Management Engineering Team (SACMET). The MEO is
called upon to manage the entire manpower standards development
process. This handbook attempts to give the MEO those "tricks of
the trade" to help make the job easier and to help train other
team members produce the highest quality products possible.

*****

A professional officer should be able to:

> *change a diaper*
> *plan an invasion*
>   *deliver a speech*
>   *butcher a hog*
>   *conn a ship*
>   *design a building*
>   *write a sonnet*
>   *balance accounts*
>   *build a wall*
>   *set a bone*
>   *comfort the dying*
>   *take orders*
>   *give orders*
>   *know when to ignore an order*
>   *cooperate*
>   *act alone*
>   *solve equations*
>   *analyze a new problem*
>   *pitch manure*
>   *program a computer*
>   *cook a tasty meal*
>   *fight efficiently, and*
>   *die gallantly*

Specialization is for insects.

- anonymous

Chapter One

MANPOWER STANDARDS DEVELOPMENT SYSTEM (MSDS)

INTRODUCTION

Although the Manpower Standards Development System (MSDS) is
not a particularly user-friendly system, it has made possible a
quantum leap forward in the important areas of accuracy, effort,
and analysis. The only way accuracy can be adversely affected is
to punch the wrong key on the keyboard. Even then, the MSDS has
several diagnostic routines which can be used to tell the operator
what and where the error is and why it's an error. Prior to 1982
when computers were installed at most Strategic Air Command Man-
agement Engineering Teams (SACMETs) each item of computed data on
an AF Form 1040, Operational Audit Data, had to be verified with
three independent quality control checks to ensure the accuracy of
the data. Depending on the number of bases involved in the meas-
urement, the number of work centers measured, and the number of AF
Forms 1040 for each work center, the quality control process could
consume 1 to 4 man-weeks of concerted effort. With MSDS this
process now takes less than 1 man-day. However, this wasn't the
big time consumer in the precomputer days. Once the AF Form 1040
data was mathematically correct, the lead SACMET had to enter each
frequency, per accomplishment time, and measured monthly man-hours
manually onto a large sheet of paper so a comparative analysis
could be performed. This slow, tedious posting process could take
as much as 6 to 8 man-weeks to do. Only then could any meaningful
analysis be done and then only with calculators or one's fingers
and toes. Once again the MSDS and the computer came to the
rescue. That entire process can be performed in a matter of hours
now versus weeks. This doesn't mean the computer has or ever
could replace the management engineering officer (MEO) or manage-
ment engineering technician (MET). What the computer and the MSDS
can do, however, is perform those repetitive, time-consuming tasks
in a timely and accurate manner. This then frees the management
engineer to return to an almost human existence and do that which
humans do best--think. Although the computer scientists are work-
ing on it, they still haven't made a computer that can duplicate
the human thought process.

Unfortunately, some people on the SACMETs seem to think the
computer and its associated software will do the thinking for them
and provide the answer. Other SACMET personnel don't trust the
computer and manually duplicate its work to make sure it performed

the calculations properly. More often than not, these misconceptions and erroneous perceptions are a result of little or no training being provided to SACMET personnel. This situation is especially true with respect to the MSDS. There is in fact no formal training being provided on the MSDS at this time, which is one of the primary reasons for this handbook.

Since use of the MSDS can save many man-months of effort and provide error-free data, the MEO must make every effort to understand the MSDS, its products, and alternate sources of equally reliable data processing systems. The MEO must then train the METs and require them to use the MSDS whenever possible. Only by using the system can one fully understand and appreciate the power and potential offered by the MSDS and other related software. This training will have a related benefit called "computer literacy" which everyone needs in this day and age. Computerization of Air Force operations, logistics, and management functions is proceeding at a phenomenal rate. Computers are here to stay and will pervade every function and every aspect of work in the not too distant future. The more SACMET personnel know about computers and computer programs, the better they will be able to identify, measure, and analyze workload and its impact on manpower requirements.

This handbook wasn't designed to make the MEO a computer expert, however. Instruction on the operation of computer hardware at a particular SACMET is addressed by the operating manual provided with the equipment. In addition, operation of the MSDS is described in AFM 25-511, MSDS Users Manual. As stated in AFM 25-511, however, the manual only provides information necessary to use the system. It does not address the meaning or intended use of the output products produced by the MSDS. That is the task undertaken in this handbook--to provide an example of each pertinent MSDS output product, explain the intended use of each product in the manpower standard development process, and highlight significant data elements and any pitfalls to be avoided. In addition to MSDS, the Air Force Management Engineering Agency (AFMEA) Manpower Systems software will be addressed in a similar manner. More specifically, the AFMEA Data Systems Branch has developed a program called "Utility Subsystem" which is considerably more user-friendly than MSDS and provides equivalent output products with much better data presentation formats.

MSDS OUTPUT

The MSDS Main Menu offers five options. Each of these options has a menu of its own with as many as 24 options. As the name implies, a menu is a listing of options available to the system operator. The specific menu and option the operator chooses to exercise will determine what the system output is. The format for this section will be to show an example of the computer output and

provide pertinent comments to enhance the reader's understanding of the data displayed.

Main Menu 1

Main Menu 1 is used to initiate study data parameters and to size/create file space. No sample output of this menu is provided because the Technical Services Branch (HQ SAC/XPMET) maintains and manages the file space for the SAC Management Engineering Program (SACMEP). This file space is reserved under User Master Catalog (UMC) OSXPME2 on a host computer at the Air Force Manpower and Personnel Center (AFMPC). One way to gain access to the file space is to have the password that matches the UMC under which the file space is reserved. Obviously that won't work since a user's password is known only to that user. The other way is for HQ SAC/ XPMET to instruct the computer to give a particular user access to the file space. This is called setting file permissions. Since XPMET controls the file space and sets the file permissions for each SACMET that is involved in a particular study, there is no need for a SACMET to exercise this menu. Should the need ever arise, contact XPMET for instructions.

Main Menu 2

Main Menu 2 allows the user to display and/or change the study and/or work center parameters which were entered using Main Menu 1. This menu offers five options which are depicted in Table 1 below.

```
YOU HAVE THE FOLLOWING OPTIONS:
    1. CHANGE STUDY LEVEL INFORMATION.
    2. CHANGE WORK CENTER INFORMATION.
    3. PRINT CURRENT WORK CENTER INFORMATION.
    4. PRINT STUDY'S AND WORK CENTERS' INFORMATION.
    5. RETURN TO THE MAIN MENU.

ENTER THE NUMBER OF THE CHANGE PRINT OPTION OR ENTER '?' TO PRINT THE MENU.
?4
```

Table 1. Main Menu 2 Options

Option 1, Change Study Level Information, and Option 2, Change Work Center Information, can only be exercised by the user who created the study parameter data because either option gives the user the ability to change the data. Again, this means XPMET is the only user who can exercise Option 1 or 2; therefore, no sample output has been provided. Notice, however, that Options 3 and 4

3

only refer to printing information, not changing it. Any user who has been given file permissions by XPMET can exercise Option 3 or 4. Option 3 should be used if the information for only one work center is to be printed. However, if the information for the entire study and all its work centers are desired, use Option 4. Table 2 below is a sample output using Option 4 since Option 3 would provide only the work center information.

STUDY PARAMETER FILE
①
STUDY LEVEL INFORMATION

STUDY ID	NMBR INPUT LOCS	NUMBER OF WORK CENTERS	NUMBER OF WORK COUNTS	NUMBER OF PERIODS OF COUNT
ECMBAR ②	13 ③	1	10	24

⑥ WORK CENTER INFORMATION
③

WORK CENTER ID	WORK CENTER TITLE	NUMBER FAC INPUT AND LOCS SHRED	NUMBER DIRECT CATS	NUMBER INDIRECT CATS	NUMBER OTHER CATS	MHR MEAS METHOD	MHR COLL LEVEL OA	MHR COLL LEVEL MS	NR TASK TITL
⑦		⑧	⑨	⑩	⑪			⑫	⑬
ECM2413	ELECTRONIC COUNTERMEASURES	8 241300 5	7	0	OA	D		234	

Table 2.   Main Menu 2, Option 4 Output –
Study Parameter File

The following numbered comments relate directly to the numbered items on the sample output:

1.   The first section of data is the "STUDY LEVEL INFORMATION" which shows all of the data parameters XPMET defined for the study.

2.   The "STUDY ID" or study identification used for this study is "ECMBAR" which stands for the Electronic Countermeasures work center (ECM) and Barksdale SACMET is the lead team (BAR). There isn't any particular pattern for naming a study. The only rule is that the name can't be more than 8 characters long.

3.   "NMBR INPUT LOCS" stands for the number of input locations the study is being sized for. Note that the study was sized for 13 input locations. Now look at the number of input locations under "WORK CENTER INFORMATION." There are actually only 8 input locations for this study. The difference between the two numbers (13 and 8) is caused by the fact that XPMET always sizes the files larger than required. This way, if an unusual situation is discovered and the lead SACMET wants to add up to 5 more locations, they can do it without XPMET having to re-input all

4

of the study parameters again--a time-consuming and tedious pro-
cess at best. The MSDS can accommodate 200 locations.

4. This study has only 1 work center being measured;
however, the MSDS can accommodate as many as 50 work centers.

5. XPMET has set aside enough space for 10 work counts
to be collected for a 24 month period if necessary. The MSDS can
handle 99 work counts for a maximum of 24 periods.

6. The second section of the output lists information on
each work center in the study. As indicated in the study level
information, there is only 1 work center in this particular study.

7. The "WORK CENTER ID" or Work Center Identification
element is "ECM2413". Once again the identification element is
restricted to no more than 8 characters in length. "ECM" stands
for Electronic Countermeasures which is the title of the work
center as well. The work center title itself can't exceed 40
characters. The "2413" is the first 4 numbers of that work cen-
ter's functional account code (FAC).

8. There are 5 direct categories of work to be measured
and reported.

9. There are 7 indirect categories of work.

10. No other categories of work such as lunch, standby,
etc., have been identified.

11. Operational audit will be the measurement methodology
used to measure the workload and the man-hour data will be col-
lected at the category level.

12. Since the work sampling methodology ("WS") will not
be used in this study, no entry is reflected in this column.

13. There are 234 task titles in the work center descrip-
tion.

Main Menu 3: Processing Menu

This menu is the largest main menu. It has 24 options the
user can select to load, change, analyze, or print a wide range of
study data and products. Be sure to consult the "Previous Action
Chart" in AFM 25-511, paragraph 2-61 before attempting to run a
particular menu. This chart will show which data files must have
been created and/or loaded prior to running a menu option. Then
consult the "File Chart" in AFM 25-511, paragraph 2-6m to deter-
mine whether a file must be created outside of MSDS by the user or
within MSDS. Once the appropriate files have been created and
loaded, the processing menu can be executed.

Processing Menu 1. This menu allows the user to load, change, or print the names of the bases which will be participating in the manpower standard development study. The location names file (LOCNAMES) must have been created before executing options 1-3 of this menu. Table 3 is a example of the options provided by Processing Menu 1.

```
  3.1


SELECT LOCATION NAMES FILE UPDATE OPTION:
     1.  LOAD NEW LOCATION NAMES
     2.  CHANGE LOCATION NAME
     3.  PRINT LOCATION NAMES
     4.  RETURN TO PROCESSING MENU
  ?3   ①


LOCATION NAMES PRINT ROUTINE.        ②
ENTER FIRST AND LAST LOCATION NUMBERS TO BE PRINTED.
?1-8


  1-8
    ^

FILE CODE 41 ILLEGAL CHAR: CORRECTION =1,8

THE FIRST LOCATION NUMBER MUST BE GREATER THAN 0
LESS THAN THE LAST NUMBER AND THE LAST NUMBER MUST NOT
BE GREATER THAN  13
LOCATION NAMES PRINT ROUTINE.
ENTER FIRST AND LAST LOCATION NUMBERS TO BE PRINTED.
?1,8

  PAUSE SET PAPER: HIT RETURN      ③
  ??


                                  ④   STUDY LOCATION NAMES

 1 BARKSDALE        3 CASTLE        5 FAIRCHILD       7 GRIFFISS
 2 CARSWELL         4 ELLSWORTH     6 GRAND FORKS     8 MINOT
```

Table 3.   Main Menu 3, Processing Menu 1 –
            Location Names File Update Option

Option 1, Load New Location Names, allows the user to access the LOCNAMES file and add new locations to the data file. This is

the responsibility of the lead SACMET and can be done without the assistance of XPMET providing two criteria are met. First, XPMET must have given file permissions to the lead SACMET. Secondly, the number of locations to be added plus the number of locations already loaded into the LOCNAMES file can't exceed the number of locations XPMET set parameters for in Main Menu 1. The "Study Level Information" provided by Main Menu 2 will show how many locations have been planned for. If this number will be exceeded, XPMET must be contacted to change the study parameters.

Option 2, Change Location Name, allows the lead SACMET to change or correct the name of any location already loaded in the LOCNAMES files.

Option 3, Print Location Names, allows the user to print the contents of the LOCNAMES file.

Option 4, allows the user to return to Main Menu 3 and select another option.

The following numbered comments refer to the numbered items on the sample output:

1. The sample shows that Option 3, the print routine was selected.

2. The next 12 lines of output show an example of the MSDS error-checking capability. In this case the program asked the user to "ENTER FIRST AND LAST LOCATION NUMBERS TO BE PRINTED." The user entered "1-8." This entry is telling the computer to print the location names for numbers 1 through 8. The computer then prints the erroneous entry, identifies it as an "ILLEGAL CHARACTER", and in this case provides the correct entry, "1,8." The program won't be able to provide the correct entry in all cases. This is a fairly simple error, the correction for which was written into the program. In most cases, the program will identify the error and provide an explanation of what the user is supposed to do. After the explanation, the original instruction will be repeated.

3. The program then stops running to give the user time to set up the printer if necessary. When the user is ready to receive or view the output, the return key on the keyboard is pressed and the program displays or prints the data. SUGGESTION: Always obtain a hard copy of data in the computer. This can save many man-hours if the computer or program fails and the data is lost or destroyed.

4. This is an example of the output for Option 3. It is important to retain this product during the study because other MSDS products will often only refer to a location by its number and not its name. The program assigns the numbers in a sequential

order as the user enters each location name into the LOCNAMES file. The program does not arrange the names alphabetically; that was done by the user.

Processing Menu 2 and Processing Menu 3. These two programs are on-line, interactive routines which are used by the lead SACMET to load, change, print, or convert the "CATNAMER" data file, which is a random file, to the "CATNAMES" file which is a sequential data file. No output of any appreciable value to an input SACMET is produced; therefore, no sample is provided. In addition, the creation of the CATNAMER file is the responsibility of the lead SACMET and that process is covered in detail by the SAC Information Processing System Tips (IPSTIPS) published and maintained by XPMET. If difficulty is encountered, refer to the IPSTIPS first, then contact XPMET if all else fails.

Processing Menu 4. This menu allows the user to obtain a printed copy of AFMEA Form 1040, Operational Audit Worksheet. The worksheets contain only the category and task titles entered by the lead SACMET into the "CATNAMER" file. While this menu doesn't offer any optional routines, the user may opt to print single-spaced or double-spaced worksheets. NOTE: If possible, print the worksheets using a 12-pitch printer. This will allow the form to fit on a 8 1/2" x 11" piece of paper. If the worksheets are printed using a 10-pitch printer, 8" x 13" paper is required. Table 4 shows the interrogative process for ordering the printed worksheets and Table 5 is a sample double-spaced AFMEA Form 1040 produced with a 16.5 pitch printer.

*****

```
ENTER PROCESSING MENU OPTION NUMBER DESIRED.  (HIT '?' AND 'RETURN' TO GET MENU.)
?4


ENTER "1" FOR SINGLE SPACE OR
     "2" FOR DOUBLE SPACE
?2  ①
ENTER STARTING AND ENDING          ②
CATEGORY/TASK SERIAL NUMBERS SEPARATED BY A COMMA.
?301.999

STARTING CATEGORY/TASK SERIAL NUMBER MUST BE GREATER THAN 300 AND LESS THAN OR EQUAL TO THE ENDING CATEGORY/TASK SERIAL NUMBER.
LSO, THE ENDING CATEGORY/TASK SERIAL NUMBER MUST NOT BE GREATER THAN   534
ENTER STARTING AND ENDING
CATEGORY/TASK SERIAL NUMBERS SEPARATED BY A COMMA.
?301.534

                         ③
TOTAL NUMBER OF PAGES FOR ONLY
THE CATEGORY/TASK SERIAL NUMBERS ENTERED IS.   14


ENTER PAGE NUMBER TO START AND TOTAL NUMBER OF PAGES.
TO USE FOR PAGE NUMBERING.
?1.14

 PAUSE LOAD PAPER. HIT RETURN
??
```

Table 4. Main Menu 3, Processing Menu 4 —
Questions and Answers

The following numbered comments refer to the numbered items in
Table 4:

    1. The user requested a double-spaced form.

    2. Here the program asked for the starting and ending
category/task serial numbers to be printed. The user requested
the program to start at serial number 301 and end at number 999.
This is an error because the work center information in Table 2
shows there are only 234 task titles entered in the system (see NR
TASK TITL on Table 2). In this instance the user either forgot
the correct ending serial number or never printed a copy of Main
Menu 2, Option 4. Anyway, the user merely entered an erroneous
number so the program's error routine would indicate the correct
entry. As can be seen on Table 5 the first category title in any
study is always serial number 301. The ending serial number of a
study can be determined by counting all of the titles in the work
center description and adding 300 to the number counted or by
taking the number from Main Menu 2, Option 4 and adding 300 (300 +
234 = 534).   It isn't necessary, however, to print every title
every time. If for instance one page was lost, stolen, bent, or
mutilated, that one page could be reprinted by specifying the

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beginning and ending serial numbers of the titles to be printed;
i.e., 301, 317 for the page shown in Table 5.

3. The program then computes how many pages it will take
to print the category/task titles asked for and asks the user to
enter the starting page number and the total number of pages to
use for page numbering purposes (see Table 5, top left hand
block-- "PAGE 1 OF 4"). If the user only wanted to print page
number 5, the entry would be 5,14.

OPERATIONAL AUDIT WORKSHEET	LOCATION				WORK CENTER	ELECTRONIC COUNTERMEASURES			
	DATE		WORCD		DIRECT	INDIRECT			
PAGE 1 OF 1A									
FREQUENCY CODE: 1=01 2=02	3=03	4=04	5=05	6=UK	7=NO	8=OT	9=YR		
		FREQUENCY			ALLOWED MANHOURS				
ACTIVITY TITLE	CAT CODE	SUM CODE	ACTIVITY SERED	FREQ CODE	CONV FACTOR	PER ACCOMP	PER MONTH	TOTAL	OPER REQ	TYPE DATA	ALL CODE
1. B-52 AIRCRAFT MAINTENANCE	301								
1.1. PERFORMS FLIGHTLINE MAINTENANCE	302								
1.1.1. PERFORMS MAINT ON AN/ALQ-117	303								
1.1.1.1. MAINT CONT EMO CONSOLE, C-8871	304								
1.1.1.2. MAINT CONTROL, C-8872	305								
1.1.1.3. MAINT RECEIVER, R-1758	306								
1.1.1.4. MAINT TRANSMITTER, T-1205	307								
1.1.1.5. MAINT TRANSMITTER, T-1204	308								
1.1.1.6. MAINT SWITCH, ANT SELECTOR	309								
1.1.1.7. MAINT BLANKING MODULE	310								
1.1.1.8. MAINT PRESSURIZATION	311								
1.1.1.9. MAINT ANTENNA	312								
1.1.1.10. MAINT OTHER AN/ALQ-117 SUB-SY	313								
1.1.2. PERFORMS MAINT ON AN/ALE-24	314								
1.1.2.1. MAINTAINS CONTROL	315								
1.1.2.2. MAINTAINS DISPENSER	316								
1.1.2.3. MAINT OTHER AN/ALE-24 SUB-SYS	317								

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Table 5. AFMEA Form 1040 - Operational Audit Worksheet

Processing Menu 5. This menu is not operative and is reserved
for use sometime in the future.

Processing Menu 6. This menu is used to load or change the
master man-hour data file and is controlled by XPMET. Therefore,
no sample output is shown.

Processing Menu 7. This menu allows the user to load man-
hour data for a work sampling study and to print a facsimile of
the AF Form 1111, Work Sampling Record. However, the program has
several logic errors in it which results in erroneous mathematical
computations. In addition the "facsimile" AF Form 1111 produced
by the system is really only a portion of the form's Part II;
therefore, it isn't suitable for reporting purposes. These inade-
quacies make the entire processing menu unusable for the SACMEP.
Instead, XPMET advises the use of the AFMEA Utility Subsystem.
This program will be discussed later in this chapter.

Processing Menu 8. This menu screens the format of the opera-
tional audit input file to ensure the correct type of data has
been entered. The menu has 2 options--1 for the lead SACMET to
use and 1 for the user. Table 6 below shows the 2 options avail-
able and a sample of the output for Option 1.

*****
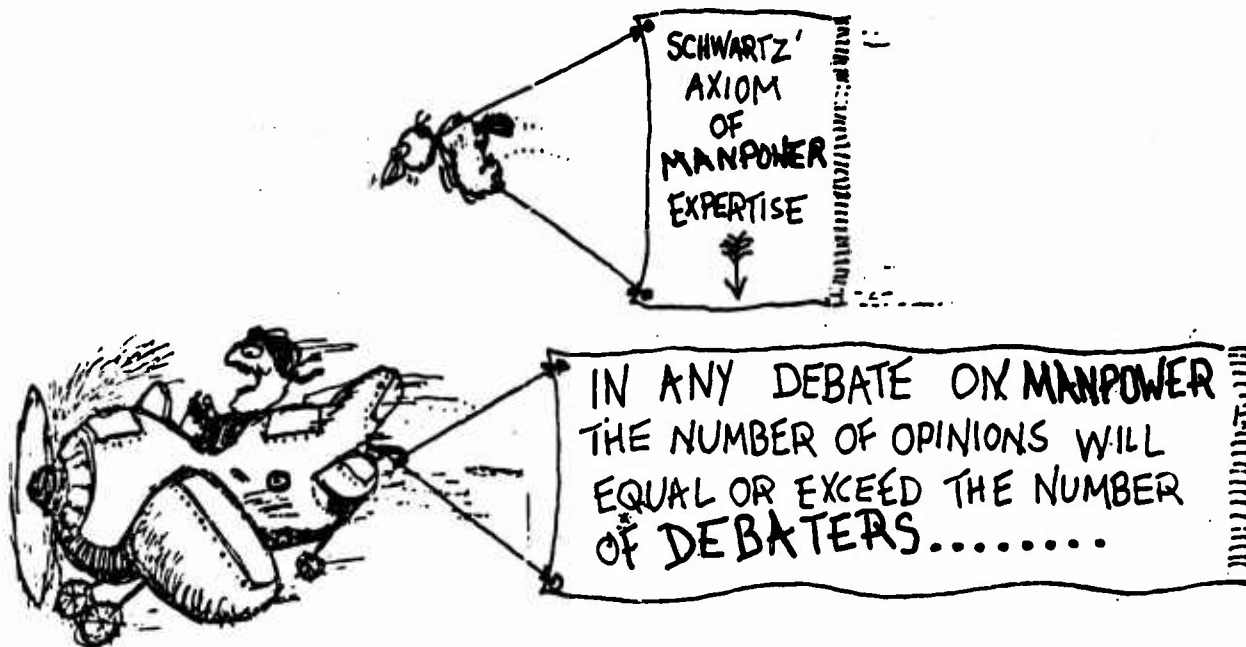
*If it sits on your desk for 15 minutes, you've
just become the "expert."*

- Brig Gen R. F. C. Winger

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```
ENTER MAIN MENU OPTION NUMBER DESIRED.   (HIT '?' AND 'RETURN' TO GET MENU.)
?3.8


CHECK OPERATIONAL AUDIT DATA FILES



SELECT THE TYPE FILE TO BE CHECKED:
    1.  USER'S SYSTEM-STORED OA PARAMETER FILE.
    2.  USER ENTERED OA DATA FILE.
?1


BEGINNING CHECK OF OA DATA FILE OSXPME2/ECMBAR/ECM2413/OABARK
        OSXPME2/ECMBAR/ECM2413/OABARK       , CHECK COMPLETE.

BEGINNING CHECK OF OA DATA FILE OSXPME2/ECMBAR/ECM2413/OACARS
        OSXPME2/ECMBAR/ECM2413/OACARS       , CHECK COMPLETE.

BEGINNING CHECK OF OA DATA FILE OSXPME2/ECMBAR/ECM2413/OACAST
        OSXPME2/ECMBAR/ECM2413/OACAST       , CHECK COMPLETE.

BEGINNING CHECK OF OA DATA FILE OSXPME2/ECMBAR/ECM2413/OAELLS
        OSXPME2/ECMBAR/ECM2413/OAELLS       , CHECK COMPLETE.
```

Table 6.   Main Menu 3, Processing Menu 8, Option 1 Output -
           Operational Audit Input Data Check

    Option 1 is used by XPMET and the lead SACMET to run data
checks on the operational audit data files submitted by the
input teams. To use this option the operational audit input
parameter (OAINPARM) file must have been loaded. The program then
automatically performs the data check on all operational audit
data files listed in the OAINPARM file.

    Option 2, on the other hand, is used by the input SACMET to
perform a data check only on their own operational audit data
file. This option does not require the OAINPARM file because only
1 data file at a time is being checked.

    The program lists each data file being checked and the results
of the data check. If no errors in data format or the number of
line entries are found, the result is "CHECK COMPLETED." If an
error is found, the program output identifies the line number in
error and provides an error message identifying the type of error.
The creation and correction of the operational audit data file

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isn't addressed here because explicit instructions are already
published in the IPSTIPS. CAUTION: This data checking program
merely identifies format errors so the data can be used in other
processing menus. The computer cannot and does not look for or
identify logic errors. That is the management engineer's respon-
sibility. Just because the data was in the proper format doesn't
mean it is logically correct, but that's a subject that will be
discussed in more detail in Chapter Two. Remember, the computer
doesn't give answers—only data. The MEO is in charge of the
answer and decision department.

Processing Menu 9. This menu allows the user to compute and
print a facsimile AF Form 1040 and load the computed category man-
hours to the master man-hour file if desired. As can be seen from
Table 7 there is only 1 output, AF Forms 1040, so no optional
routines are provided.

```
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 ENTER:
     CAT/FILE NAME -- USE OA INPUT FILE
     'PARM' -- USE OA PARAMETER FILE
     'DONE' -- RETURN TO PROCESSING MENU
 ?OSXPME2/ECMBAR/ECM2413/OABARK    (1)


 DO YOU WANT TO PRINT 1040'S
 ?Y  (2)


 DO YOU WANT TO LOAD THE MASTER MANHOUR FILE?
 ?N  (3)
```

Table 7.   Main Menu 3, Processing Menu 9 -
Questions and Answers

The following numbered comments refer to the numbered items in
Table 7:

     1.   In this example the user has chosen to print just 1
operational audit data file. Regardless of the option chosen,
however, the "LOCNAMES," "CATNAMER," and "MASTERMH" files must
have been loaded. In selecting this option, the user had to
provide the User Master Catalog (UMC), "OSXPME2;" the study iden-
tification, "ECMBAR;" the work center identification, "ECM2413;"
and the operational audit data file name, "OABARK;" which is the
Barksdale SACMET's data file. If the user wanted to print AF
Forms 1040 for all of the input locations at one time, the "PARM"

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response would have been entered. However, to use the "PARM" response, the OAINPARM file must be loaded into the system.

2. Here the user has entered a yes ("Y") response to the question of printing the forms or not.

3. Pay particular attention to this question--an incorrect response could foul up the whole works. Input SACMETs DO NOT load the master man-hour file. The answer for input SACMETs is "N" or NO! The lead SACMET loads the master man-hour file after insuring all operational audit data files are correctly formatted. If the lead SACMET has already loaded the master man-hour file, it must be zeroed out by XPMET before new data can be loaded. If this isn't done, the new man-hour data will be added to the old man-hour data and render the file useless for subsequent analysis and computations.

Table 8 is an example of the AF Form 1040 produced by Processing Menu 9. The asterisks preceding the category and task titles were left in by mistake when the "CATNAMER" file was created and loaded. The asterisk is used in Processing Menu 4 to denote that the line asterisked was not to be underlined on the AFMEA Form 1040 worksheets because no measurement data entry was required. These asterisks should be removed from the data file after the worksheets are printed.

*****

The results of not keeping an
AUDIT TRAIL!!!

OPERATIONAL AUDIT DATA AF FORM 1040

ACTIVITY TITLE	.NO. .RQ.	ACT FREQ	. CON . FAC	FREQUENCY . PER . MONTH	.	ALLOWED MAN-HOURS PER ACCOMP	. PER . MONTH	. TOTALS. .
DIRECT								
*1. B-52 AIRCRAFT MAINTENANCE:								
*1.1. PERFORMS FLIGHTLINE MAINTENANCE:								
*1.1.1. PERFORMS MAINT ON AN/ALQ-117:								
1.1.1.1. MAINT CONT EWO CONSOLE, C-8871		6.00/MO	1.00	6.00		0.640	3.84	
1.1.1.2. MAINT CONTROL, C-8872.		7.00/MO	1.00	7.00		0.640	4.48	
1.1.1.3. MAINT RECEIVER, R-1758.		20.00/MO	1.00	20.00		3.440	68.80	
1.1.1.4. MAINT TRANSMITTER, T-1205.		23.00/MO	1.00	23.00		3.440	79.12	
1.1.1.5. MAINT TRANSMITTER, T-1206.		16.00/MO	1.00	16.00		3.440	55.04	
1.1.1.6. MAINT SWITCH, ANT SELECTOR.		21.00/MO	1.00	21.00		2.580	54.18	
1.1.1.7. MAINT BLANKING MODULE.		3.00/MO	1.00	3.00		1.860	5.58	
1.1.1.8. MAINT PRESSURIZATION.		4.00/YR	0.08	0.33		3.720	1.24	
1.1.1.9. MAINT ANTENNA.		4.00/MO	1.00	4.00		4.350	17.40	
1.1.1.10. MAINT OTHER AN/ALQ-117 SUB-SY		6.00/MO	1.00	6.00		4.350	26.10	
*1.1.2. PERFORMS MAINT ON AN/ALE-24:								
1.1.2.1. MAINTAINS CONTROL.		12.00/MO	1.00	12.00		1.860	22.32	
1.1.2.2. MAINTAINS DISPENSER.		14.00/MO	1.00	14.00		3.440	48.16	
1.1.2.3. MAINT OTHER AN/ALE-24 SUB-SYS		2.00/MO	1.00	2.00		4.350	8.70	
*1.1.3. PERFORMS MAINT ON AN/ALE-20:								
1.1.3.1. MAINTAINS CONTROL.		2.00/MO	1.00	2.00		1.860	3.72	
1.1.3.2. MAINTAINS FLARE EJECTOR.		2.00/MO	1.00	2.00		3.440	6.88	
1.1.3.3. MAINT OTHER AN/ALE 20 SUB-SYS		2.00/MO	1.00	2.00		1.860	3.72	
*1.1.4. PERFORMS MAINT ON AN/ALT-16A:								
1.1.4.1. MAINTAINS CONTROL.		6.00/MO	1.00	6.00		1.860	11.16	
1.1.4.2. MAINTAINS TRANSMITTER.		23.00/MO	1.00	23.00		3.720	85.56	
1.1.4.3. MAINTAINS ANTENNA.		1.00/MO	1.00	1.00		4.350	4.35	
1.1.4.4. MAINTAINS COAXIAL CABLE.		2.00/MO	1.00	2.00		3.720	7.44	
1.1.4.5. MAINT OTHER AN/ALT-16A.		1.00/MO	1.00	1.00		3.720	3.72	
*1.1.5. PERFORMS MAINT ON AN/ALQ-122:								
1.1.5.1. MAINTAINS PROCESSOR.		2.00/MO	1.00	2.00		1.860	3.72	
1.1.5.2. MAINTAINS DUPLEXER.		5.00/MO	1.00	5.00		3.720	18.60	
1.1.5.3. MAINTAINS RECEIVER.		4.00/MO	1.00	4.00		1.860	7.44	
1.1.5.4. MAINTAINS CONTROL MONITOR.		2.00/MO	1.00	2.00		1.860	3.72	
1.1.5.5. MAINTAINS COAXIAL CABLE.		2.00/YR	0.08	0.17		3.720	0.62	
1.1.5.6. MAINT OTHER AN/ALQ-122 SUB-SYS		2.00/YR	0.08	0.17		3.720	0.62	

Table 8. Computed AF Form 1040, Operational Audit Data

Processing Menu 10.   This menu allows the user to produce an
AF Form 308, Standard Input Data Computation.   The master man-hour
file, the category name random file, and the location names file
must have already been created and loaded.   Table 9 is an example
of the questions and possible responses the user is required to
enter.   Table 10 is a sample AF Form 308.


```
ENTER PROCESSING MENU OPTION NUMBER DESIRED.   (HIT '?' AND 'RETURN' TO GET MENU.)
?10


ENTER MANHOUR AVAILIBILITY FACTOR
?145.2  ①


ENTER LOCATION NUMBER SPECIFICATIONS.  (? FOR HELP)
?1,8  ②


YOU HAVE INDICATED THE FOLLOWING   2 LOCATIONS:
    1   8
IS THIS CORRECT?  ENTER YES OR NO.  ②
?Y
```

Table 9.   Main Menu 3, Processing Menu 9 –
                 Questions and Answers

The numbered comments below refer to the numbered items in
Table 9:

        1.   While the questions aren't real tough, don't forget
to process overseas locations separately from CONUS locations.
The program will only accommodate 1 man-hour availability factor
at a time.   This would result in the overseas data being divided
by the wrong man-hour availability factor (145.2 versus 143.5).

        2.   Here the user enters the number of each location an
AF Form 308 is to be printed for.   In this case the user chose
location number 1 and number 8.   The program then asked a check
question to make sure the entry was correct and the user answered
yes   If an AF Form 308 was required for each of the 8 locations
the user could have indicated so by entering "1-8."

*****

You can't antagonize and persuade at the same time.

– *anonymous*

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```
BARKSDALE                        ELECTRONIC COUNTERMEASURES

05 OCT84 14.226

          STANDARD INPUT DATA COMPUTATION AF FORM 308
```

PRODUCTIVE CATEGORIES	ALLOWED TIME FROM WORK SAMPLING	ADJUSTED 0.000XB	MONTHLY ALLOWED TIME		
			TIME STUDY	OPERAT'L AUDIT	TOTAL (C+D+E)
A	B	C	D	E	F
DIRECT					
#1. B-52 AIR	0.00	0.00	0.00	4031.53	4031.53
#2. SUPERVI	0.00	0.00	0.00	278.00	278.00
3. ALTERNA	0.00	0.00	0.00	8.00	8.00
4. FUNCTIO	0.00	0.00	0.00	48.00	48.00
#I1. SUPERV	0.00	0.00	0.00	199.38	199.38
TOTAL DIRECT	0.00	0.00	0.00	4564.91	4564.91
INDIRECT					
#I1.1. ADMI	0.00	0.00	0.00	0.00	0.00
#I2. ADMINI	0.00	0.00	0.00	60.81	60.81
#I3. MEETIN	0.00	0.00	0.00	45.44	45.44
#I4. TRAINI	0.00	0.00	0.00	122.50	122.50
#I5. SUPPLY	0.00	0.00	0.00	397.85	397.85
#I6. EQUIPM	0.00	0.00	0.00	84.51	84.51
#I7. CLEANU	0.00	0.00	0.00	140.38	140.38
TOTAL INDIRECT	0.00	0.00	0.00	851.49	851.49
TOTALS	0.00	0.00	0.00	5416.40	5416.40
MANPOWER REQUIRED					37.303

Table 10. Computed AF Form 308, Standard
Input Data Computation

Processing Menu 11. This menu allows the user to add or
delete man-hours in the master man-hour file. Again, access to
the master man-hour file is controlled by XPMET; therefore, no
output product is shown. In reality, XPMET doesn't use this
processing menu because it's much simpler and quicker to zero out
the file and load it again using Processing Menu 6.

Processing Menu 12. This menu gives the user the ability to
list the status of man-hour data loaded for the entire study or to
print the contents of a particular work center's master man-hour
file for selected SACMETs. Naturally, the master man-hour file
must have been created and loaded by the lead SACMET. In fact,
the lead SACMET and XPMET use this menu to check the currency of
the data in the master man-hour file against the data reflected on
the printed AF Forms 308 and 1040. This is also a good way to
make sure no one has mistakenly loaded the master man-hour file
without zeroing out the file first. Table 11 shows the questions
and answers required to obtain an output and Table 12 is a sample
output for Option 2.

```
ENTER PROCESSING MENU OPTION NUMBER DESIRED.  (HIT '?' AND 'RETURN' TO GET MENU.)
?12


`ENTER:
    1 TO LIST LOADED DATA STATUS INFO
    2 TO READ MASTER MAN-HOUR FILE CONTENTS
?2


ENTER FIRST LOCATION NUMBER AND NUMBER OF LOCATIONS TO PRINT.
?1


?1


DO YOU WANT WS AND OA DATA PRINTED?
?Y
```

Table 11.   Main Menu 3, Processing Menu 12 —
Questions and Answers

Option 1 allows the user to determine which of the input teams
have loaded their data into the master man-hour file. Since input
SACMETs do not load the master man-hour file, this option is only
used by the lead SACMET and XPMET. In fact, this option is sel-
dom, if ever, used since Option 2 provides status information as
wel' as the actual contents of the file.

Option 2 allows the user to read and/or print the contents of
the master man-hour file for any or all locations desired. In the
example in Table 11, the user chose to print the master man-hour
file contents of location number 1 (Barksdale) only. The user also
chose to have the man-hour data printed. If the user wanted to
start at location number 4 and read the contents for the rest of
the locations, but didn't want to print the data, the entries

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should be "4", "5," and "N." The "4" tells the computer to start
at location number 4 and the "5" tells the computer to print the
contents for locations 4, 5, 6, 7, and 8. The "N" or no entry
tells the computer the user only wants to view or read the data
and no report is to be printed. For safety's sake, the user
should always have the entire contents of all files printed to
ensure no one has inadvertently entered the data in the wrong
location or file space.

Table 12.   Master Man-hour File Contents
for Location 1

The following numbered comments refer to the numbered items in
Table 12:

    1.   This is the location number from the location names
(LOCNAMES) file.

    2.   These two data elements are not used. They are
reserved for future use.

    3.   This data element indicates the number of changes
that have been made to this particular master man-hour file.

    4.   This data element indicates the number of direct
categories of work to be measured.

    5.   This is the number of indirect categories of work.

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6.   This is the number of other categories of work.

7.   This is the number of operating days for the work center.   In this case it is 5 days per week.   A'work center that worked 7 days per week would have an entry of 30.4400000.

8.   This data element shows whether or not the work sampling data has been loaded.   A "O" entry means no and a "1" means yes.

9.   This entry shows whether or not supplement operational audit data for a work sampling study was loaded.   The same "0/1" approach is used.

10.   This element shows the number of minimum manning man-hours loaded.

11.   This element reflects the number of days work sampling data was collected.

12.   This entry shows the number of standby man-hours measured.

13.   These entries reflect the beginning serial number of each category of work starting with Category 1 at serial number 30100.0000000 and ending with Category I7 at serial number 59200.0000000.   Remember, Item 4 shows there are 4 direct categories and Item 5 shows there are 7 indirect categories for a total of 11 categories which matches the 11 serial numbers.   This information is nice to have at your finger tips when you begin category and task analysis.

14.   These elements show the number of man-hours measured for each of the 11 categories using the work sampling methodology. In this case work sampling was not used; therefore, the entry is "0."

15.   These elements show the allowance factor used to adjust the measured man-hours for each category of work.   Of course this is only used for work sampling data since operational audit data is assumed to already include necessary allowances for personal, fatigue, and delay.

16.   These entries reflect the number of measured man-hours for each of the 11 categories using the operational audit measurement methodology.

Processing Menu 13.   This menu can be used to load, change, and print a work count input (WRKCNTIN) file of raw workload data. The work count names (WRKLDFNM) file and the location names (LOCNAMES) file must have been loaded to exercise this menu. While it can be used to load raw work count data, this can be done

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only in an "on-line" mode. This menu can also be used in lieu of
building the work count correlation and regression (C&R) data
file. No output is shown since it would be the same as the
input. This menu must be used to create the WRKCNTIN file before
processing menu 14 can be used.

Processing Menu 14. This is the primary menu used by the lead
SACMET to load, change, print, and analyze work count data. The
menu will handle up to 99 work counts from 200 locations and 24
time periods. In addition, the menu offers 12 options or opera-
tions on the data with 4 options for analysis and 5 options for
producing a report embedded in each operation. Obviously, the
number of possible combinations staggers the imagination. For
that reason the basic possibilities will be discussed, but only
one output will be shown. Interested users are encouraged to
exercise as many combinations as possible to gain an appreciation
for the wealth of information obtainable from the system. Again
this menu is the lead SACMET's primary tool for loading the work
count data, building the work count correlation and regression
(C&R) data file, and analyzing the work count data to ensure nor-
malcy and accuracy prior to using the data to perform subsequent
regression and ratio analysis. Before exercising this menu, the
lead SACMET must have loaded the work count names (WRKLDNM), the
location names (LOCNAMES), and the work count input (WRKCNTIN)
files and must have created the master work count (WRKLDFAC) file.
Table 13 lists the basic options available to the user and Table
14 shows a sample output of the "Print-Record" option.

*****

DOCUMENT, DOCUMENT, DOCUMENT!!!

```
ENTER PROCESSING MENU OPTION NUMBER DESIRED.   (HIT '?' AND 'RETURN' TO GET MENU.)
?

 14


05 OCT84  14.2583
ENTERING THE WORK COUNT SUBSYSTEM
ENTER WORK COUNT OPTION. ('?' AND 'RETURN' TO GET MENU) .
??


VALID OPTIONS ARE:
    CMP     CREATE-MASTER-PRINT
    CM      CREATE-MASTER
    PM      PRINT-MASTER
    PD      PRINT-DETAIL
    CMC     CREATE-MASTER-CR
    CMCP    CREATE-MASTER-CR-PRINT
    CMPC    CREATE-MASTER-PRINT-CR
    CMPCP   CREATE-MASTER-PRINT-CR-PRINT
    CCP     CREATE-CR-PRINT
    CC      CREATE-CR
    CHM     CHANGE-MASTER
    PR      PRINT-RECORD
    DONE    DONE
?PM


 PAUSE LOAD PAPER, HIT RETURN
??
```

Table 13.   Main Menu 3, Processing Menu 14 Options

The "CMP" or "CREATE-MASTER-PRINT" option will create, load,
and print the master work count file using the work count input
(WRKCNTIN) file.

The "CM" or "CREATE-MASTER" option will create and load the
master work count file only. No output is produced.

The "PM" or "PRINT-MASTER" option prints the master work count
file contents. This option can only be used after the master work
count file has been created and loaded using one of the options
beginning with "CM" or "CREATE-MASTER."

The "PD" or "PRINT-DETAIL" option allows the user to compute
the average, the standard deviation, the upper control limit
(UCL), and the lower control limit (LCL) for each work count and
each location over a specified period of time. The exact nature
of the computations and detail output will depend upon the selec-

tion criteria and report criteria provided by the user. These criteria will be discussed later.

The "CMC" or "CREATE-MASTER-CR" option creates and loads the master work count file from the WRKCNTIN file and creates and loads the work count C&R file from the master work count file.

The "CMCP" or "CREATE-MASTER-CR-PRINT" option does the same thing as the "CMC" option, but it also prints the work count C&R file.

The "CMPCP" or "CREATE-MASTER-PRINT-CR-PRINT" option does the same thing as the "CMC" option, but also prints both the master work count file and the work count C&R file.

The "CCP" or "CREATE-CR-PRINT" option creates and loads the work count C&R file from the master work count file and prints the C&R file.

The "CC" or "CREATE-CR" option creates and loads the work count C&R file only.

The "CHM" or "CHANGE-MASTER" option allows the user to change any work count in any record as long as the master work count file has been created and loaded.

The "PR" or "PRINT-RECORD" option prints any records selected by the user as long as the master work count file has been created and loaded.

Within each of the options above, the user is required to input some selection criteria which is used to calculate the average value of each set of work counts. The criteria also determine what data are provided in the detail report using the "PD" option. There are four valid responses the user can input.

1. If the user selects criteria "1," all data for all periods contained in the WRKCNTIN file for each location will be used to compute the average, the standard deviation, the UCL, and the LCL. This is the best criteria to select since each period's data can be compared to the computed average and extreme values can be identified.

On the other hand, if data for a certain period or periods within the WRKCNTIN file have been identified as unrepresentative or incorrect, or if more data was gathered than was needed, the user can select criteria "2, N, M." These criteria allow the user to designate the periods to be used in computing the average, standard deviation, UCL, and LCL. The "N" represents the first period to be included in the computation and "M" represents the last period to be used. For instance, if the user

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wanted to specify the periods 4 through 14, the user would select the following criteria: "2, 4, 14."

The third selection criteria is designated "3, N, M, Y." In this option the user designates the beginning period, "N"; the ending period, "M"; and an incrementer, "Y." For instance, if the user wanted to begin at period 1 and end at period 9, but only use every other period's data in computing the average, the user would select the following criteria: "3, 1, 9, 2." The program would then use only the data from periods 1, 3, 5, 7, and 9 to compute the statistics.

The last selection criteria is designated "4, P1, P2, ... P24." This option allows the user to randomly select the periods to be used in the computations. For instance, the criteria "4, 1, 2, 9, 23" would tell the computer to use the data in periods 1, 2, 9, and 23 to compute the statistics.

That only leaves one more set of criteria for the user to select from--the type of report desired. When questioned by the computer as to the type of report desired the user has 5 options.

Option "1" does not produce a report.

Option "2" produces a report with the average, standard deviation, and user defined UCL and LCL displayed.

Option "3" produces a report with the same statistics as produced by option "2," but also identifies those work counts that exceed the control limits.

Option "4" produces a report with the same data displayed as in option "3," but also identifies the two highest and two lowest work counts between the average and the UCL and LCL respectively.

Last, is Option "5" which produces a report with the average, standard deviation, UCL, LCL, and the actual work count data and percentage of total work count for the periods the user has selected to be printed. If the user selected any criteria except "1," the program will automatically print those periods used to compute the average. However, if the user had selected criteria "1," then the user will be asked to reenter the criteria again to make sure all periods are to be printed.

One last note of caution remains. While the master work count file can hold data for up to 99 work counts, the C&R file can only hold data for 10 work counts. That means the user must specify which work counts are to be used to create the C&R file. Of course, more than one C&R file can be created as long as each file is named differently. Thus, if there were 38 work counts, it would require 4 separate C&R files to accommodate all 38 work

counts. Based on the above, the user might want to be more selective when choosing work counts for the C&R file.

LOCATION	1	2	3	4	5	6
BARKSDALE	26.58	830.95	114.83 ①	53.00	0.00	44.00
CARSWELL ③	0.00	0.00	0.00	0.00	0.00	44.00
CASTLE	23.00	1242.22	170.82	-2.00	-2.00	-2.00
ELLSWORTH	21.83	729.06	96.33	-2.00	-2.00	-2.00
FAIRCHILD	14.08	432.46	58.17	-2.00	-2.00	-2.00
GRAND FORKS	16.82	436.97	65.25	-2.00	-2.00	-2.00
GRIFFISS	17.75	447.17	58.42	-2.00	-2.00	-2.00
MINOT	17.00	475.08	67.92	-2.00	-2.00	-2.00
NOT USED ②	-2.00	-2.00	-2.00	-2.00	-2.00	-2.00
NOT USED	-2.00	-2.00	-2.00	-2.00	-2.00	-2.00
NOT USED	-2.00	-2.00	-2.00	-2.00	-2.00	-2.00
NOT USED	-2.00	-2.00	-2.00	-2.00	-2.00	-2.00
NOT USED	-2.00	-2.00	-2.00	-2.00	-2.00	-2.00

Table 14.   Main Menu 3, Processing Menu 14 -
Option "PRINT-RECORD" Output

The numbered comments that follow refer to the numbered items in Table 14:

1.   As can be seen from the list of locations, although the files were sized for 13 input locations, only 8 locations were actually used. While the original files were also sized to accommodate 10 work counts, the work counts 7-10 have been excluded from this example so it would fit inside the box.

2.   The "-2.00" means that no work count data has been entered for that location and that particular work count.

3.   A "0.00" entry means that the location reported a zero work count. However, if a particular work count wasn't available at the time of data input, the user should change the " "-2.00" to "-1.00." This will serve as a flag for the lead SACMET to follow-up on and ensure the data is reported. A "0.00" should be entered only if no work was produced. Neither the "-1.00" nor the "-2.00" is used in computing work count averages, standard deviations, etc. However, the "0.00" is included in the computation and if not correct, could affect the statistics considerably.

Processing Menu 15.   This menu gives the user bivariate regression analysis for the linear, power, ratio, and parabolic models.   The user must have loaded the C&R data on file before using this menu.   Table 15 below shows the questions the user will

be required to answer to obtain a bivariate regression analysis. Table 16 is a sample output of the analysis results. Following that is Table 17 which shows the various options available to the user after the analysis has been done. Finally, Table 18 will show a sample of the detailed output and Table 19 will show a sample of the scattergram and plot of the regression line.

```
ENTER PROCESSING MENU OPTION NUMBER DESIRED.   (HIT '?' AND 'RETURN' TO GET MENU.)
?15




***************************************************

          BIVARIATE REGRESSION ANALYSIS

***************************************************




ENTER THE COMPLETE CATALOG FILE STRING FOR THE C & R DATA FILE.
JUST HIT RETURN TO RETURN TO THE HIGHER MENU.
?OSXPME2/ECMBAR/ECM2413/CRDATA  (1)

ENTER THE NUMBER OF VARIABLES PER DATA SET, POSITION OF Y VALUE, POSITION OF X VALUE,
AND PRINT FILE (YES/NO) ?  JUST RETURN TO GO TO HIGHER MENU.
?4,1,3,Y    (2)

ENTER UP TO 50 CHARACTERS OF IDENTIFYING INFORMATION TO BE USED AS A REPORT HEADER.
?ELECTROIC COUNTERMEASURES, RUN #1  (3)
```

Table 15.   Main Menu 3, Processing Menu 15 –
Questions and Answers

The numbered comments below refer to the numbered items in Table 15:

1. Remember that the C&R data file must have been loaded prior to running this menu. This first question asks for the complete catalog file string and the name of the C&R data file. In SAC, XPMET keeps things simple and calls it "CRDATA." Refer to the IPSTIPS 15 for help on creating C&R data files outside of MSDS.

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2.   Here the program asks 4 questions. The first
question asks for the number of variables per data set in the C&R
data file. In this case the answer was "4"--one "Y" value or man-
hours and 3 work counts or "X" values. The next question asks the
position of the "Y" value to be used for regression analysis. In
this case and in almost all cases the "Y" value will be in posi-
tion number 1 in the C&R data file. The next question asks what
position the "X" value is in. In this case the "X" value to be
regressed against the man-hours was in the number 3 position. The
user could have chosen to regress the number 2 or the number 4 "X"
value. Lastly, the program asks whether or not the user wants the
results to be printed and the answer was "Y" or yes.

3.   Here the program asks for the user to enter a title
for the printed report. Note that the title can't exceed 50
characters. This title is used on all of the output products
produced by this menu. The author went to great pains to put an
error in the title to graphically portray how this one error will
be repeated throughout the program. In a more serious vein,
please note that the user has identified this requested analysis
of "RUN 1." This should be done for all trial runs. Develop
some means of differentiating between each different run, other-
wise chaos could reign supreme. These points can be seen in Table
16 on the next page.
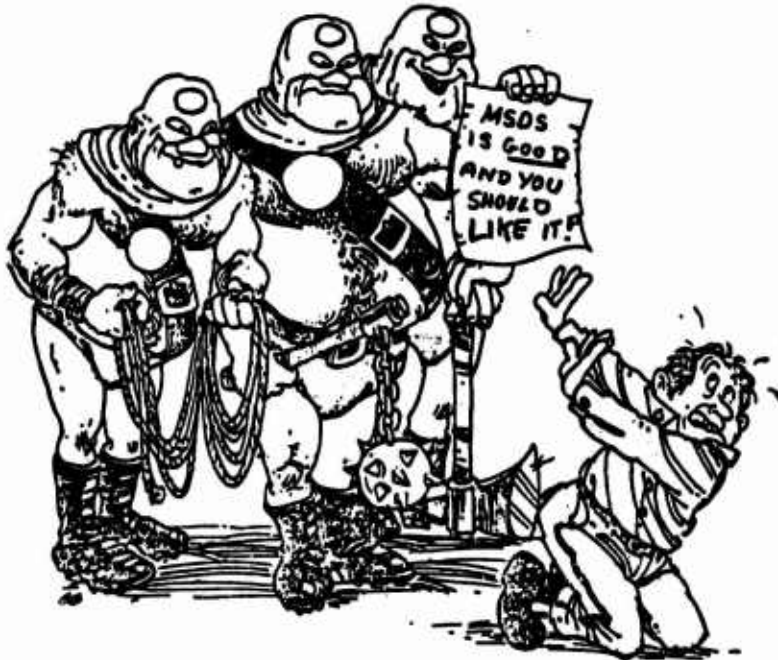
*****

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SEQU NUMBERS	LINE	Y	X
1	1	5416.40	830.95
2	2	7328.08	1242.22
3	3	4685.28	729.06
4	4	3069.88	432.46
5	5	2655.22	436.97
6	6	3338.60	447.17
7	7	3454.29	475.08
MEAN		4278.25	656.27
STD DEV		1654.22	303.83

BIVARIATE MODELS
ELECTROIC COUNTERMEASURES, RUN #1

	MODEL 1 LINEAR	MODEL 2 POWER	MODEL 3 RATIO	MODEL 4 PARABOLA
R	0.99071	0.99155	0.99219	0.99231
R2	0.98151	0.98318	0.98444	0.98468
A	738.33569336	16.85136223	0.13074974	17.22380734
B	5.39396733	0.85503018	0.00003052	7.50569194
C				-0.00130390
SYX	246.38882	235.01319	226.02140	250.73751
V	0.05759	0.05493	0.05283	0.05861

TESTS				
REALISTIC	PASSES	PASSES	PASSES	PASSES
ECONOMIC	PASSES	PASSES	PASSES	PASSES
F	265.457	292.273	316.396	128.579
LEV SIG	0.000016	0.000013	0.000010	0.000235
TB				3.201
LEV SIG				0.032877
TC				0.910
LEV SIG				0.414311

EXTREME VALUES   R-LOWER= 0.006   R-UPPER= 0.508

LOWER/UPPER LIMITS				
Y-LOWER	1787.536	1739.596	1720.804	1735.803
Y-UPPER	8722.305	8681.482*	8434.742*	8288.318*
X-LOWER	194.514	226.597	237.466	238.894
X-UPPER	1480.166	1485.148	1485.148	1485.148

FOR THE PARABOLA X-APEX =   2878.17

Table 16.   Bivariate Regression Analysis Output

5. The output in Table 16 will be discussed in detail in
Chapter Two with respect to choosing the most responsive model for
the manpower standard equation. Once the bivariate analysis re-
sults are printed, however, the user then has 9 options to review
before the menu is done. Table 17 shows the options provided by
the menu.

```
SELECT OPTION
   1 - DETAIL
   2 - PLOT
   3 - DIFFERENT X AND Y
   4 - NEW FILE
   5 - CHANGE X/Y VALUES
   6 - ADD X/Y VALUES
   7 - DELETE X/Y VALUES
   8 - START COMPUTATIONS
   9 - PRINT X/Y VALUES
  10 - RETURN TO HIGHER MENU
?1


ENTER MODEL NUMBER (1-4) FOR DETAILED OUTPUT, AND NUMBER OF STANDARD ERRORS.
TO RETURN TO OPTION SELECTION, ENTER  0,0
?1,2
```

Table 17.   Main Menu 3, Processing Menu 15 Options

Option 1 provides a detailed output of the actual and pre-
dicted values of the "Y" variable (man-hours) using the model
equation chosen by the user. The output also shows the amount of
deviation of the actual man-hours from the predicted man-hours and
identifies those values which are outside the standard error of
the estimate control limits.

Option 2 provides a scattergram of the data pairs used in the
analysis and/or a plot of the regression model chosen by the user.

Option 3 allows the user to rerun the regression analysis with
a different X and Y value without returning to the main menu and
starting all over again.

Option 4 allows the user to rerun the regression analysis
using a new or different C&R file. Remember, if there are more
than 10 work counts to be analyzed, there must be at least 2 C&R
files because 1 file can only handle 10 counts.

Option 5 allows the user to change the current X and Y values being used in the analysis without changing the values in the C&R file.

Option 6 lets the user add X an Y values to the values being analyzed without changing the values in the C&R file.

Option 7 allows the user to delete some of the X and Y values currently being analyzed without changing the values in the C&R file.

Option 8 is used to restart the regression analysis after making any changes to the X and Y values using Options 5, 6, or 7.

Option 9 allows the user to list the X and Y values to be used in the regression analysis before actually starting the computations. This way the user can make sure these are the correct values. This is especially useful after making a change in either of the variables. This option should always be run before using Option 8.

Lastly, the table shows the user chose to run Option 1 and instructed the computer to use the model 1 (linear model) statistics and 2 standard errors of the estimate to establish the control limits for identifying extreme values. Table 18 below shows the output for Option 1.

*****

```
                    ELECTROIC COUNTERMEASURES, RUN #1


       FILE NAME:  OSXPME2/ECMBAR/ECM2413/CRDATA          X POSITION:    3
                                                          Y POSITION:    1



                    DETAILED OUTPUT FOR  LINEAR  MODEL



                                                            OUTSIDE
  SEQU   LINE                  ACTUAL    PREDICTED          +/- 2.00
   NUMBERS          X            Y          Y      DEVIATION   SYX

    1     1      830.95      5416.400   5220.453   -195.947    0.000
    2     2     1242.22      7328.080   7438.830    110.750    0.000
    3     3      729.06      4685.280   4670.862    -14.419    0.000
    4     4      432.46      3069.880   3071.011      1.131    0.000
    5     5      436.97      2655.220   3095.338    440.118    0.000
    6     6      447.17      3338.600   3150.356   -188.244    0.000
    7     7      475.08      3454.290   3300.902   -153.388    0.000
```

Table 18. Detailed Output for Linear Model

The only note of importance here concerns the sequence (SEQU)
and line numbers in the first 2 columns. These are the same
numbers that appear on the Bivariate Regression Analysis Output in
Table 16. The sequence numbers keep track of how many locations
are being analyzed. The line numbers keep track of the X/Y data
pairs in the C&R data file. If the user deleted data pair number
4, the sequence numbers would be 1-6 and the line numbers would be
1, 2, 3, 5, 6, and 7.

Table 19 on the next page shows a sample plot of the linear
model and a scattergram of the variables used to compute the re-
gression equation. Notice at the top of the table that the user
selected model number 1 (linear) and responded "Y" (yes) for a
scattergram. Had the user responded "N" (no), the resultant
output would not have shown the data variables used in the regres-
sion analysis--only the regression line would have been shown.

31

Table 19. Scattergram and Plot of Linear Model

The following numbered comments refer to the numbered items in Table 19:

    1.   Before calling the computer repairman, please note that the graph is printed lengthwise on the paper. In other words, the X-axis, which is normally printed horizontally, is actually printed vertically by the computer. Of course, the same is true of the Y-axis—it is printed horizontally instead of vertically. That means the slope of the regression line is actually positive and not negative as it appears in the table.

    2.   The plot points for the linear model regression line are denoted by asterisks on the graph.

    3.   The scattergram of the data variables (X/Y) are denoted by the letter "X." If the letter "M" is shown, that means there was more than one data pair that were the same values. If the letter "C" is shown, that means the data point is on the regression line. These situations can be verified by referring to the detailed output of the model.

    Processing Menu 16. This menu allows the user to conduct multivariate regression analysis. The user must have loaded the correlation and regression (C&R) data file before using this menu. Table 20 is an example of the questions the user will be required to answer to obtain a multivariate analysis. Table 21 shows a sample output of the analysis results. Following that is Table 22 which shows the various options available to the user after the analysis has been performed. Finally, Table 23 will show an example of the detail output available to the user.

<div align="center">*****</div>

<div align="center">IMMUTABLE LAWS OF MANAGEMENT ENGINEERING</div>

NONRECIPROCAL LAWS OF EXPECTATIONS:
    Negative expectations yeild negative results.
    Positive expectations yeild negative results.

MAIER'S LAW:
    If the facts don't conform, dispose of them.

NINETY-NINETY RULE:
    The first 90% of the task takes 90% of the time and the last 10% takes the other 90%.

KOWALSKI'S LAW:
    The light at the end of the tunnel is usually an on-rushing freight train.

```
ENTER PROCESSING MENU OPTION NUMBER DESIRED.   (HIT '?' AND 'RETURN' TO GET MENU.)
?16




          **************************************************



                    MULTIVARIATE REGRESSION ANALYSIS



          **************************************************


ENTER THE COMPLETE CATALOG FILE STRING FOR THE C & R DATA FILE.
DONE = RETURN TO HIGHER MENU.
?OSXPME2/ECMBAR/ECM2413/CRDATA        ①

ENTER THE FOLLOWING:
     NUMBER OF DATA SETS
     NUMBER OF VARIABLES PER SET
     NUMBER OF X'S TO USE             ②
     PRINT FILE?
     PRINT R-TABLE?
?7,4,3,Y,Y


 ENTER POS OF Y, POS OF X'S
?1,2,3,4                        ③




ENTER UP TO 50 CHARACTERS OF IDENTIFYING DATA TO BE USED AS A HEADING FOR OUTPUT.
?E.C.M.  RUN #2    ④
```

Table 20.   Main Menu 3, Processing Menu 16 —
Questions and Answers

The numbered comments below refer to the numbered items in
Table 20:

      1.   At item number 1, the computer is asking for the
complete catalog file string to include the name of the C&R file.
Just as in the bivariate regression analysis example the C&R data
file is named "CRDATA."

      2.   Next the computer asks five questions. First, the
user must enter the number of data sets, which means how many
input locations. Next, the user must enter the number of vari-
ables in the C&R file. In this case, there are 4 variables.

                              34

Then the user must tell the computer how many of the "X" variables
are to be used in doing the analysis. In this case, the user has
decided to use all 3 "X" values. The user could have chosen
any combination of 2 "X" values as well. Then the user must tell
the computer whether or not to print the multivariate analysis
results. The user entered "Y" (yes). Lastly, the user is asked
to indicate whether or not a table of "R" values is to be printed.
Again the user, being a wise management engineering officer,
answered yes.

       3. Here the user is asked to identify the position of
the "Y" and "X" values in the data sets. The user answered that
the "Y" value was in position 1 and the "X" values were in posi-
tions 2, 3, and 4.

       4. Lastly, the user is asked to enter a title for the
analysis report. Again, always number or title each run with a
unique identifier so the reports don't get mixed up.

<p align="center">*****</p>

<p align="center">"THE GOOD OLD DAYS"</p>

I'm lost, but I'm making record time!

<p align="right">- A fighter pilot, somewhere
over the Pacific - 1944</p>

```
FILE NAME:  OSXPME2/ECMBAR/ECM2413/CRDATA          Y POSITION:    1
X POSITIONS:    2   3   4

SEQU  LINE
 NUMBERS         Y          X 1       X 2       X 3
  1      1    5416.400    26.58     830.95    114.83
  2      2    7328.080    23.00    1242.22    170.82
  3      3    4685.280    21.83     729.06     96.33
  4      4    3069.880    14.08     432.46     58.17
  5      5    2655.220    16.82     436.97     65.25
  6      6    3338.600    17.75     447.17     58.42
  7      7    3454.290    17.00     475.08     67.92


MEAN         4278.250    19.58     656.27     90.25
STD DEV      1654.225     4.35     303.83     41.43


            TABLE OF R VALUES BETWEEN VARIABLES


(R) OF    TO Y     TO X 1    TO X 2    TO X 3



X 1    0.7937   1.0000
X 2    0.9907   0.7660   1.0000
X 3    0.9820   0.7604   0.9971   1.0000



 X ORDER OF ENTRY     INTERMEDIATE R VALUES     R2 VALUES



       X 2                0.9907                0.9815
       X 1                0.9922                0.9845
       X 3                0.9949                0.9899
     A          R         R2          SY        V            F
  418.4336   0.9949    0.9899    235.6147   0.0551      97.5858


X(I)   B(I)          T(I)     SIG LEV



 1    29.03712559   0.842    0.461377

 2    10.36594141   2.444    0.092130

 3   -38.91049384  -1.264    0.295510

EXTRAPOLATION LIMITS    Y-UPPER          Y-LOWER


                        8611.555        1371.745
```

Table 21. Multivariate Regression Analysis Output

The output in Table 21 will be discussed in detail in Chapter Two with respect to using the data to make decisions about the manpower standard equation. Once the multivariate analysis results are printed, the user has 11 options to review before the menu is done. Table 22 shows the options offered by the menu.

```
SELECT OPTION                                       ___
        1 - DETAIL USING 1 STANDARD ERROR
        2 - DETAIL USING 2 STANDARD ERRORS
        3 - DETAIL USING 3 STANDARD ERRORS
        4 - DIFFERENT COMBINATION OF X'S
        5 - NEW DATA FILE
        6 - CHANGE X/Y VALUES
        7 - ADD X/Y VALUES
        8 - DELETE X/Y VALUES
        9 - START COMPUTATIONS
       10 - PRINT X/Y VALUES
       11 - RETURN TO HIGHER MENU
??
```

Table 22.   Main Menu 3, Processing
Menu 16 Options

Options 1-3 give the user a printout of the detail record. The only difference between the three options is the number of standard errors of the estimate (SYX) the user may use to have the upper and lower control limits computed. The detail output is a comparison of the actual and predicted "Y" variable (man-hours). The difference between the two "Y" variables is shown as the deviation. The output also shows any actual "Y" values that fall outside the control limits selected by the user.

Option 4 allows the user to rerun the multivariate regression analysis without having to return to the main menu and starting all over again.

Option 5 allows the user to run multivariate analysis again using a new C&R file without exiting the processing menu.

Options 6, 7, and 8 allow the user to change, add, or delete "X" and/or "Y" values respectively, without changing the values in the C&R file.

Option 9 is used to restart the regression analysis after making any changes to the "X" and "Y" values using Option 6, 7, or 8.

Option 10 allows the user to list the "X" and "Y" values to be used in the regression analysis before actually starting the computations using Option 9. This should be done anytime the user has attempted any change to the values.

Lastly, the user opted to run option 2, the results of which are shown in Table 23 below.

		E.C.M. RUN #2			
SEQU LINE NUMBERS		ACTUAL Y	PREDICTED Y	DEVIATION	OUTSIDE +/- 2.00 SYX
1	1	5416.400	5335.727	-80.673	0.000
2	2	7328.080	7316.377	-11.703	0.000
3	3	4685.280	4861.459	176.179	0.000
4	4	3069.880	3046.708	-23.172	0.000
5	5	2655.220	2897.534	242.314	0.000
6	6	3338.600	3296.030	-42.570	0.000
7	7	3454.290	3193.915	-260.375	0.000

Table 23. Detailed Output for Multivariate Analysis

Processing Menu 17. This menu gives the user the ability to analyze frequency and per accomplishment data from operational audit input files. The user must have already loaded the operational audit input file, the operational audit parameter file, the category/task titles random file, the location names file, and the master work count file. The menu will produce an output product that lists each input location, the actual frequency period, and per accomplishment time. The actual frequencies and the work count are then all converted to a period of time (monthly, weekly, etc.) which was specified by the user. The program then performs a ratio analysis of the frequency per work count. Lastly, the mean, standard deviation, and coefficient of variation are computed for the per accomplishment times, the converted frequency, the converted work count, and the computed ratios of frequency to work count. While this menu might be useful if the lead SACMET had 1-10 tasks that defied normal analysis, it is so slow and limited in scope that it is seldom, if ever, used. The primary drawback is that the menu will only handle 1 task at a time. This would cause an inordinate amount of machine time and man-hours for a large study with 200 or more tasks to analyze. For these reasons, no output is shown for this menu.

Processing Menu 18. This menu produces a category level man-
hour percentage comparison for all locations and all categories of
work in the study files. The user must have loaded the master
man-hour file, the location names file, and the category/task titles
random file prior to running this menu. Table 24 shows the
various questions the user is required to answer. Table 25
then shows a sample output produced by the program.

```
ENTER PROCESSING MENU OPTION NUMBER DESIRED.  (HIT '?' AND 'RETURN' TO GET MENU.)
?18

ENTER MAN-HOUR AVAILABILITY FACTOR.
?145.2


ENTER LOCATION NUMBER SPECIFICATIONS.  (? FOR HELP)
??


LOCATION NUMBER SEPCIFICATIONS ARE 'RANGES' AND/OR INDIVIDUAL LOCATION NUMBERS,
SEPARATED BY COMMAS.  A 'RANGE' IS TWO LOCATION NUMBERS SEPARATED BY A DASH,
AND MEANS ALL LOCATIONS FROM THE FIRST LOCATION NUMBER GIVEN TO THE LAST
LOCATION NUMBER GIVEN.  DELETIONS FROM A GIVEN RANGE ARE INDICATED BY REPEATING
SOME OF THE NUMBERS AS EITHER SPECIFIC LOCATIONS OR AS AN INCLUDED RANGE.  TO
HANDLE VERY LONG INPUTS, THE SYSTEM WILL REQUEST AN ADDITIONAL LINE OF INPUT
IF ANY LINE ENDS WITH A COMMA.
      EXAMPLES:-
           2,4-7,9  MEANS  2,4,5,6,7,9
           4-9,6,11  MEANS  4,5,7,8,9,11
           4-12,7-9  MEANS  4,5,6,10,11,12
           1,4-12,7-9,  MEANS  1,4,5,6,10,11,12  AND READ AN ADDITIONAL LINE

ENTER LOCATION NUMBER SPECIFICATIONS.  (? FOR HELP)
?1-8


YOU HAVE INDICATED THE FOLLOWING   8 LOCATIONS:
     1    2    3    4    5    6    7    8
IS THIS CORRECT?  ENTER YES OR NO.
?Y


 PAUSE LOAD PAPER, HIT RETURN
??
```

Table 24.   Main Menu 3, Processing Menu 18 –
Questions and Answers

39

The only real option the user has with this menu is the locations included in the analysis. Take time to review the explanation provided by the program on how to specify the location numbers. The explanation is self-explanatory. Notice also that even after the location numbers have been specified, the program will check to make sure those are the locations actually desired by the user. Due to the length of the output produced by this menu, it is shown in two tables--Table 25 and Table 26.

*****

40

①

05 OCT84 14.49? EST

TOTAL MONTHLY ALLOWED MAN-HOURS
PMARS TO TOTAL PRODUCTIVE MAN-HOURS
PMARS TO DIRECT OR INDIRECT MAN-HOURS

②   ③

CATEGORY	BARKSDAL 1	CARSWELL 2	CASTLE 3	ELLSWORT 4	FAIRCHIL 5	GRAND FO 6	GRIFFISS 7	MINOT 8	MEAN	STD DEV
#1. B-52 AIR	4031.53	4255.93	5440.78	3183.69	1943.63	1977.06	2100.86	2308.43		
	0.7443	0.6821	0.7425	0.6795	0.6331	0.7446	0.6293	0.6683	0.6905	0.0482
	0.8832	0.8808	0.8701	0.7968	0.8525	0.8629	0.8153	0.8760	0.8547	0.0320
#2. SUPERVI	278.00	195.96	341.00	309.00	47.74	121.00	229.00	138.00		
	0.0513	0.0314	0.0465	0.0660	0.0156	0.0456	0.0686	0.0400	0.0456	0.0174
	0.0609	0.0406	0.0545	0.0773	0.0209	0.0528	0.0889	0.0524	0.0560	0.0209
3. ALTERNA	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00		
	0.0015	0.0013	0.0011	0.0017	0.0026	0.0030	0.0024	0.0023	0.0020	0.0007
	0.0018	0.0017	0.0013	0.0020	0.0035	0.0035	0.0031	0.0030	0.0025	0.0009
4. FUNCTIO	48.00	102.00	232.00	180.00	133.00	21.00	60.00	13.50		
	0.0089	0.0163	0.0317	0.0384	0.0433	0.0079	0.0180	0.0039	0.0210	0.0149
	0.0105	0.0211	0.0371	0.0451	0.0583	0.0092	0.0233	0.0051	0.0262	0.0190
#11. SUPERV	199.38	270.26	231.57	314.73	147.62	164.20	179.00	167.28		
	0.0368	0.0433	0.0316	0.0672	0.0481	0.0618	0.0536	0.0484	0.0489	0.0120
	0.0437	0.0559	0.0370	0.0788	0.0647	0.0717	0.0695	0.0635	0.0606	0.0142
TOTAL DIRECT	4564.91	4832.15	6253.35	3995.42	2279.99	2291.26	2576.85	2635.21		
	0.8428	0.7745	0.8533	0.8528	0.7427	0.8629	0.7718	0.7629	0.8080	0.0493
	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000		
#11.1. ADMI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
#12. ADMINI	60.81	79.90	76.59	30.36	77.75	12.07	52.57	67.86		
	0.0112	0.0128	0.0105	0.0065	0.0253	0.0045	0.0157	0.0196	0.0133	0.0068
	0.0714	0.0568	0.0713	0.0440	0.0984	0.0332	0.0690	0.0829	0.0659	0.0209

Table 25.   Category Man-hour Ratio Analysis
            Output - PART I

41

The numbered comments below relate to the numbered items on table 25:

1. It's important to note at the outset that this analysis is conducted at the category level only; therefore, this analysis can't be used as the sole basis for making any data refinements or adjustments. In fact, no one analysis tool should ever be used by itself to make a change in measured man-hours, but that's a subject to be discussed in more detail in Chapter Two.

2. To ensure everyone understands what the output indicates, take a look at Barksdale's Category 1 numbers. The first number indicates that Barksdale reported 4031.53 man-hours per month for Category 1. The second number indicates that the 4031.53 man-hours is 74.43 per cent of the Total Productive Man-hours (shown on Table 26 as 5416.40 man-hours) reported by Barksdale. The third number indicates that 4031.53 man-hours is 88.32 per cent of the total direct man-hours (4564.91) reported by Barksdale.

3. In addition, the menu computes a mean and standard deviation for each percentage or "PBAR." These statistics can help the user identify any extreme values for further analysis at the task level, and give the MEO a general feel for how good or bad the data might be.

*****

REMEMBER: WHO, WHAT, WHEN, WHERE, HOW, AND WHY!!

① *13. MEETIN	45.44	54.88	36.96	45.18	28.34	10.23	26.66	51.48		
②	0.0084	0.0088	0.0050	0.0096	0.0092	0.0039	0.0080	0.0149	0.0085	0.0033
	0.0534	0.0390	0.0344	0.0655	0.0359	0.0281	0.0350	0.0629	0.0443	0.0142
*14. TRAINI	122.50	455.20	270.59	319.07	216.70	127.14	69.08	155.23		
	0.0226	0.0730	0.0369	0.0681	0.0706	0.0479	0.0207	0.0449	0.0481	0.0209
	0.1439	0.3235	0.2518	0.4625	0.2743	0.3493	0.0907	0.1895	0.2607	0.1198
*15. SUPPLY	397.85	158.68	330.55	89.92	158.07	134.02	198.73	254.51		
	0.0735	0.0254	0.0451	0.0192	0.0515	0.0505	0.0595	0.0737	0.0498	0.0199
	0.4672	0.1120	0.3076	0.1303	0.2001	0.3682	0.2609	0.3107	0.2697	0.1200
*16. EQUIPM	84.51	143.52	13.19	58.72	102.71	49.60	157.22	143.07		
	0.0156	0.0230	0.0018	0.0125	0.0335	0.0187	0.0471	0.0414	0.0242	0.0154
	0.0992	0.1020	0.0123	0.0851	0.1300	0.1363	0.2064	0.1747	0.1182	0.0590
*17. CLEANU	140.38	515.06	346.85	146.62	206.33	30.89	257.49	146.93		
	0.0259	0.0825	0.0473	0.0313	0.0672	0.0116	0.0771	0.0425	0.0482	0.0254
	0.1649	0.3660	0.3227	0.2125	0.2612	0.0849	0.3380	0.1794	0.2412	0.0978
TOT INDIRECT	851.49	1407.24	1074.73	689.86	789.90	363.96	761.74	819.08		
	0.1572	0.2255	0.1467	0.1472	0.2573	0.1371	0.2282	0.2371	0.1920	0.0493
	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000		
TOTAL PROD	5416.40	6239.38	7328.08	4685.28	3069.88	2655.22	3338.60	3454.29		
	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000		
STANDBY MHRS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
TOTAL ALLOW	5416.40	6239.38	7328.08	4685.28	3069.88	2655.22	3338.60	3454.29		
MANPOWER REQ	37.303	42.971	50.469	32.268	21.142	18.287	22.993	23.790		

OTHER INFORMATION

WS ADJ MHRS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
OA MAN-HOURS	5416.40	6239.38	7328.08	4685.28	3069.88	2655.22	3338.60	3454.29		
MIN MAN-HOUR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
DAYS SAMPLED	0	0	0	0	0	0	0	0		
AVAILABILITY	145.2	145.2	145.2	145.2	145.2	145.2	145.2	145.2		

Table 26.   Category Man-hour Ratio Analysis
Output--PART II

The numbered comments below refer to the numbered items in
Table 26:

1.   To clear up any confusion, this table shows the last
half of the output from Processing Menu 18.   The first half of the
output was shown in Table 25.

43

2.   The same computations are performed for the indirect categories as was done for the direct categories with one exception.   The third number indicates the percent of indirect categoty man-hours to Total Indirect Man-hours.   For instance, using the first column (Barksdale) again, the 84.51 man-hours in indirect category I6 represents 1.56 percent of Total Productive Man-hours (5416.40), but 9.92 percent of Total Indirect Man-hours (851.49).

Processing Menu 19.   This option allows the user to create and load a man-hour C&R file.   The user is constrained to using a maximum of 200 locations and 9 variables.   The user must have loaded the master man-hours file prior to using this menu. SACMETs seldom use this menu.   The program was written for a "dumb terminal" and is too slow and cumbersome to warrant further discussion.

Processing Menu 20.   This menu could be used to change or print the C&R data files created with Processing Menu 19.   This menu suffers from the same shortcomings as menu 19.   No further discussion is warranted.

Processing Menu 21.   This menu allows the user to compute work unit time standards or perform ratio analysis of man-hours to work counts.   Unfortunately this menu can only accommodate analysis at the category level.   Obviously, this isn't good enough to satisfy the quality and accuracy requirements for a SAC manpower standard. However, there are other programs available to help the MEO accomplish this most important task.   More details will be provided later in this chapter.   Right now, take a look at the options for this menu in Table 27.   They can still be used to perform some preliminary analysis if the MEO is so inclined.

*****

AXIOMS FOR SUCCESS IN SAC MANPOWER

When your boss picks up speed, it
doesn't mean he is over the hill.

Manpower officers should always dis-
tribute dissatisfaction uniformly.

Critize behavior, not people.

Somewhere, right now, there is
a committee deciding your future;
only you weren't invited.

- Colonel John W. Elftmann, Jr.

```
ENTER PROCESSING MENU OPTION NUMBER DESIRED.   (HIT '?' AND 'RETURN' TO GET MENU.)
?21




SELECT OPERATION(S) TO BE PERFORMED
    1  GENERATE WORK UNIT TIME STANDARD
    2  GENERATE C&R DATA FILE
    3  DO BOTH 1 AND 2
    4  RETURN TO PREVIOUS MENU
?1


SELECT SOURCE FOR INPUT DATA
    1  MASTER MANHOUR FILE
    2  OA INPUT FILE
    3  C&R DATA FILE
    4  USER INPUT
?1
```

Table 27.   Main Menu 3, Processing Menu 21
Options

Option 1 is used to generate work unit time standards (WUTS)
based on the number of man-hours measured divided by the number of
work units produced. Any work count in the master work count file
or the C&R data file can be chosen by the user. The best way is
to create the C&R data file first using option 2 or 3.

Option 2 allows the user to generate a C&R data file if one
has't already been created and loaded using IPSTIPS 15.

Option 3, however, does both options 1 and 2 at the same time.

Once the user has selected the option to be run, the source
for input data must be selected. In most cases it is best to use
the master man-hour file as the source. While the operational
audit input file can be used, this requires the user to input each
line number contained within a category. Using the master man-
hour file, the user only has to enter the beginning and ending
line numbers. Of course, if a C&R data file has not been created
and loaded outside this menu, Option 3 can't be used. Selecting
user input as the source for input data (Option 4) would require a
significant amount of machine time since this is an interactive
"on-line" process. The bottom line is to use the master man-hour
file (source 1) if at all possible.

Once the menu option and source for input data have been selected, the user is required to respond to several questions which are depicted in Table 28 on the following page.

*****
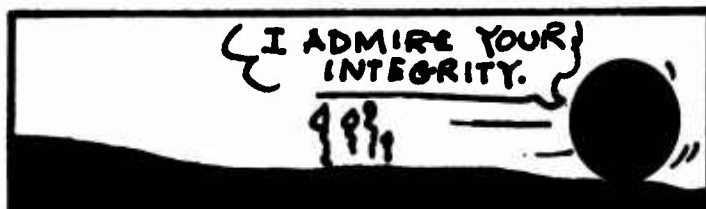
The most effective USAF leaders (and communicators)
literally force their staffs to disagree with them.
Only by personally prodding for the reasons something
won't work, can decisionmakers obtain an honest and
balanced view from the grinning and bowing blue legions.
Not surprisingly, we have damn few effective leaders.

- H. A. Staley, Lt Col, USAF

```
HOW MANY CATEGORY NUMBERS DO YOU WANT SUMMED FOR MAN-HOURS?
?4    (1)

WHICH CATEGORY NUMBERS?  ENTER SEPARATED BY COMMAS.
?1,2,3,4   (1)

ENTER NUMBER OF WORK COUNTS DESIRED.
?1
      (2)
WHICH WORK COUNT(S)?  ENTER SEPARATED BY COMMAS.
?2   (2)


ENTER LOCATION NUMBER SPECIFICATIONS.   (? FOR HELP)
?1-4,6-8   (3)


YOU HAVE INDICATED THE FOLLOWING   7 LOCATIONS:
     1    2    3    4    6    7    8
IS THIS CORRECT?  ENTER YES OR NO.     (3)
?Y

DO YOU WANT A PRINTOUT?  ENTER YES OR NO.
?Y   (4)



            (5)              1        2
     1 BARKSDALE         4365.53   830.95
     2 CARSWELL          4561.89     0.00
     3 CASTLE            6021.78  1242.22
     4 ELLSWORTH         3680.69   729.06
     5 GRAND FORKS       2127.06   436.97
     6 GRIFFISS          2397.86   447.17
     7 MINOT             2467.93   475.08

DO YOU WANT TO MAKE A CHANGE?  ENTER YES OR NO.
?N   (6)

ENTER THE NUMBER OF STANDARD DEVIATIONS FOR THIS RATIO ANALYSIS,
UPPER AND LOWER CONTROL LIMITS. EX 1.5          (7)
?2
```

Table 28.   Main Menu 3, Processing Menu 21 —
             Questions and Answers

The following numbered comments refer to the numbered items in Table 28:

   1. The program asks how many categories are to be added together to obtain the man-hours to be used in computing the WUTS. Then the program asks for the actual number of the categories to be used. In this case, the user picked the four direct categories.

   2. Here the program asks how many work counts are to be used and which work count the user has selected.

   3. The user then enters the number of each location. In this case, it's "1-4, 6-8." The computer then displays the base location numbers that have been selected. This give's the user one last chance to change the numbers, if necessary.

   4. The program then asks if the user wants a print-out of the data selected. Once again, just as any intelligent MEO would do, the user responded with a yes.

   5. This is the print-out of locations, total man-hours for Categories 1,2,3 and 4, and the monthly average values for the number 2 work count at each location.

   6. The program then gives the user an opportunity to change any of the data selected.

   7. Lastly, the program asks for the number of standard deviations to use in computing an UCL and LCL. The user can use any number, but anything less than 1.00 or greater than 3.00 won't provide a very useful analysis. The author recommends 1.5 be used during this type of category-level analysis. This makes the initial analysis run a little bit more discerning in the identification of "possible" extreme values. It also guards against the control limits being too wide in case an extremely large value has affected the mean and standard deviation computations.

After establishing the selection criteria, the program produces an output like the one in Table 29.

*****

People who believe that the dead never come back to life should visit this place at quitting time.

- an anonymous MAJCOM staffer

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```
                    ELECTRONIC COUNTERMEASURES


ITEMS SUMMED FOR MAN-HOURS ARE:
  1  *1. B-52 AIRCRAFT MAINTENANCE:
  2  *2. SUPERVISOR FOLLOW-UP INSPECTION:
  3   3. ALTERNATE MISSION EQUIPMENT (AME).
  4   4. FUNCTIONAL CHECK.
WORK COUNT USED IS  2  A FLYING HOUR FLOWN
        LOCATIONS    MAN-HOURS   WORK COUNT   WU TIME STD   DIFF(+/- 2.00 STDDEV)


  1 BARKSDALE      4365.53      830.95       5.254
  2 CARSWELL                                 **
  3 CASTLE         6021.78     1242.22       4.848
  4 ELLSWORTH      3680.69      729.06       5.049
  5 GRAND FORKS    2127.06      436.97       4.868
  6 GRIFFISS       2397.86      447.17       5.362
  7 MINOT          2467.93      475.08       5.195



MEANS=             3510.14      693.57       5.09579


            WUTS STANDARD DEVIATION=         0.21052


            COEFFICIENT OF VARIATION=        0.04131


** X AND/OR Y < _ 0
POINT NOT USED DURING COMPUTATIONS AND WILL NOT APPEAR ON CHART.
```

Table 29.   Work Unit Time Standard Output

Note the Carswell output at line 2.   The print-out in Table 28
shows that Carswell didn't have any work count for the work unit
selected.   The double asterisk note at the bottom of Table 29
explains why no WUTS was computed for Carswell--because the "X"
value was equal to zero.

Once the WUTS computations are complete the program asks if
the user wants a chart of each location's WUTS printed.   Table 30
shows a sample of the chart provided.

```
DO YOU WANT THE CHART PRINTED?  ENTER YES OR NO.
?Y


                              WORK UNIT TIME STANDARD



            ----------------------------
    5.685 -:                          :
    5.643 -:                          :
    5.601 -:                          :
    5.559 -:                          :
    5.517 -:------------------------- :  ①
    5.475 -:                          :
    5.433 -:                          :
    5.391 -:                          :
    5.348 -:             X            :
    5.306 -:                          :
    5.264 -: X                        :
    5.222 -:                          :
    5.180 -:                 X        :
    5.138 -:                          :
    5.096 -:+++++++++++++++++++++++++:  ②
    5.054 -:         X                :
    5.012 -:                          :
    4.969 -:                          :
    4.927 -:            .             :
    4.885 -:             X            :
    4.843 -:          X               :
    4.801 -:                          :
    4.759 -:                          :
    4.717 -:                          :
    4.675 -:------------------------- :  ③
    4.633 -:                          :
    4.591 -:                          :
    4.548 -:                          :
    4.506 -:      0                   :
            +++++++++++++++++++++++++
            1   3   5   7   9        ④   ⑤
              2   4   6   8  10
    ----
```
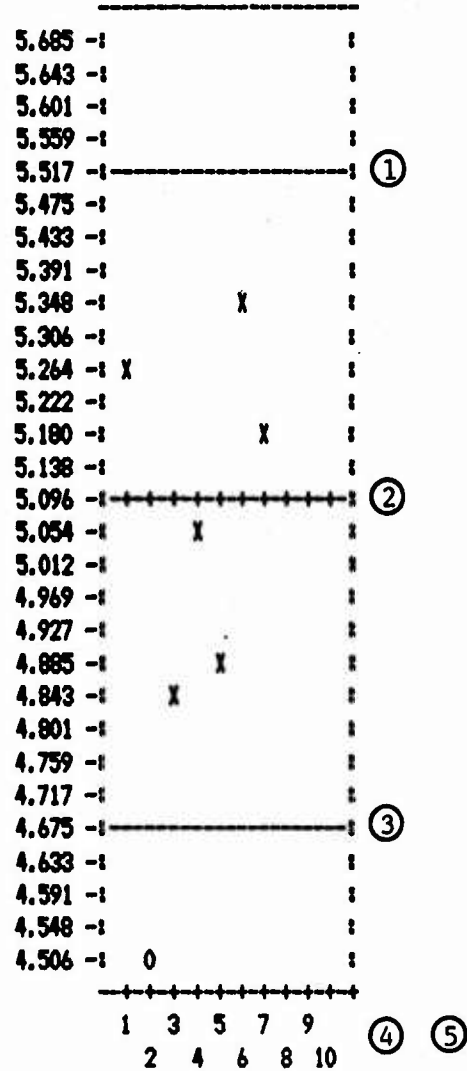
Table 30.   Work Unit Time Standard Chart

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The following numbered comments relate to the numbered items in Table 30:

1. The top line at 5.517 represents the upper control limit (mean plus two standard deviations).

2. This line represents the mean (5.096).

3. This line represents the lower control limit (4.675).

4. This line keeps track of the line number of each location. Notice that the point (X) on the chart above the number 1 on the bottom line is opposite the WUTS value 5.264. This corresponds to the output in Table 29 where location number 1 (Barksdale) has a WUTS of 5.254. Notice also that location number 2 (Carswell) is "0" on both tables.

5. Notice also that the chart is symmetrical; therefore, it isn't a box chart. This chart is just a simple scattergram.

Processing Menu 22. This menu computes workload breakpoints for all values of Y (manpower) within a given man-hour range. Table 31 shows the questions the user must respond to and Table 32 shows a sample of the output.

```
ENTER PROCESSING MENU OPTION NUMBER DESIRED.   (HIT '?' AND 'RETURN' TO GET MENU.)
?22

ENTER UP TO 50 CHARACTERS OF IDENTIFYING INFORMATION TO BE USED AS A REPORT HEADER.
?ELEC. COUNTER MEAS

ENTER TYPE MODEL: 1=LINEAR; 2=POWER; 3=RATIO; 4=PARABOLA;  5=DONE
?1

ENTER VALUES FOR A AND B
?738.34,5.39397

ENTER MAN-HOUR LIMITS - LOWER,UPPER
?1787.5,8722.3

ENTER TYPE OF STANDARD "MIL" OR "CIV"
?MIL

ENTER MAN-HOUR AVAILABILITY FACTOR(MHAF)
?145.2
```

Table 31.   Main Menu 3, Processing Menu 22—
Questions and Answers

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As can be seen from the table, most of the user responses are obtained from the bivariate (Processing Menu 15) regression analysis output, a sample of which is shown in Table 16. Also note that the program will perform computations for either a "MIL" (military) or a "CIV" (civilian) standard. The biggest problem with this program is that it can't do a manpower table for a multivariate equation.

MANPOWER TABLE
ELEC. COUNTER MEAS

TYPE STANDARD: MILITARY
TYPE EQUATION: LINEAR

VALUES USED FOR THIS TABLE
      A= 730.34000000
      B= 5.39397000
      C= 0.00000000
      MMF= 145.2

WORKLOAD BRKPT	MAN-POWER	WORKLOAD BRKPT	MAN-POWER	WORKLOAD BRKPT	MAN-POWER	WORKLOAD BRKPT	MAN-POWER	WORKLOAD BRKPT	MAN-POWER	WORKLOAD BRKPT	MAN-POWER
102.027											
211.018	12	455.307	21	697.578	30	939.049	39	1182.119	48	1424.390	57
239.956	13	482.226	22	724.497	31	966.767	40	1209.038	49	1451.309	58
266.875	14	509.145	23	751.416	32	993.686	41	1235.957	50	1478.228	59
293.794	15	536.064	24	778.335	33	1020.605	42	1262.876	51	1505.146	60
320.713	16	562.983	25	805.254	34	1047.524	43	1289.795	52		
347.632	17	589.902	26	832.173	35	1074.443	44	1316.714	53		
374.551	18	616.821	27	859.092	36	1101.362	45	1343.633	54		
401.470	19	643.740	28	886.011	37	1128.281	46	1370.552	55		
428.389	20	670.659	29	912.930	38	1155.200	47	1397.471	56		

Table 32.   Manpower Table

There are two other menus in Main Menu 3. One is Finish Menu 23 which allows the user to return to the Main Menu level. The other is Finish Menu 24 which allows the user to terminate execution of the program. The only input required is the number of the menu.

Other Main Menus

Having just finished with Main Menu 3, that leaves 2 menus that haven't been discussed. Main Menu 4, Enter New Study ID, is

used by XPMET to establish new files and can't be executed by
SACMETs. Therefore, it won't be discussed any further. Main Menu
5 allows the user to terminate execution of the program and
requires no further explanation.

AFMEA UTILITY SUBSYSTEM

As promised, the remainder of this chapter will be devoted to
a discussion of the AFMEA utility subsystem. This software was
developed by the AFMEA Data Systems Branch (AFMEA/MEXD). In
actuality, more and more options are being developed as time
permits. That's why no user's manual has been published yet;
however, if everything goes all right, a user's guide should be
published sometime in 1985. The lack of a guide really doesn't
create a problem for the user in most instances. The software was
developed with the user in mind. It leads the user through the
various steps of the program and doesn't require a computer
scientist to operate it. Most importantly, however, the Utility
Subsystem takes those functions that the Manpower Standards
Development System (MSDS) does poorly or not at all and improves
on them or gives the MEO that previously missing capability.

While the Utility Subsystem offers the user 10 options, only
options 3 and 5-10 will be discussed in detail. Option 1 is
titled, "Random Number Generator," and gives the user the ability
to generate random numbers, especially for work sampling studies.
The user can generate random observation times for 24 hours a day
and a maximum of 30 days. The times can be stratified or purely
random. Due to the straightforward approach of this option, no
further discussion is necessary. Option 2 is titled, "MSDS
LOCNAMES file Work," and allows the user to insert or delete
locations anywhere within the MSDS LOCNAMES file. It also has a
routine to display a ranking of locations according to a given
workload factor. While the lead SACMET may find this option
useful at times, overall usage of this option is not considered to
be frequent enough to warrant further discussion. The last option
that will not be discussed in detail is Option 4, entitled,
"Create/Initialize MSDS OA Files." This option allows the user to
build a new operational audit (OA) file or to resequence an
existing file. Since this is done by XPMET and doesn't require
any SACMET input, no further discussion is warranted.

Utility Subsystem Options

Table 33 shows the other 7 options that will be discussed in
this section. The same basic format which was used to present the
MSDS products will be followed here.

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```
OPTIONS ARE:
    1 = RANDOM NUMBER GENERATOR          2 = MSDS LOCNAMES FILE WORK
    3 = MSDS WRKLDFAC FILE WORK          4 = CREATE/INITIALIZE MSDS OA FILES
    5 = AF FORM 1040 FORMAT DESK AUDIT   6 = COMPUTE EXTRAP & MPWR TBL LIMITS
    7 = COMPUTE MANHRS-COMPARE EQUATIONS 8 = OPERATIONAL AUDIT TASK ANALYSIS
    9 = ADP MANAGEMENT TASKS             10 = MSDS WORK SAMPLING
   20 = DONE
```

Table 33.   AFMEA Utility Subsystem Options

Please note that the various programs or routines offered by
the Utility Subsystem are called options. Once the user has
selected an option, the user will be asked to choose various
alternatives within that option which are also referred to as
options. For sake of clarity, the options depicted in Table 33
will be called "Utility Options" and the alternatives within a
"Utility Option" will be called simply an "option."

Utility Option 3

This utility option allows the user to access the MSDS master
work count file (WRKLDFAC), which was created using Processing
Menu 14, and facilitates the manual loading, printing, and zeroing
of data. It is of little use to an input SACMET. Table 34 on the
following page shows the various options available to the user.
Note that the study identification in this example is "TRAIN."
This is a training file developed by XPMET for the MEO to use in
training technicians.

*****

YOU KNOW IT'S GOING TO BE A BAD DAY WHEN:

    You see a 60 Minutes new team waiting in your office!

        You turn on the news and they're showing
            emergency routes out of the city!!

        Your wife wakes up feeling amorous
            and you have a headache!!!

                                            - anonymous

```
3

THIS ROUTINE ACCESSES YOUR MSDS STUDY 'WRKLDFAC' FILE
(WORKCOUNT AVERAGES) AND FACILITATES THE MANUAL LOADING,
PRINTING, AND ZEROING OF DATA.
ENTER STUDY ID:
=TRAIN


OPTIONS ARE:
    (I)NITIALIZE (FILL WITH ZEROS)
    (C)HANGE
    (P)RINT
    (L)OAD
    (D)ONE
```

Table 34.   Utility Option 3 - Options

Option (I)nitialize allows the user to zero out any work
counts that may have already been loaded into the WRKLDFAC file.

Option (C)hange allows the user to change work count values
for any location.

Option (P)rint allows the user to print the work count
value(s) for any location.

Option (L)oad allows the user to load new work count values to
the WRKLDFAC file.   This option is used most by the functional
management engineering teams.

Option (D)one allows the user to return to the Utility Option
level.

Table 35 shows a sample output provided by Option (P)rint and
Option (C)hange.

*****

PLAN! PLAN! PLAN! . . . . . LOGIC! LOGIC! LOGIC!

- XPMET Good Guys

```
ENTER OPTION:                          ENTER OPTION:
=P                                     =C

ENTER COUNT NUMBERS                    ENTER BASE NUMBER TO CHANGE, 0= DONE
=2,3                                   =2

ENTER FIRST AND LAST BASE NUMBER TO PRINT   BASE B
=1,4
                                       ENTER COUNT NUMBER TO CHANGE, 0= DONE
 PAUSE ROLL TO A NEW PAGE              =3
??
                                       COUNT IS    10.833
WLF NUMBERS                            ENTER CHANGE
      2        3                       =10.38

   1 BASE A                            ENTER COUNT NUMBER TO CHANGE, 0= DONE
     13.83    12.83                    =0

   2 BASE B                            ENTER BASE NUMBER TO CHANGE, 0= DONE
     22.83    10.83                    =0

   3 BASE C
     10.33     8.50

   4 BASE D
      8.08    11.33


TOTALS
     55.08    43.50
```

Table 35.   Utility Option 3, Options (P)rint
and (C)hange Output

Upon viewing the output product, one can readily see how much
more user-friendly the Utility Subsystem programs are compared to
the MSDS interrogatives and required user responses. In fact, the
process of printing and performing a change is made so simple and
straightforward, no explanation of the output or user responses is
required. In fairness, however, one must remember that the
WRKLDFAC file must already have been created and loaded to be able
to use this option.

Utility Option 5.

This utility option allows the user to produce a desk-audit
product of operational audit input data in three different formats

or to produce a formal AF Form 1040, Operational Audit Data.
Table 36 shows the options available to the user. In actual
practice, this utility option is of little use to an input SACMET.

```
ENTER UTILITY OPTION OR 'UMC=USERID':
  <PRESS RETURN TO LIST OPTIONS>
=5

  ## THIS ROUTINE PRODUCES A DESK-AUDIT PRODUCT OF OA-INPUT
  DATA IN THREE DIFFERENT FORMATS OR A FORMAL AF FORM 1040.  THE
  OUTPUT MAY BE DIRECTED TO THE TERMINAL OR TO A TEMPORARY FILE. ##


  ENTER OUTPUT DESTINATION- (T)ERMINAL OR (F)ILE:
=T  ①

  ENTER STUDY ID, AND WORKCENTER ID:
=ECMBAR,ECM2413

  DO YOU WANT ALL BASES RUN (LEAD TEAM ONLY)?
=Y  ②

ENTER OPTION:
1 = ALL COLUMNS          ③
2 = LINE#S & TOTALS         ④
3 = CATEGORY TOTALS      ⑤
4 = AF FORM 1040            ⑥
=2

  ENTER MAF
=145.2  ⑦
```

Table 36. Utility Option 5 - Options

     The numbered comments below refer to the numbered items in
Table 36:

     1. The user can direct the output to go to the terminal
and be printed out or to go to a temporary file. If a temporary
file is used, the user will eventually have to name it and make it
a permanent file or abandon it before leaving the system. Again,
for documentation purposes, the user should direct the output to
the terminal so a print-out can be obtained.

     2. Notice that the lead SACMET (or XPMET) is the only
user that can request a run for all bases.

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3.   Option 1 allows the user to request a print out of all columns of data off of the operational audit input file for one base or all bases at once. A sample of the output is shown in Table 37.

4.   Option 2 allows the user to request a print-out of the man-hour totals for each line number and category and the direct, indirect, and standard man-hour totals as well. A sample of the output is shown in Table 38.

5.   Option 3 allows the user to request a print-out of just the category man-hour totals for each base. A sample of the output is shown in Table 39.

6.   Option 4 allows the user to obtain a print-out of a formal AF Form 1040 for each base. A sample of the form is shown in Table 40.

7.   The man-hour availability factor (MAF) value is used to compute measured manpower which appears at the end of each run.

*****

THE CONVENTIONAL TRIAD

:MSDS :LINE#	:NPER	ACTIVITY FREQUENCY B	:FREQ :CODE C	CONV FACTOR D	PER ACCOMP E	:PER MONTH: :(F=BXDXE): F	TOTAL G
:03040 :	:	6.00/MO :	7 :	1.0000 :	0.64	: 3.84 :	
:03050 :	:	7.00/MO :	7 :	1.0000 :	0.64	: 4.48 :	
:03060 :	:	20.00/MO :	7 :	1.0000 :	3.44	: 68.80 :	
:03070 :	:	23.00/MO :	7 :	1.0000 :	3.44	: 79.12 :	
:03080 :	:	16.00/MO :	7 :	1.0000 :	3.44	: 55.04 :	
:03090 :	:	21.00/MO :	7 :	1.0000 :	2.58	: 54.18 :	
:03100 :	:	3.00/MO :	7 :	1.0000 :	1.86	: 5.58 :	
:03110 :	:	4.00/YR :	9 :	0.0833 :	3.72	: 1.24 :	
:03120 :	:	4.00/MO :	7 :	1.0000 :	4.35	: 17.40 :	
:03130 :	:	6.00/MO :	7 :	1.0000 :	4.35	: 26.10 :	
:03150 :	:	12.00/MO :	7 :	1.0000 :	1.86	: 22.32 :	
:03160 :	:	14.00/MO :	7 :	1.0000 :	3.44	: 48.16 :	
:03170 :	:	2.00/MO :	7 :	1.0000 :	4.35	: 8.70 :	
:03190 :	:	2.00/MO :	7 :	1.0000 :	1.86	: 3.72 :	
:03200 :	:	2.00/MO :	7 :	1.0000 :	3.44	: 6.88 :	
:03210 :	:	2.00/MO :	7 :	1.0000 :	1.86	: 3.72 :	

Table 37.   Utility Option 5, Option 1 Output –
            All Columns

Again, notice that the format and display of data are clean
and simple. One other note of interest is that the program won't
print lines without measurement data. The output in Table 37
shows that line numbers 301-303, 314, and 318 were omitted. These
were category or task title lines that didn't contain measurement
data.

*****

"HEY ROLLO, YOU MAKE YOUR INPUT TO SACMET YET?"

```
LOCATION  BARKSDALE      WORKCENTER:  ECM2413    05 OCT 84    14.93


   JOB #     TOTAL


  03040       3.84
  03050       4.48
  03060      68.80
  03070      79.12
  03080      55.04
  03090      54.18
  03100       5.58
  03110       1.24
  03120      17.40
```

Table 38.   Utility Option 5, Option 2 Output -
            Line Numbers and Totals

*****
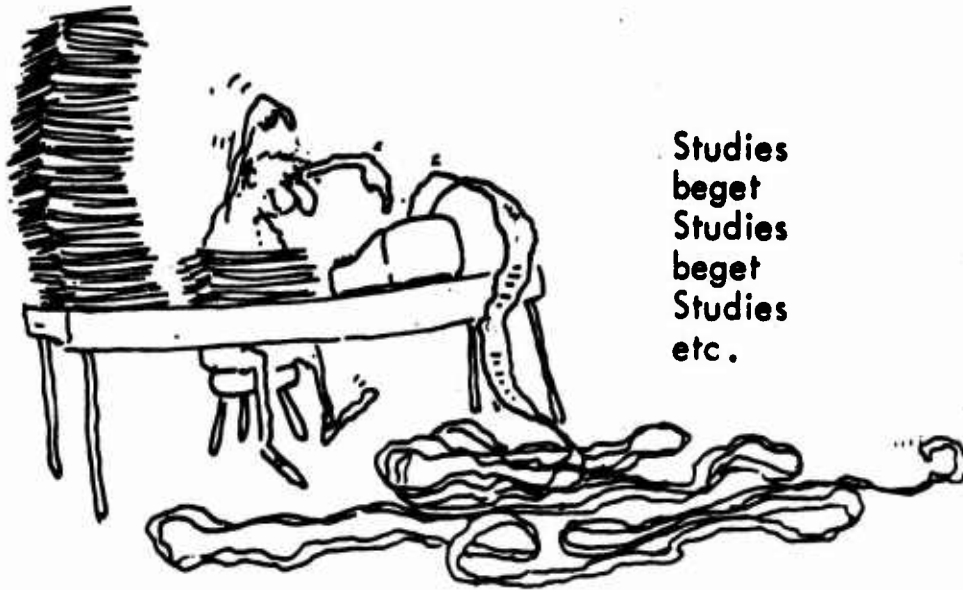
Studies
beget
Studies
beget
Studies
etc.

```
LOCATION: BARKSDALE        WORKCENTER: ECM2413      05 OCT 84     15.07


                           CATEGORY  1  TOTAL :  4031.53 :


                           CATEGORY  2  TOTAL :   278.00 :


                           CATEGORY  3  TOTAL :     8.00 :


                           CATEGORY  4  TOTAL :    48.00 :

                                                 DIRECT MAN-HOUR TOTAL    4365.53


                           CATEGORY  5  TOTAL :   199.38 :


                           CATEGORY  6  TOTAL :    60.81 :


                           CATEGORY  7  TOTAL :    45.44 :


                           CATEGORY  8  TOTAL :   122.50 :


                           CATEGORY  9  TOTAL :   397.85 :


                           CATEGORY 10  TOTAL :    84.51 :


                           CATEGORY 11  TOTAL :   140.38 :

                                                 INDIRECT MAN-HOUR TOTAL   1050.87

                                                 TOTAL MAN-HOURS   5416.40
                                                 TOTAL MANPOWER     37.303
```

Table 39.   Utility Option 5, Option 3 Output –
            Category Totals

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:1. WORK CENTER TITLE/CODE	:2. COMMAND/INSTALLATION	:3. DATE
ELECTRONIC COUNTERMEASURE/241300	UNK / BARKSDALE	05 OCT 84

:4. FREQUENCY CODES: 1=D1 2=D2 3=D3 4=D4 5=D5 6=WK 7=MO 8=QT 9=YR

:5.	FREQUENCY			ALLOWED MAN-HOURS		
ACTIVITY TITLE A	ACTIVITY FREQUENCY B	FREQ: CODE: C	CONV FACTOR D	PER ACCOMP E	PER MONTH: (F=BXDXE): F	TOTAL G
DIRECT						
#1. B-52 AIRCRAFT MAINTENANCE:						
#1.1. PERFORMS FLIGHTLINE MAINTE						
#1.1.1. PERFORMS MAINT ON AN/ALQ						
1.1.1.1. MAINT CONT EMO CONSOLE, C-8871	6.00/MO	7	1.0000	0.64	3.84	
1.1.1.2. MAINT CONTROL, C-8872.	7.00/MO	7	1.0000	0.64	4.48	
1.1.1.3. MAINT RECEIVER, R-1758.	20.00/MO	7	1.0000	3.44	68.80	
1.1.1.4. MAINT TRANSMITTER, T-1205.	23.00/MO	7	1.0000	3.44	79.12	
1.1.1.5. MAINT TRANSMITTER, T-1206.	16.00/MO	7	1.0000	3.44	55.04	
1.1.1.6. MAINT SWITCH, ANT SELECTOR.	21.00/MO	7	1.0000	2.58	54.18	
1.1.1.7. MAINT BLANKING MODULE.	3.00/MO	7	1.0000	1.86	5.58	
1.1.1.8. MAINT PRESSURIZATION.	4.00/YR	9	0.0833	3.72	1.24	
1.1.1.9. MAINT ANTENNA.	4.00/MO	7	1.0000	4.35	17.40	
1.1.1.10. MAINT OTHER AN/ALQ-117 SUB-SY	6.00/MO	7	1.0000	4.35	26.10	
#1.1.2. PERFORMS MAINT ON AN/AL						
1.1.2.1. MAINTAINS CONTROL.	12.00/MO	7	1.0000	1.86	22.32	
1.1.2.2. MAINTAINS DISPENSER.	14.00/MO	7	1.0000	3.44	48.16	
1.1.2.3. MAINT OTHER AN/ALE-24 SUB-SYS	2.00/MO	7	1.0000	4.35	8.70	
#1.1.3. PERFORMS MAINT ON AN/AL						
1.1.3.1. MAINTAINS CONTROL.	2.00/MO	7	1.0000	1.86	3.72	
1.1.3.2. MAINTAINS FLARE EJECTOR.	2.00/MO	7	1.0000	3.44	6.88	
1.1.3.3. MAINT OTHER AN/ALE 20 SUB-SYS	2.00/MO	7	1.0000	1.86	3.72	
#1.1.4. PERFORMS MAINT ON AN/AL						
1.1.4.1. MAINTAINS CONTROL.	6.00/MO	7	1.0000	1.86	11.16	
1.1.4.2. MAINTAINS TRANSMITTER.	23.00/MO	7	1.0000	3.72	85.56	
1.1.4.3. MAINTAINS ANTENNA.	1.00/MO	7	1.0000	4.35	4.35	
1.1.4.4. MAINTAINS COAXIAL CABLE.	2.00/MO	7	1.0000	3.72	7.44	
..1.4.5. MAINT OTHER AN/ALT-16A.	1.00/MO	7	1.0000	3.72	3.72	
#1.1.5. PERFORMS MAINT ON AN/AL						

Table 40.   Utility Option 5, Option 4 Output -
AF Form 1040

Utility Option 6.

This utility option enables the user to compute manpower table limits and extrapolation limits in terms of both man-hours and workload. The option will compute these limits for all standard man-hour availability factors currently approved for use in the management engineering program. Table 41 shows a sample of the required user responses.

```
ENTER UTILITY OPTION OR 'UMC=USERID':
  <PRESS RETURN TO LIST OPTIONS>
=6


THIS PROGRAM COMPUTES MANPOWER TABLE LIMITS AND EXTRAPOLATION
 LIMITS INTERNS OF MANHOURS AND WORKLOAD FOR ALL , STANDARD MAFS.
ENTER WORKCENTER NAME-FUNCTIONAL ACCOUNT CODE
=ELECTRONIC COUNTERMEASURES/241300


ENTER EQUATION MODEL#:  1=LINEAR,2=POWER,3=RATIO,4=PARABOLA,5=MULTIVARIATE OR MODULAR
=1


ENTER EQUATION PARAMETERS: A,B,X-LOWER,X-UPPER, C-VALUE OR 0, AND Y-BAR.
=738.3357,5.394,194.514,1480.166,0,4278.25


PAUSE ROLL TO A NEW PAGE
```

Table 41. Utility Option 6 - Questions & Answers

Notice that this utility option gives the user the ability to compute manpower table limits and extrapolation limits for all 4 bivariate regression models and multivariate or modular models as well. This is an improvement over the MSDS Processing Menu 22, Manpower Table, which can only handle bivariate models. As is the case with Processing Menu 22, however, the user must have run the bivariate or multivariate regression analysis programs in MSDS (Processing Menus 15 and 16 respectively) to be able to provide the equation parameters asked for by Utility Option 6.

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```
WORKCENTER:    ELECTRONIC                          ①
                           MANPOWER TABLE RANGE
MAF:       143.5      145.2      145.3      147.2
           ─────      ─────      ─────      ─────

MIN:          5          5          6          6
MAX:         69         68         69         68


MAF:       180.0      180.8      183.1      244.0
           ─────      ─────      ─────      ─────

MIN:          5          4          4          3
MAX:         56         55         54         41




                    EXTRAPOLATION LIMITS
              MANHOURS                   WORKLOAD
      LOWER:        UPPER:        LOWER:         UPPER:
      738.336     10005.826        0.00        1865.86



                                                  ②
                   EXTRAPOLATION COMPUTATIONS



    MAX YC= 8722.351              MAX X=   1480.17
    MIN YC= 1787.544              MIN X=    194.51
    YBAR=   4278.250              RANGE=   1480.17-     194.51
    Y-EXTRAP= .30( 4278.250)      RANGE=   1285.65
    Y-EXTRAP+ 1283.475            X-EXTRAP= .30( 1285.65)
    YU= 8722.351+ 1283.475        X-EXTRAP=    385.70
    YU= 10005.826                 XU=  1480.17+     385.70
    YL= 1787.544- 1283.475        XU=  1865.86
    YL=   504.069                 XL=    194.51-     385.70
                                  XL=      0.00

    YXL=(   194.514-    385.696)(5.3940)+   738.336
    YXU=(  1480.166+    385.696)(5.3940)+   738.336


    YXL=   738.336
    YXU= 10005.826
```

Table 42.   Utility Option 6 — Output

   The numbered comments on the following page relate to the
numbered items in Table 42:

1.   As promised, the minimum and maximum manpower range for each approved man-hour availability factor is presented.

2.   Another nice aspect of this utility option is that the computation of extrapolation limits is performed in accordance with Chapter 34 of AFR 25-5 and satisfies the requirement to show computations according to AFR 25-5, Volume II, paragraph 40-3e(4). Suffice it to say, MSDS doesn't satisfy these requirements at all.

Utility Option 7

This utility option allows the user to make a comparative analysis of up to 3 man-hour equations at one time.   This option is great for determining the manpower impact of competing bivariate and multivariate models based on a like change in the level of workload being performed.   Table 43 shows the required user responses.

*****

```
ENTER UTILITY OPTION OR 'UNC=USERID':
 (PRESS RETURN TO LIST OPTIONS)
=7

THIS PROGRAM SIMULATES MANHOURS OVER A VARIABLE RANGE OF
WORKLOAD AND PROVIDES A COMPARISON OF UP TO THREE EQUATIONS.
HOW MANY EQUATIONS DO YOU HAVE FOR COMPARISON?
=3

ENTER EQUATION TYPE FOR EACH EQUATION:
        1-LINEAR
        2-POWER
        3-RATIO
        4-PARABOLA
        5-MULTIVARIATE OR MODULAR
=1

=3     ①

=4

ENTER PARAMETERS FOR EQUATION #1 (A,B, AND C OR 0):
=738.3357,5.394,0     ②

ENTER PARAMETERS FOR EQUATION #2 (A,B, AND C OR 0):
=.1307,.0000305,0     ②

ENTER PARAMETERS FOR EQUATION #3 (A,B, AND C OR 0):
=17.2238,7.506,-.001304     ②

ENTER THE BEGINING WLF VALUE AND INCREMENT FOR EQUATION #1
=150,50     ③

ENTER THE BEGINING WLF VALUE AND INCREMENT FOR EQUATION #2
=150,50     ③

ENTER THE BEGINING WLF VALUE AND INCREMENT FOR EQUATION #3
=150,50     ③

ENTER MAF
=145.2     ④
```

Table 43.   Utility Option 7 - Questions
             and Answers

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The numbered comments below refer to numbered items in Table
43:

    1.   The user has chosen to compare the linear, ratio, and
parabola equations.

    2.   The user must have run the MSDS Processing Menu 15,
Bivariate Regression Analysis, or Processing Menu 16, Multivariate
Regression Analysis, to get the equation parameters needed to
provide the proper responses.

    3.   The proper response for the beginning workload factor
(WLF) value should be the lower "X" value (XL) value computed in
Utility Option 6 for each particular equation.   The increment
value should be small enough to allow at least 10 comparisons
between the equations.   For instance, if the range between the
upper and lower "X" extrapolation limits (XU and XL) in Utility
Option 6 was 1000 (XU=9000 and XL=8000), then the increment value
should be no larger than 100(1000÷100=10).   For the purpose of
comparison, the increment value should be the same for all
equations.

    4.   The man-hour availability factor is used to compute
the fractional manpower requirement (FMPR) generated by each level
of workload, which can be seen in Table 44.

                          *****

                        THREE BLIND MICE

                       (translated for MEOs)

        A TRIUMVERATE OF OPTICALLY DEFICIENT RODENTS
            OBSERVE HOW THEY PERAMBULATE
        THEY ALL PERAMBULATED
            AFTER THE HORTICULTURIST'S SPOUSE
        WHO REMOVED THEIR POSTERIER APPENDAGES
            WITH A CULINARY INSTRUMENT
        HAVE YOU EVER OBSERVED SUCH A VISUAL PHENOMENON
            IN YOUR CUMULATIVE METABOLIC PROCESS
        AS A TRIUMVERATE OF OPTICALLY DEFICIENT RODENTS

                      - from Mother's Goosed Rhymes
                        by H. Alan Schwartz

	EQUATION #1			EQUATION #2			EQUATION #3	
WLF	MHRS	FMPR	WLF	MHRS	FMPR	WLF	MHRS	FMPR
		①			②			③
150.	1547.44	10.657	150.	1108.85	7.637	150.	1113.78	7.671
200.	1817.14	12.515	200.	1461.99	10.069	200.	1466.26	10.098
250.	2086.84	14.372	250.	1807.34	12.447	250.	1812.22	12.481
300.	2356.54	16.230	300.	2145.16	14.774	300.	2151.66	14.819
350.	2626.24	18.087	350.	2475.69	17.050	350.	2484.58	17.111
400.	2895.94	19.944	400.	2799.16	19.278	400.	2810.98	19.359
450.	3165.64	21.802	450.	3115.80	21.459	450.	3130.86	21.562
500.	3435.34	23.659	500.	3425.83	23.594	500.	3444.22	23.721
550.	3705.04	25.517	550.	3729.45	25.685	550.	3751.06	25.834
600.	3974.74	27.374	600.	4026.85	27.733	600.	4051.38	27.902
650.	4244.44	29.232	650.	4318.22	29.740	650.	4345.18	29.926
700.	4514.14	31.089	700.	4603.75	31.706	700.	4632.46	31.904
750.	4783.84	32.947	750.	4883.61	33.634	750.	4913.22	33.838
800.	5053.54	34.804	800.	5157.96	35.523	800.	5187.46	35.726
850.	5323.24	36.661	850.	5426.98	37.376	850.	5455.18	37.570
900.	5592.94	38.519	900.	5690.80	39.193	900.	5716.38	39.369
950.	5862.64	40.376	950.	5949.59	40.975	950.	5971.06	41.123
1000.	6132.34	42.234	1000.	6203.47	42.724	1000.	6219.22	42.832
1050.	6402.04	44.091	1050.	6452.60	44.439	1050.	6460.86	44.496
1100.	6671.74	45.949	1100.	6697.11	46.123	1100.	6695.98	46.116
1150.	6941.44	47.806	1150.	6937.11	47.776	1150.	6924.58	47.690
1200.	7211.14	49.663	1200.	7172.74	49.399	1200.	7146.66	49.219
1250.	7480.84	51.521	1250.	7404.12	50.993	1250.	7362.22	50.704
1300.	7750.54	53.378	1300.	7631.35	52.557	1300.	7571.26	52.144
1350.	8020.24	55.236	1350.	7854.55	54.095	1350.	7773.78	53.538
1400.	8289.94	57.093	1400.	8073.82	55.605	1400.	7969.78	54.888
1450.	8559.64	58.951	1450.	8289.27	57.089	1450.	8159.26	56.193
1500.	8829.34	60.808	1500.	8500.99	58.547	1500.	8342.22	57.453
1550.	9099.04	62.666	1550.	8709.09	59.980	1550.	8518.66	58.668
1600.	9368.74	64.523	1600.	8913.65	61.389	1600.	8688.58	59.839

Table 44.   Utility Option 7 - Output

The following numbered comments refer to the numbered items in Table 44:

1.   Notice that the linear model's FMPR rises at a steady rate of 1.857 or 1.858 manpower spaces for each increment of 50 WLF units (12.515-10.657=1.858 and 14.372-12.515=1.857).

2.   The FMPR for the power equation, however, rises at a decreasing rate (10.069-7.637=2.432 and 61.389-59.980=1.409). Note also that the power equation always results in less manpower than the linear equation.

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3.   The parabolic equation also results in less manpower
than the linear equation; however, it provides just a little more
manpower than the power equation until the WLF value reaches 1100
units. At that point the slope of the parabolic model begins to
decrease at a faster rate than the slope of the power model. This
can be seen through a comparison of the change in FMPR as well.
Between 150 and 200 WLF units of work the FMPR changed 2.427
manpower spaces, but between 1550 and 1600 WLF units the FMPR only
increased 1.171 manpower spaces.

Utility Option 8

This utility option allows the user to perform mathematical,
statistical, and ratio analysis of all operational audit input
data at one time. It is the "Cadillac" of the fleet with respect
to other data analysis programs currently available to the
management engineering community. This program was designed to
complement and enhance the MSDS--a chore it does well. The only
analysis techniques provided by the MSDS prior to the development
of this utility option were statistical and ratio analyses of
various individual segments of data. The results of these
analyses, although useful in making gross generalizations about
category-level data, were not in-depth enough to help the MEO and
technicians identify and correct the problems. This program,
however, provides the user with a statistical analysis of the
frequency, per accomplishment time, monthly man-hours, and up to
three ratios of man-hours to work units--all at one time. That's
enough superlatives! The utility option speaks for itself. Table
45 shows the 4 options provided.

*****

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```
ENTER UTILITY OPTION OR 'UMC=USERID':
  <PRESS RETURN TO LIST OPTIONS>
=8




    ****************************************************
                OPERATIONAL AUDIT TASK ANALYSIS
                        (07 MAR 84)
    ****************************************************




        THIS PROGRAM IS DESIGNED TO COMPLEMENT MSDSII.
        TO USE IT YOU MUST HAVE CREATED A STUDY ID AND
        WORKCENTER ID AND LOADED DATA INTO ALL FILES.


            OPS AUDIT ANALYSIS MENU

          1. ANALYZE A RANGE OF TASKS.
          2. ANALYZE A RANGE OF TASKS USING
             THE RATIOS OPTION.
          3. ANALYZE A RANGE OF TASKS USING
             THE DELETE AN INPUT BASE OPTION.
          4. ANALYZE A RANGE OF TASKS USING
             THE RATIOS OPTION AND THE DELETE
             AN INPUT BASE OPTION.
          5. RETURN TO UTILITY MENU.

            ENTER SELECTION, PRESS RETURN.
```

Table 45.   Utility Option 8 - Options

This utility option provides 4 options.   Options 1 and 3 are
the same with one exception.   Option 3 does the same thing as
Option 1, but also gives the user the ability to delete 1 or more
input locations and their data from further analysis.   For that
reason, only Option 1 will be discussed.   On the other hand,
Options 2 and 4 are essentially the same.   Once again, Option 4
does the same thing as Option 2, but it also gives the user the
ability to delete a base or bases from further analysis.

Therefore, Option 4 will be discussed and Option 2 won't be. One
last note of caution. This program uses all of the data files in
the MSDS; therefore, the user must have created a study and work
center identification and all files required by the MSDS before
running this program.

Option 1. Table 46 shows the responses the user is required
to provide in Option 1.

```
ENTER MSDS II STUDYID AND WORKCENTER ID.
SEPARATE BY A COMMA (E.G. SUPPLY,4152).
(PRESS RETURN TO RETURN TO UTILITY MENU.)
=ECMBAR,ECM2413
                        ①

PLEASE WAIT - CHECKING FOR NECESSARY FILES...


ENTER THE FIRST AND LAST TASK REF. NO. E.G. 03010,03990
=03010,04270    ②




PLEASE WAIT, READING BASE OA INPUT FILES....


THE NUMBER OF OA INPUT FILES READ IN IS:  8    ③



*  INDICATES POINT IS BEYOND 1 STD DEV FROM THE MEAN.
                                       ④
** INDICATES POINT IS BEYOND 2 STD DEV FROM THE MEAN.
```

Table 46. Utility Option 8, Option 1 -
Questions and Answers

The numbered comments below refer to the numbered items in
Table 46:

    1. The user first inputs the study identification and
work center identification. The program then answers that it is
checking to make sure all of the necessary files have been loaded
into the MSDS.

    2. The program then asks for the first and last line
numbers in the operational audit data input files the user wants

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analyzed. The user picked line numbers 03010 through 04270 to be
analyzed. The user can pick one line number or all line numbers,
it doesn't matter.

3. The computer then calls up the operational audit
input files and reads them into the system. In this case, the
computer found 8 files, which agrees with the number of locations
in the study.

4. This is just an informational note to remind the user
that any item marked with 1 asterisk is beyond 1 standard
deviation from the mean and 2 asterisks means it's beyond 2
standard deviations. The user can't select or establish any other
control limits at this time, but that's only a minor deficiency.
It certainly doesn't affect the usefulness of the analysis
results.

*****
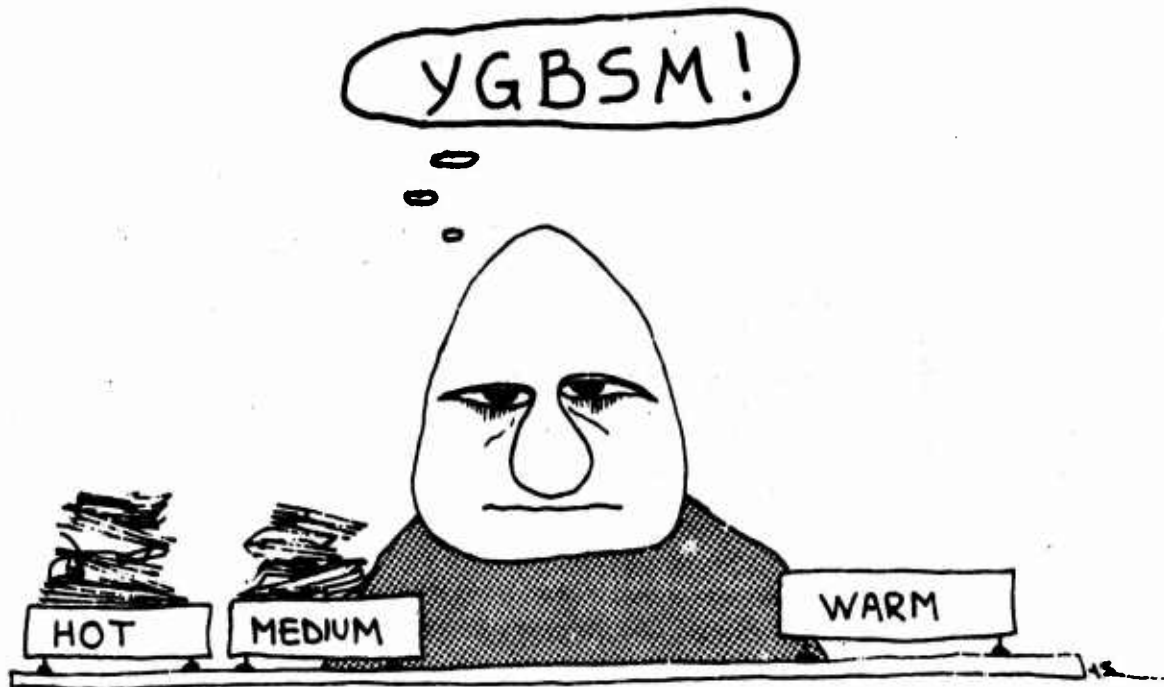
THE EARLIEST CHRISTIAN GETS THE HUNGRIEST LION!!!!

- Colonel John W. Elftmann, Jr.

```
**** NO BASES MEASURED FOR TASK WITH *****
**** REF. NO.  3010 AND TITLE #1. B-52 AIRCRAFT MAINTENANCE:   ①   *****

**** NO BASES MEASURED FOR TASK WITH *****
**** REF. NO.  3020 AND TITLE #1.1. PERFORMS FLIGHTLINE MAINTENANCE:   *****

**** NO BASES MEASURED FOR TASK WITH *****
**** REF. NO.  3030 AND TITLE #1.1.1. PERFORMS MAINT ON AN/ALQ-117:   *****

TASK REF. NO.:   3040
TASK TITLE:   1.1.1.1. MAINT CONT EWO CONSOLE, C-8871
WORKLOAD FACTOR TITLES USED IN RATIOS---->


        BASE          FREQUENCY/CC     ACCOMP TIME    MONTHLY MANHOURS
              ②

BARKSDALE               6.00/MO **        0.64000  *       3.84000
CARSWELL                7.00/YR           5.71000  *       3.33070
CASTLE                  1.00/MO           3.72000          3.72000
ELLSWORTH              11.00/MO           3.35000          3.07071
FAIRCHILD               2.00/MO           2.96000          5.92000  *
GRAND FORKS             1.00/MO           2.10000          2.10000
GRIFFISS                2.00/YR           0.93000  *       0.15499  *
MINOT                   1.00/MO           2.79000          2.79000


              ③    MEAN            MEAN            MEAN
                   MONTHLY FREQ   ACCOMP TIME    MONTHLY MANHOURS
                      1.58           2.77500         3.11580


              ③    STD DEV         STD DEV         STD DEV
                   MONTHLY FREQ   ACCOMP TIME    MONTHLY MANHOURS
                      1.86           1.61644         1.63470



TASK REF. NO.:   3050
TASK TITLE:   1.1.1.2. MAINT CONTROL, C-8872.
WORKLOAD FACTOR TITLES USED IN RATIOS---->


        BASE          FREQUENCY/CC     ACCOMP TIME    MONTHLY MANHOURS


BARKSDALE               7.00/MO  *        0.64000  *       4.48000
CARSWELL                7.00/YR           5.71000  *       3.33070
CASTLE                  5.00/MO  *        3.72000         18.60000  *
ELLSWORTH              10.00/YR           3.95000          3.29153
FAIRCHILD               3.00/MO           2.96000          8.88000
GRAND FORKS             1.00/MO           2.10000          2.10000
GRIFFISS               10.00/YR           0.93000  *       0.77497
MINOT                   3.00/MO           6.51000  *      19.53000  *


                   MEAN            MEAN            MEAN
                   MONTHLY FREQ   ACCOMP TIME    MONTHLY MANHOURS
                      2.66           3.31500         7.62340


                   STD DEV         STD DEV         STD DEV
                   MONTHLY FREQ   ACCOMP TIME    MONTHLY MANHOURS
                      2.34   '        2.10297         7.44805
```

Table 47.   Utility Option 8, Option 1 - Output

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The numbered comments below refer to the numbered items in Table 47:

1. When the computer encounters a line number (3010,3020, & 3030) that has not been measured by any of the input bases, this message is printed. This applies to "not applicable" tasks as well as tasks where no measurement was intended, i.e., a category title. However, even if only one base reports measurement it will be shown as in Item 2 in the table. The thing to be careful of, is to watch out for the one base that doesn't report any data. The program merely omits that location and doesn't inform the user what location has been omitted. If the user is working with 10-15 locations, this condition may be hard to spot. In the case of Option 3, of course, the user identifies which locations are to be deleted from the analysis and the program prints a clear message when this is done. An example of this can be seen in the Option 4 output in Table 51.

2. Not only does the program identify the location by name (unlike MSDS), but the contents of the operational audit file are printed for each location.

3. The program also computes and displays the mean and standard deviation for each data element. Notice also that Barksdale's frequency is marked with 2 asterisks which means the value exceeds 2 standard deviations. The single asterisks in the "ACCOMP TIME" and "MONTHLY MANHOURS" columns mean those values are outside 1 standard deviation.

At the end of each run the program prints "CATEGORY TOTALS" and "TOTAL MONTHLY MANHOURS" for each location. The total monthly man-hours table reflects the actual number of man-hours computed from the first task number the user identifies through the last task number identified, i.e., 3010-5340 in the example in Table 48. However, that isn't the case with the category man-hours column. In the example below, the category man-hours shown are actually for Category I7, cleanup and not category totals for task 3010 to task 5340 as the print-out states. If the user limits the tasks to be analyzed to the inclusive tasks of a particular category, then the category man-hour total will be correct and the total monthly man-hours will be the same value. For instance, if the user had analyzed tasks 5310-5340 only, the category total for Barksdale would be 140.37600 and the total monthly man-hours would have been 140.37600. The point is, whichever category total the computer read last from the operational audit data file will be the total displayed in the "CATEGORY TOTALS" table.

```
CATEGORY TOTALS FROM TASK   3010 TO TASK   5340

   BASES          CATEGORY MONTHLY MANHOURS

BARKSDALE            140.37600
CARSWELL             515.06000
CASTLE               346.85000
ELLSWORTH            146.61920
FAIRCHILD            206.33000
GRAND FORKS           30.89100
GRIFFISS             257.48880
MINOT                146.93250

MEAN MONTHLY MANHOURS FOR ALL   8 BASES REPORTED AND
ALL TASKS FROM REF. NO.   3010 TO   5340 IS        223.81844




TOTAL MONTHLY MANHOURS FOR TASK 3010 TO   5340 BY BASE:

   BASES          TOTAL MONTHLY MANHOURS

BARKSDALE            5416.4022
CARSWELL             6239.3831
CASTLE               7328.0840
ELLSWORTH            4685.2772
FAIRCHILD            3069.8831
GRAND FORKS          2655.2216
GRIFFISS             3338.5977
MINOT                3454.7697
```

Table 48.   Utility Option 8, Option 1 —
Category and Total Man-hours

One final word about this option is needed. While this option
provides some good information, it does not provide sufficient
data with which to make informed judgements with respect to input
data analysis. While this subject will be covered in more detail
in Chapter 2, it must be clear that no refinements or adjustments
to the input data can be made based on this output.

Option 4. This option, however, does provide sufficient data
with which to perform input data analysis. This option allows the

user to analyze a range of tasks using both ratio and delete
options. An example of the required user responses is shown in
Table 49. This option supplements the MSDS Processing Menu 17 and
fixes all of the deficiencies Menu 17 had. Again, as in Option 1,
the user must have loaded all of the MSDS files before running
this option.

```
ENTER ANALYSIS OPTION:
=4


ENTER MSDS STUDYID AND WORKCENTER ID (e.g. SUPPLY,4152):
=ECMBAR,ECM2413


PLEASE WAIT - CHECKING FOR NECESSARY FILES...


  THE FOLLING BASES AND THEIR ASSOCIATED NUMBERS
ARE VALID FOR THIS STUDY ID AND WORKCENTER ID:      ①
   1 BARKSDALE        2 CARSWELL        3 CASTLE        4 ELLSWORTH
   5 FAIRCHILD        6 GRAND FORKS     7 GRIFFISS       8 MINOT


ENTER THE NUMBER OR NUMBERS OF THE BASE OR BASES TO
BE ELIMINATED FROM THIS ANALYSIS RUN.  SEPARATE THE BASE
NUMBERS BY COMMAS IF YOU SPECIFY MORE THAN ONE.          ①
(EXAMPLE: 5,8,14) MAX OF              6 MAY BE ELIMINATED.
=2
          ②
             1 BASE NUMBERS ACCEPTED FOR ELIMINATION FROM ANALYSIS.
ENTER THE NUMBER OF WORKLOAD FACTORS TO BE USED       ③
IN WORKLOAD FACTOR RATIO ANALYSIS (MAXIMUM OF 4).
=3


ENTER THE WLF NUMBERS TO BE USED IN THIS ANALYSIS,    ④
MAXIMUM OF 4 (example: 1,4,5,9).
=1,2,3
```

Table 49.   Utility Option 8, Option 4 —
Questions and Answers

The numbered comments below refer to the numbered items in
Table 49:

     1.   Unlike Option 1, this option allows the user to
delete locations from analysis if necessary. Here the program is
showing the location names and numbers that are valid for this
study. The program then asks which location the user wants to
delete from analysis. This action has no impact on the data

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loaded in the files. The program simply doesn't read the files associated with the location number the user picks. In this example, the program reminds the user a maximum of 6 bases may be eliminated. This is because there are only 8 bases involved in the study and the program needs at least 2 (8-6=2) with which to compute the mean and standard deviation. In this case, the user chose to delete base number 2, Carswell.

2. The program then confirms it has accepted 1 base number for elimination from analysis.

3. The program then asks how many workload factors (work counts) are to be used in the analysis. The program can load a maximum of 4 work counts at a time. In this case, the user wants to load 3 work counts.

4. Here the program tells the user to identify the number of each work count to be used in the analysis. The user chose work count numbers 1,2, and 3. The work count numbers can be obtained from the work count input file in the MSDS.

Once the program has this information, the user must tell the program which work counts and which of the three data elements (frequency, per accomplishment time, or monthly man-hours) are to be used to compute the ratios. For those who may have hit a mental block, the numerator is the number on top of a fraction and the denominator is the number on the bottom. Table 50 shows an example of the ratio set up menu and its output.

*****

Important research findings go through three stages of public reaction: first, the public pays no attention; then every effort is made to disprove the phenomenon; and finally the findings are accepted and become so familiar that people claim they knew them all along.

- Eckhard H. Hess

It never ends
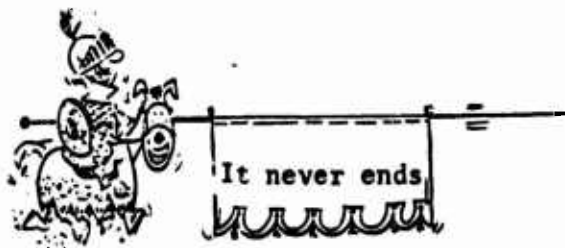
```
            RATIO SET UP MENU
    NUMERATOR CHOICES    DENOMINATOR CHOICES
                              ①

    1. FREQUENCY         1. AN AIRCRAFT AS
    2. PER ACCOMP TIME   2. A FLYING HOUR
    3. MONTHLY MANHOURS  3. A SORTIE FLOWN
                         4.

ENTER A NUMERATOR CHOICE AND A DENOMINATOR CHOICE FOR THE 3 RATIO(S)
TO BE USED IN THIS TASK ANALYSIS.  ENTER ONE SET OF CHOICES PER LINE
SEPARATED BY A COMMA (Example: 3,2).
=3,1

=3,2  ②

=1,3




        ③   WORKLOAD FACTOR DATA USED IN RATIO ANALYSIS

    BASE          AN AIRCRAFT AS A FLYING HOUR  A SORTIE FLOWN
                       ( 1)          ( 2)           ( 3)

    BARKSDALE         26.583        830.950        114.833

    CASTLE            23.000        1242.218       170.818

    ELLSWORTH         21.833        729.058        96.333

    FAIRCHILD         14.083        432.458        58.167

    GRAND FORKS       16.817        436.967        65.250

    GRIFFISS          17.750        447.167        58.417

    MINOT             17.000        475.075        67.917

ENTER THE FIRST AND LAST TASK REF. NO. E.G. 03010,03990:
=03010,04270

PLEASE WAIT, READING BASE OA INPUT FILES....

THE NUMBER OF OA INPUT FILES READ IN IS:  7   ④
```

Table 50.   Utility Option 8, Option 4 —
            Ratio Set Up Menu

The numbered comments below refer to the numbered items in Table 50:

1. While the program can load 4 work counts at a time, only three ratios can be computed at one time.

2. In this example the user chose to set up 3 ratios: 3,1 (monthly man-hours per aircraft assigned); 3,2 (monthly man-hours per flying hour); and 1,3 (frequency per sortie flown).

3. Here the program shows the user the monthly average for each work count at each location to be used in the analysis. Note that Carswell's data is not shown since it has been deleted from this analysis run.

4. Again, the computer confirms that 7 instead of the original 8 operational audit input files have been read.

Once all of the analysis parameters have been established by the user, the program produces an analysis output. An example of the output is shown in Table 51.

*****

In over 20 years of service, from the jungles of Panama to the Gulf of Siam, and from the dust of Texas to the sleet of Illinois, there are three things I've never seen: the BIG PICTURE, the REAL Air Force, or the REGULAR CREW CHIEF!

- Lt Gen H. A. Schwartz

```
  * INDICATES POINT IS BEYOND 1 STD DEV FROM THE MEAN.
 ** INDICATES POINT IS BEYOND 2 STD DEV FROM THE MEAN.

 WORK CENTER:  ECM2413


 **** NO BASES MEASURED FOR TASK WITH*****      ①
 **** REF. NO.  3010 AND TITLE #1. B-52 AIRCRAFT MAINTENANCE:      *****


 **** NO BASES MEASURED FOR TASK WITH*****
 **** REF. NO.  3020 AND TITLE #1.1. PERFORMS FLIGHTLINE MAINTENANCE:   *****


 **** NO BASES MEASURED FOR TASK WITH*****
 **** REF. NO.  3030 AND TITLE #1.1.1. PERFORMS MAINT ON AN/ALQ-117:   *****


 TASK REF. NO.:   3040
 TASK TITLE:   1.1.1.1. MAINT CONT EWO CONSOLE, C-8871   ②
 WORKLOAD FACTOR TITLES USED IN RATIOS—>        AN AIRCRAFT   A FLYING HOU   A SORTIE FLO
```

BASE	FREQUENCY/CC	ACCOMP TIME	MONTHLY MANHOURS	NO. MHRS/WL 1	NO. MHRS/WL 2	FREQ/WLF 3
BARKSDALE	6.00/MO **	0.64000 *	3.84000	0.1445	0.0046	0.0522
CASTLE	1.00/MO	3.72000 *	3.72000	0.1617	0.0030	0.0059
ELLSWORTH	11.00/YR	3.35000	3.07071	0.1406	0.0042	0.1142 **
FAIRCHILD	2.00/MO	2.96000	5.92000 *	0.4204 **	0.0137 **	0.0344
GRAND FORKS	1.00/MO	2.10000	2.10000	0.1249	0.0048	0.0153
GRIFFISS	2.00/YR	0.93000 *	0.15499 *	0.0087 *	0.0003 *	0.0342
MINOT	1.00/MO	2.79000	2.77000	0.1641	0.0059	0.0147

	MEAN MONTHLY FREQ	MEAN ACCOMP TIME	MEAN MONTHLY MANHOURS	MEAN NO. MHRS/WLF1	MEAN NO. MHRS/WLF2	MEAN FREQ/WLF 3
	1.73	2.35571	3.08510	0.1664	0.0052	0.0387

	STD DEV MONTHLY FREQ	STD DEV ACCOMP TIME	STD DEV MONTHLY MANHOURS	STD DEV NO. MHRS/WLF1	STD DEV NO. MHRS/WLF2	STD DEV FREQ/WLF 3
	1.96	1.18641	1.76318	0.1240	0.0041	0.0368

```
 NOTE - THESE BASE NUMBERS NOT ANALYZED - 2   ③
```

Table 51.   Utility Option 8, Option 4 - Output

The numbered comments below refer to the numbered items in Table 51:

1. Just as with Option 1, no bases measured man-hours for task numbers 3010, 3020, and 3030.

2. At this task, however, the ratio analysis results are shown. Now the user has a relative measure of activity with which to analyze the data elements, namely the monthly man-hours and frequency.

3.   At the end of each task the program reminds the user
which base number(s) is not included in the analysis if any were
deleted.

One final note concerning both Option 2 and Option 4 is
needed.   Although not shown in Table 51, Carswell was deleted
because no work count data had been loaded for that location yet.
In that situation, the computed ratios would all equal zero
because any number divided by zero is zero by definition.
Unfortunately, the program doesn't recognize this situation and
uses the zero ratios to compute the mean and standard deviation.
Obviously, this doesn't give the user accurate information.   If
this situation occurs, the user must use Option 4 to delete the
location from ratio analysis.   This situation doesn't bother Op-
tions 1 and 3 because the program is built to automatically delete
any base that reports zero man-hours or "not applicable."

Utility Option 9

This utility option offers the user three options for use in
automated data processing management.   An example of the options
available is shown in Table 52.

```
ENTER UTILITY OPTION OR 'UMC=USERID':
  (PRESS RETURN TO LIST OPTIONS)
=9



     1 - LIST REACQ USERS
     2 - CLIST CATALOGS/FILES
     3 - LA100 PITCH CONTROL
     10 - RETURN TO UTILITY MENU

ENTER TASK:
=1
```

Table 52.   Utility Option 9 -
Options

Option 1 allows the user to obtain a list of authorized users
for the REACQ computer at Randolph AFB, TX.   This is the only
option available to the SACMETs.   The output is a list of User
Master Catalogs (UMC) or user identifications with their location,
organization, point of contact, and a telephone number.   The
output is not shown.

Option 2 allows users who control the file space on the
computer to obtain a "C-list" of the various catalogs and files

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/0/

stored in the file space. Since this option can only be run by
XPMET, no output is shown.

Option 3 is for use by the functional management engineering
teams and is of no use to XPMET or the SACMETs. No output is
shown.

Utility Option 10.

This utility option fixes all those things that are wrong with
the MSDS Processing Menu 7. While it isn't fully operational at
this time, it will be in the near future. A sample of the options
available to the user is shown in Table 53.

```
ENTER UTILITY OPTION OR 'UMC=USERID':
 (PRESS RETURN TO LIST OPTIONS)
=10




THIS ROUTINE DUPLICATES MSDS PROCESSING MENU 7 - WS STUDY
DATA-LOAD AND PRINT AF FORM 1111 AND PROVIDES THE ADDITIONAL
CAPABILITY OF STORING THE DATA FOR ELECTRONIC TRANSMISSION.
IT WILL ADD A RANDOM FILE CALLED 'WSINPUT' TO EACH WORK
CENTER SUBCATALOG PLUS A DAILY INPUT FILE FOR EACH LOCATION.


ENTER STUDYID, AND WORKCENTER ID
=WORKSAMP.SAMPWC    (1).



    ** PROCESS MENU **
                       (2)

 1 - OBSERVATION INPUT & ANALYSIS
 2 - DAILY RECORD (AF FORM 1111, PART I)
 3 - COMPUTATIONS (AF FORM 1111, PART II)
 4 - DISPLAY BOTH PARTS I & II
 5 - RETURN TO UTILITY MENU
```

Table 53. Utility Option 10 - Options

The numbered comments below refer to the numbered items in
Table 53:

        1. In this example, the work sampling training study is
used as the study and work center identification.

        2. The Process Menu lists 4 process options, but Option
1, Observation Input and Analysis, isn't operational yet. When

it's ready for use, AFMEA/MEXD will put a message for all users at
the beginning of the Utility Subsystem sign on procedures.
Process Option 2 allows the user to read or print part I of the AF
Form 1111, Work Sampling Record. Process Option 3 allows the user
to read or print part II of the AF Form 1111. However, Process
Option 4 allows the user to read or print both parts of the form
at the same time.

An example of the required user responses is shown in Table 54.

```
 ENTER PROCESS:
=4


ENTER THE LOCATION NUMBER TO DISPLAY
=1       ①


YOU HAVE SELECTED:    ②


BASEA              SAMPLING WORK CENTRE


IS THIS THE CORRECT LOCATION AND WORK CENTER?
=Y


 FORM DISPLAYS TO (T)ERMINAL OR (F)ILE?
=T            ③


 PAUSE SET PAGE, PRESS RETURN
??
```

Table 54.   Utility Option 10, Option 4
Questions and Answers

The numbered comments below refer to the numbered items in
Table 54:

1.   Here the user choses the location number of the base
whose AF Form 1111 is to be reviewed and/or printed.

2.   Here the program confirms the location name and
workcenter the user has selected and asks if these are correct.

3.   Lastly the program asks whether to send the data to
the terminal or to a file. In almost all cases, the answer should
be "Terminal." If the data is sent to file, it will be a
temporary file and the data could be destroyed if the temporary
file isn't made a permanent file. With "off-line" storage

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capability, there is no reason to send the data to file. The user
can maintain the data.

Last, but certainly not least, Tables 55 and 56 show an
example of the output AF Form 1111. No explanation of the output
is required since the forms comply with AFR 25-5, Vol II, Chapter
24 requirements.

```
OSXPME2                                        04 JAN 85    14.4448
:===================================================================:
:              WORK SAMPLING RECORD           :1.    D A T E S     :
:---------------------------------------------:STARTED   :COMPLETED :
:PART I.            DAILY RECORD              : 01 AUG 84 : 23 DEC 88 :
:-------------------------------------------------------------------:
:2. WORKCENTER TITLE/CODE          :3. COMMAND/INSTALLATION         :
: SAMPLING WORK CENTRE       /99999:    SAC   /BASEA                :
:-------------------------------------------------------------------:
:4.                       S U M M A R Y                             :
:-------------------------------------------------------------------:
:         :         :         :         :NUMBER OF :        :AVERAGE :
:SAMPLING:         :MANHOURS:TOTAL NUMBER:PRODUCTIVE:PRODUCTIVITY:LEVELING:
: DAY    :DAY OF MONTH: SAMPLED: SAMPLES : SAMPLES :        : FACTOR :
:  A     :    B      :  C     :    D     :   E     :   F    :   G    :
:-------------------------------------------------------------------:
:  1     :   29      : 245.00:   33     :   21    : 0.636  : 0.90   :
:  2     :   30      : 343.00:  987     :  501    : 0.508  : 1.23   :
:  3     :   1       : 333.00:  989     :  634    : 0.641  : 1.11   :
:  4     :   2       : 321.00:  990     :  232    : 0.234  : 1.12   :
:  5     :   12      : 123.00:   33     :   21    : 0.636  : 1.09   :
:        :           :        :          :         :        :        :
:        :           :        :          :         :        :        :
:-------------------------------------------------------------------:
:5. TOTAL            : 1365.00:  3032    :  1409   ://////////////: 5.45  :
:6. AVERAGE          :////////://////////://///////://////////////: 1.09  :
:-------------------------------------------------------------------:
 AF FORM 1111   PREVIOUS EDITION IS OBSOLETE.
    DEC 81
```

Table 55.   Utility Option 10, Option 4 —
AF Form 1111, Part I

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```
OSXPME2                                                          14.4448
:----------------------------------------------------------------------:
:PART II.      WORK SAMPLING COMPUTATIONS          : PAGE 2 OF 2 PAGES :
:----------------------------------------------------------------------:
:7. WORKCENTER TITLE/CODE    :8. COMMAND/INSTALLATION  :9. DATE         :
:   SAMPLING WORK CENT/999999 :  SAC   /BASEA          :    04 JAN 85   :
:----------------------------------------------------------------------:
:10.          :       :       :         M A N - H O U R S             :
```

CATEGORY A	NUMBER OF SAMPLES B	PERCENT OCCUR (P) C	MEASURED D	LEVELED E	ALLOWANCE FACTOR F	ALLOWED (EXF) G	TOTAL (AF(%)XG) H
1. DIRECT ON	454	0.493	673.60	917.78	1.116	1024.24	5374.70
2. DIRECT TW	231	0.251	342.73	466.97	1.098	512.74	2690.59
3. DIRECT 3	65	0.071	96.44	131.40	1.116	146.64	769.50
I1. IND ONE	72	0.078	106.83	145.55	1.001	145.70	764.54
I2. IND TWO	33	0.036	48.96	66.71	1.116	74.45	390.67
I3. IND 3	28	0.030	41.54	55.60	1.116	63.17	331.48
11. TOTAL PROD.	883	0.960	1310.10	1785.02	//////////	1966.93	######
12. OTHER							
IDLE	34	0.037	50.45	/////////////////////////////////////			
REST	1	0.001	1.48	/////////////////////////////////////			
DELAY	2	0.002	2.97	/////////////////////////////////////			
13. TOTAL	920	1.000	1365.00	/////////////////////////////////////			

```
:14. SAMPLES   :15. PRECISION OBTAINED FOR :16. (%) ADJUSTMENT FACTOR (AF) :
: REQ. N =  1  : LARGEST P OF 0.493=0.0323 :    20.99/ 4     AF = 5.248   :
:----------------------------------------------------------------------:
```

Table 56.   Utility Option 10, Option 4 -
AF Form 1111, Part II

CONCLUSION

That was a rather lengthy, but necessary, safari through the jungles of computerland. It should be obvious to the MEO by now, however, that the days of the stubby pencil, chewed eraser, and rolls of butcher paper are gone. It is the MEO's responsibility to learn as much as possible about the MSDS and the AFMEA Utility

Subsystem. At the same time the MEO must make sure the management engineering technicians learn also. The SACMET that cannot operate, manage, and use these two systems proficiently will always be behind the power curve. These are the only tools left with the speed, power, and accuracy to keep the SACMET efficient and, most importantly, effective.

Learning these systems is not a one time affair either. Two new system releases for the MSDS should be developed and sent to the field in 1985. Judging from AFMEA/MEXD's past performance, the Utility Subsystem will be continually updated and expanded with more user-friendly software. In addition, if current plans are realized, the MSDS and AFMEA Manpower Systems will be combined with Lotus 1,2,3 and graphic software to form a single set of programs available to micro-soft users. This means that SACMETs may some day soon have the capability to perform a manpower standard study using their own computer. If that occurs, SACMETs will be called upon to perform the same functions they perform today, but will also perform those functions now performed by the Technical Services Branch.

In the vernacular of a headquarters weenie, "We've come a long way, down that dark tunnel and we're beginning to see the light. Lets just make sure it's not an on-rushing freight train."

*****

MITCH, YOU GET THE PAPER; PETE, YOU LINE UP A TYPIST; FARNSWORTH, YOU READ THE MEAS-PLAN ... AND I'll LOBBY FOR A HIGHER GRADE

Chapter Two

DATA ANALYSIS AND COMPUTATION

PHASE PROCEDURES

INTRODUCTION

While each phase of a manpower standard development study is interrelated and equally important, the data analysis and computation phase has become the one phase of greatest concern recently. The biggest reason for this concern is the decreasing experience level of the management engineering officers and technicians. Another big reason is the lack of formal and unit training these new people have been given with respect to the Manpower Standards Development System (MSDS) and data analysis techniques in general. Chapter 1 of this handbook attempted to address the MSDS problem as well as the Air Force Management Engineering Agency (AFMEA) Utility Subsystem. This chapter will trace the major steps of the data analysis and computation phase from the perspective of the Management Engineering Officer (MEO) at a lead SACMET. Of course, the information presented will be just as pertinent to a lead team technician. The input team technician shouldn't be left out of this either. The more the input technician knows about lead team procedures, the better that technician will understand what the lead team needs to get the job done right. In the interest of brevity, certain assumptions must be made with respect to the first four phases of the manpower standard development process before embarking on the final phase of the process. First, it is assumed that all four phases have been completed satisfactorily. Secondly, it is assumed the lead SAC Management Engineering Team (SACMET) and the Technical Services Branch (HQ SAC/XPMET) have created and loaded all required data files in the MSDS. Lastly, it is assumed that all input SACMETs have loaded all necessary data files in the MSDS and sent other data requested by the lead SACMET via the SAC Information Processing System (IPS) or mail.

Now that the stage is set, it's time to proceed with the task at hand--what to do with all that data!

GROUND RULES

The data analyses and computation phase is, in the author's opinion, the most tedious, frustrating, and demanding phase of a manpower standard development study. Before starting an endeavor such as this, it sure helps to know the ground rules being applied to and by the people involved. It's really up to the MEO to establish these ground rules and to understand and communicate the guidance and direction provided by the SACMET commander and Headquarters SAC. With that in mind, the following is a discussion of rules of thumb that have stood the tests of time and circumstances. That doesn't mean, however, that Murphy's Law is no longer operable. In fact, before the MEO finishes that first lead team effort, Murphy will seem like a charter member of the Optimists Club.

MEO - Lead Technician

The relationship between the MEO and the lead technician can be a source of frustration and consternation or one of teamwork, pride, and efficiency. This assumes, of course, that a lead technician is required. If the MEO has an in-depth knowledge of the functions under study, a good grasp of AFR 25-5, and only one or two small projects to lead, then a lead technician may not be required. However, seldom are MEOs blessed with such circumstances or knowledge. If that is true, the MEO will find it necessary to select a lead technician. While this was probably done at the start of the study, the MEO needs to establish some ground rules with the lead technician at the beginning of the data analysis and computation phase to avoid a counterproductive effort.

The first aspect of the relationship that needs to be established is a division or delegation of responsibilities. Let there be no doubt, the MEO is ultimately responsible for the quality and timeliness of the manpower standard study. As such, the MEO must be the center of the communications network and the decision-making authority. The lead technician, on the other hand, is the implementer and communications facilitator for the other SACMET technicians involved in the study. The lead technician is also responsible for performing the analysis and computations for his/her assigned work centers. In actuality, the author has seen very few instances where the lead technician had trouble implemen'ing or understanding this relationship. Most of the problems arose when the MEO didn't use the lead technician enough or let the lead technician assume too much responsibility. Either situation can lead to trouble.

The MEO must be the decision-maker. The lead technician must make sure those decisions are communicated to each technician involved in the study. Good decisions are based on good informa-

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tion. The lead technician is responsible for ensuring the MEO has all the information possible with which to make the decision.

The key to any group effort is teamwork. The relationship between the MEO and the lead technician can either enhance or frustrate the efforts of the other technicians. The best way to describe the appropriate delegation of responsibilities is the example of not being able to see the forest for the trees. The MEO should approach the study from the aspect of a forest. Stand back and try not to count each tree in the forest. The lead technician, however, should be concerned with each tree and monitor its day-to-day growth. When problems arise, then the efforts of both individuals can be applied quickly with better results in the end. The last major advantage of a good MEO-lead technician relationship is that of having a back-up. During periods of absence by either person, the other can keep the team moving in the right direction with no loss of continuity.

Audit Trail

One ground rule of data analysis and computation that many MEOs learn the hard way and quite often too late in the process is the need to maintain an audit trail. An audit trail is a record of all changes made to the original measurement data and the reason why those changes were made. First of all, this process helps the MEO understand what changes were made and why. Secondly, it requires the technician to investigate the desired change and provide a logical reason for the change rather than just pursuing good statistics. Lastly, the audit trail serves as a "corporate memory" for the reporting and approval phase of the study when the MEO is called upon to explain the difference between the original measurement data and the data used to compute the manpower standard equation. This "corporate memory" also becomes indispensable when the responsible technician must leave unexpectedly and some other technician must take up the challenge and finish the standard. Without an audit trail, the new technician might as well start over again. There have even been instances in recorded history when the audit trail documentation has been used years after the study was done to answer those innocuous questions that keep coming back to haunt the staff at headquarters. Of course, for the audit trail to be useable, the original data and the final data must also be preserved. That's not a new requirement, however, that's been a responsibility of the lead team for many years. The addition of an audit trail just makes those two sets of data more understandable and valuable.

Coordination

Successful management of a manpower standard development study requires a significant amount of coordination. Some studies have required coordination between and among every organizational level of the Air Force. Of course, the Project Manager assigned to the

Studies Supervision Branch (HQ SAC/XPMED) performs a large portion of the higher level coordination, but the MEO and lead SACMET technicians are responsible for performing the majority of the coordination. Most of the coordination required during the data analysis and computation phase occurs between the lead SACMET and the functional manager, input SACMETs, and HQ SAC/XPMED. Another area of coordination that is sometimes overlooked occurs between the lead SACMET members.

Coordination between the lead SACMET and the functional manager usually occurs at two levels--base level and HQ SAC. The MEO must make sure all coordination with the functional manager at base level is carefully constructed and well documented. More often than not the coordination will be conducted by the technicians and will involve discussion concerning changes to the original measurement data at that location, workload requirements at other bases, or the manager's best judgment with respect to the required level of service. In essence the base level functional manager is performing as an "expert witness." The MEO must ensure that decisions based on the functional manager's "testimony" are fully documented with a memorandum for record or specially prepared coordination worksheet. The outcome of many studies has often hinged on this documentation. When the MEO was able to produce it, the outcome has usually been a more efficient and economical manpower standard. Coordination with the functional manager at HQ SAC, however, is usually performed by the Project Manager. No SACMET personnel should ever attempt to coordinate with the HQ SAC functional manager without prior coordination with the Project Manager.

Coordination with input SACMETs will probably consume the most time and is absolutely essential to the resolution of problems or questions generated as a result of data analysis. The important point to remember here, is that all changes to the original data coordinated by the input SACMET with their functional manager must be documented and forwarded to the lead SACMET. Enforcement of this ground rule will ensure no mistakes are made as a result of relying solely on telephonic contact and challenges to the acceptability of the data can be rebutted with hard copy concurrences. A related, but somewhat different, problem is often encountered with respect to lead/input SACMET coordination. The problem concerns the amount of time spent in coordination. This is especially true for studies involving a large number of work centers and 2 or more lead SACMET technicians. When the lead SACMET technician finds a problem during data analysis, the basic tendency is to immediately call the input SACMET responsible for the data, explain the problem, and ask the input technician to check it out. Just imagine being on the receiving end of 5-10 phone calls a day for a 2-3 month period and still try to perform other scheduled workload. The lead SACMET MEO should establish a ground rule that no coordination with an input team can be made until the MEO or lead technician has reviewed the data analysis

results and approved the areas requiring further investigation. Secondarily, the technician should attempt to coordinate an entire section of data at once. For instance, a ground rule that has worked well in the past is to allow the technicians a phone call for: work count analysis, supplemental AF Forms 1040 and measurement report analysis, analysis of direct categories, and analysis of indirect categories. These are natural breakpoints in the data analysis effort where the questions can't be put off any longer because the answers could impact later analysis in another area.

Coordination with the Project Manager is another major area of concern. The Project Manager's ground rule is to coordinate only with the MEO if possible. This eliminates a lot of confusion and miscommunication. The same ground rule should be applied in reverse at the lead SACMET. The MEO should do all of the coordinating with HQ SAC. As the hub of communication at the SACMET, the MEO can then ensure the right people get the right information.

The last major area of coordination concerns the technicians involved in the study. While the MEO is the decision-maker and the lead technician is the implementer, some method other than face-to-face communication is necessary to pass on critical decisions and information. One of the best ways of handling this problem is to establish a sequential numbering system for tracking memorandums pertaining to a particular study. The memos are typed and numbered with a copy going to each individual concerned. Each technician is then responsible for maintaining those memos and referring to them as necessary. This method makes it easy for the lead technician or MEO to make sure everybody got "the word."

Scheduling

One thing that always happens at the end of a major study phase is the inevitable crunch for time. One of the prime reasons for this situation is the failure of the team to set interim suspenses and time lines for certain actions. The Milestone/Man-week Schedule provided by XPMED is just that—a schedule of major milestones. There's no way for XPMED to establish a schedule for each action to be accomplished between each milestone. Each team has a different experience level. Each MEO approaches the study from a different perspective and each study requires a different approach in some way or another. Therefore, it is up to the MEO to establish interim target dates between the major milestone dates provided by XPMED. The interim dates should be linked to the completion of a specific action or product. For instance, if there are 3 technicians working on the study and each technician is responsible for 3 work centers, the MEO could establish an interim suspense for the completion of data analysis for the direct categories of work in each work center. Another major cause of missed suspenses, and the need to surge is the failure to

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consider time for quality assurance checks and administration. The MEO should set the suspense dates back far enough from the milestone dates to accommodate the performance of these two critical tasks. The time required to perform these two tasks will vary for each team, so no attempt is made here to provide any rules-of-thumb. When faced with a decision between quality and timeliness, however, the author recommends that quality take precedence every time. While there are times when this won't be possible, the MEO will find in the long-run that the penalty for an untimely product will not be as severe as the penalty for poor quality--unless "the General" is waiting.

PROCEDURES

The following discussion will concentrate on the procedures to follow when using the MSDS and AFMEA Utility Subsystem to develop manpower standards. While there is no hard, fast rule for the order in which these steps or procedures are performed, the results obtained in one procedure are sometimes dependent on the results of a previous procedure. For that reason alone, the order in which these procedures are presented should be the order in which they are performed until the MEO becomes familiar with the process.

Preliminary Analysis

The beginning of the data analysis and computation phase is marked by the receipt of the measurement report (MEAS-REP) from each input SACMET. One of the first steps to be performed is to put a copy of the original MEAS-REP in the files. This is the first of many actions needed to maintain an audit trail. It's not a bad idea either to maintain the MEAS-REP data file on disk until the end of the study. Having preserved a copy of the original MEAS-REP, the MEO or lead technician then reviews and inventories its contents. The first objective is to make sure all data requested in the measurement plan (MEAS-PLAN) was included in the MEAS-REP. If any items are missing, a note should be made on the cover page or an inventory checklist. The input team should then be contacted immediately to provide the requested data. Once the inventory is complete, the MEO or lead technician must then review each MEAS-REP in-depth. Particular attention should be paid to the work center comments. Annotate questionable areas or requirements for more information using margin notes or a separate sheet of paper. The answer to these questions can usually be answered later in the phase by the technician responsible for developing the standard. This way, however, the technician will know to put extra emphasis on the annotated areas. Once the review is complete, the MEAS-REP needs to be broken down by work

center and distributed to the responsible technician for further analysis.

Work Count Analysis

Before proceeding any further, it is important to note that work count stands for any data to be entered into the work count input data file. That can be a work unit, a workload factor, or any other measure of work.

Now that a work count has been defined, analysis can begin. The first step is to review the raw work count data submitted by the input SACMETs and ensure the proper number of periods were reported. Next inspect the data and find the extreme values that have been identified by the input team as exceeding 2 standard deviations. Then review the comments provided by the input team as to why the particular value is an outlier and their recommendation for including or excluding the value in computing the work count average. If there is not enough information provided, identify the value for further investigation. Next, using MSDS Processing Menu 14 (see Table 13), create and print the master work count file and the work count correlation and regression file. Then print the detail for all work counts, all locations, and all periods. If selection criteria "1" and type of report "5" are chosen, the program will provide all available data possible. This will include the average for each work count, the standard deviation, upper and lower control limits, and the work count values and percentages for all periods. In addition the report will identify those work counts which exceed either of the control limits. These work counts should be classified as Type "A" counts, which definitely require further investigation. Check the contents of the MSDS product against the information provided by the input SACMET. If enough justification is provided to warrant retaining the work count for a particular period, no further action by the technician is required. An example of Type "A" data is shown in Table 57.

JANUARY	1000		JULY	900
FEBRUARY	950		AUGUST	750
MARCH	1050		SEPTEMBER	1600*
APRIL	1100		OCTOBER	700
MAY	1075		NOVEMBER	950
JUNE	1200		DECEMBER	975

$$\text{MEAN} = 1020.83$$
$$\text{SD} = 229.83$$
$$\text{UCL} = 1480.49$$
$$\text{LCL} = 561.17$$

Table 57.   Sample Work Count Data — Type "A"

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If the data shown in Table 57 is, for instance, the number of supply transactions or the number of contracting actions for a base, it is definitely necessary to include the extreme value (1600 for September) in the computation of the work count average. The reason this can and should be done, even though the extreme value exceeds 2 standard deviations, is because the flow of workload experienced by most supply and contracting work centers in heavily influenced by the budgeting cycle or fiscal year. Every year, almost without fail, there is a flurry of activity to spend any funds left in the budget at the end of the fiscal year. One way of doing that is buying supplies or equipment. Another way is to award those lower priority contracts that were being held back in case the funds were needed for some unplanned higher priority project that might arise. The point here is that the flow of work depicted in Table 57 is indeed representative of the actual flow of work and this particular situation occurs every year. In other words, the extreme value wasn't caused by some unusual circumstance that is unlikely to happen again on a regular basis, e.g., at least once per year.

The data in Table 57 also shows why collecting at least 12 months of work count data is so important. As AFR 25-5 points out, only 6 months of data is required; however, the analysis results would be quite different in the example if only 6 months of data were used. The mean work count value for January-June is 1062.50 and for July-December it is 979.17 versus the actual mean of 1020.83. The standard deviations are even farther apart. The standard deviation for January-June is 86.24. For July-December it is 332.32. The 12-month standard deviation, however, is 229.83. Using either 6-month period, there would be no extreme values and the average work count used to do ratio and/or correlation analysis could differ by as much as 83.33 actions per month. The data for the July-December time frame also show what kind of impact an extreme value can have on the computed mean and standard deviation. The caution that naturally follows from this type of situation is that the computer can't determine whether or not the data is valid. All the computer can do is compute the statistics. It takes a MEO or technician to make the decision.

Making a decision about Type "B" data is even more difficult because all of the data pass the statistical constraints. An example of Type "B" data is shown in Table 58.

JANUARY	95		JULY	124
FEBRUARY	89		AUGUST	130
MARCH	98		SEPTEMBER	129
APRIL	100		OCTOBER	140
MAY	109		NOVEMBER	143
JUNE	115		DECEMBER	151

```
MEAN = 118.58
SD   =  20.62
UCL  = 159.83
LCL  =  77.34
```

TABLE 58.   Sample Work Count Data - Type "B"

The data in Table 58 are all within the control limits; there-
fore, there's nothing wrong with the data, right? Wrong! The
workload for January-April is fairly stable. However, the data
for May-December shows a definite upward trend in workload. Why
is the workload increasing? Is the trend going to continue or has
it stabilized? Will the level of workload decrease back to the
level of January-April? These are the questions that must be
answered before a sound, logical decision can be made. The trend
may not be as easy to detect as the sample in Table 58. The trend
may also be downward or it may start low, build to a peak, and
then recede back to the previous low. Once again, the computer
failed to give the right answer. To reiterate, one can't simply
look down a column of numbers on the print-out for extreme values
to determine whether or not the work count data are valid and
representative of the normal volume of workload--only investiga-
tion and logic will suffice.

One last item of interest is presented for consideration. The
direct man-hour total for each location should be entered into the
work count input data file. Later on when the indirect category
and task man-hours are being analyzed, the direct man-hours might
have to be used as the work count in ratio analysis. Some MEOs
like to wait until the direct man-hours have been analyzed and
refined before loading them as a work count. If there is a sig-
nificant difference between the measured totals and refined
totals, however, the refined totals won't give the MEO a very
accurate ratio to be analyzed. After the indirect man-hours have
been analyzed and refined is a better time for comparison with the
refined direct man-hours.

Once all of the data have been analyzed and the extreme values
or questionable data have been identified, it's time to contact
the input SACMET for some answers and further investigation.
First, however, the MEO should review each technician's audit
trail and analysis of the data. Again, the MEO usually doesn't

have time to count each tree, but should take time to look at the
forest. Identification of Type "A" data is fairly simple, so
concentrate on the Type "B" data. Once the MEO has reviewed the
data and agreed with the technician's analysis, the fun begins.
The fun or challenge is to find out why the data is an extreme
value or why a particular trend exists. The first thing to do in
any investigation is to make sure everyone involved in the search
for a reason knows what to look for. The lead SACMET technician
should review the work count definition with the input technician
to make sure he or she understands what was supposed to be
counted. Next make sure the input technicians used the source of
count stipulated in the Measurement Plan. Then the lead SACMET
technician should explain, as specifically as possible, what
information the input technician should be looking for. When the
investigation is complete, log the results and make a decision to
keep the data, exclude the data, or change the data based on new
work counts provided by the input SACMET.

The MEO should again review the results of the investigation
and the technician's decisions. After the MEO approves the
results, the technician can make the necessary changes to the
master work count file using Processing Menu 14 (see Table 13).
The particular period to be excluded from computation of the
monthly average can be identified using selection criteria "4."
In this option, the user specifies the particular periods to be
used in computing the average, thus excluding the unwanted data.
Utility Option 3 can only be used to change the value or zero-fill
the file. This option can't be used to exclude periods from the
computation of the mean.

The process described above must be continued until all work
count data has been analyzed and found to be acceptable or
refined. Without accurate work count data, no meaningful ratio
analysis of man-hours can be performed.

Original Data

Before proceeding any further, the MEO must ensure that a copy
of all the data loaded by the input SACMETs is printed on paper
and stored on disk. First, this ensures that none of the data
will be completely destroyed. Secondly, this data will serve as
the base line or starting point for the study before any changes
are made to it. Lastly, the printed copy will allow any tech-
nician or the MEO to view the same data the input SACMETs have in
their files during any discussion. For documentation purposes use
Utility Option 5 to print the AF Form 1040 (see Tables 36 and 40)
and/or Utility Option 10 (see Table 54) to print the AF Form 1111,
Work Sampling Record. Also, print a copy of the AF Form 308,
Standard Input Data Computation, using Processing Menu 10 (see
Tables 9 and 10).

Supplemental AF Form 1040 Analysis

Just like work count analysis, analysis of supplemental AF
Form 1040, Operational Audit Record, data must be completed prior
to performing analysis on the man-hours in the operational audit
input data files. This is because some of the entries in the
operational audit files are derived directly from the supplemental
operational audit data which is reported in each input SACMET's
Measurement Report. If the input SACMET used the Supplement AF
Form 1040 Routine provided by HQ SAC/XPMET to compute the data,
only one set of numbers needs to be checked. The lead SACMET
technician must check the operational audit input data files to
make sure each entry in the files, which was derived from the
supplemental AF Form 1040, was transposed accurately. Of course,
if the input SACMET did not use the supplemental AF Form 1040
program, the lead SACMET will have to do that before checking the
transposed numbers. Once the transposed entries have been
checked, the technician can look for obvious disparities in the
supplement operational audit data. One such disparity to look for
is a mismatch between related tasks. For instance, if there are
12 people assigned to the work center, but the supplemental data
shows 31 airman performance reports being written by the work
center supervisor, the lead SACMET technician should find out why
that many reports are being written. Another area to look at is
the relationship between drafting letters, messages and reports
and typing them. This doesn't mean that the numbers have to be
the same, but if they are significantly different, the technician
needs to find out why. Another area that should be fairly well
standardized is the "Meeting" category. If this category hasn't
already been standardized with respect to the number, type, fre-
quency, and duration of meetings, that should be done now. The
same must be done with reports and the training category. The
point is that supplemental operational audit data is aggregated
and put into the operational audit input file as a frequency and a
per accomplishment time. Therefore, if that aggregate data is
identified as an extreme value later on, the technician will have
to come back and do this analysis before being able to determine
whether or not the aggregate data are really extreme values. It's
much better to find out now and fix the faulty data while it is in
its simplest form. If the analysis isn't done now, the chances
are also good that an aggregate data entry could pass the statis-
tical tests of the computer and the technician would never know
the aggregate data was based on faulty supplemental data. After
the MEO or lead technician have reviewed and approved the analysis
results, the technician is ready to make another phone call or
send a message to the input SACMET technician. The same basic
rules of investigation apply equally well to this analysis. After
the MEO or lead technician has reviewed and approved the suggested
changes to the supplemental data, the technician can make the
changes and rerun the supplemental AF Form 1040 routine. The new
aggregate data need to be transposed to the operational audit
input data file next. Once all of the necessary changes have been

transposed, the technician is almost ready to begin man-hour analysis.

Operational Audit Input Data Check

Before proceeding with man-hour analysis, the technician must run Processing Menu 8 on the operational audit input files (see Table 6). This step is necessary to make sure all of the data elements were formatted properly when the input SACMET created and loaded the file and to make sure any changes to the data file by the lead SACMET technician were formatted properly. This step should be performed even if the input SACMET has performed it and even if no changes were made to the original file. Using the Operational Audit Parameter (OAPARM) file, this step takes no more than 10 minutes to perform and can save the technician untold man-hours that could be spent tracing an error if Processing Menu 8 isn't used. Once the data check is complete and any errors have been identified and corrected, man-hour analysis can begin.

Man-hour Data Analysis

The various analysis methods and steps discussed in this section make maximum use of the MSDS and AFMEA Utility Subsystem data analysis programs. As the MEO or technician gains experience with both systems and with the manpower standard development process in general, it may not be necessary to go through each step. However, for the purpose of instruction, it is assumed the reader has never performed in the lead team capacity. In fact, it really doesn't matter how experienced the MEO is, the more data an MEO has with which to make a decision, the better the decision usually is. The author's personal motto is, "Never ignore the opportunity to obtain useful data!" In case no one has ever articulated SACMEP policy on input data analysis here it is: Input data analysis of operational audit data must be performed at no less than the task level. Category-level analysis may be sufficient for work sampling data, but not for operational audit data.

A New Baseline. Before beginning the actual analysis, the MEO needs to obtain at least one copy of the measurement data after all supplemental measurement data has been checked, all errors have been corrected, and Processing Menu 8, the operational audit data check, has been performed. The resultant man-hours will form the base line for the man-hour analysis. This is also the best point in the process to load the master man-hour data file. If the master man-hour data file has already been loaded and changes to the operational audit data file were made subsequent to that, the MEO will have to get XFMET to zero out the master man-hour file so it can be loaded with the updated data. The time and effort required to change the master man-hour data file using the MSDS Processing Menu 11 is much greater than the time required to zero out the file using Processing Menu 6. Once the master man-

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hour file is straight, the MEO can use Processing Menu 9 to print
a facsimile of the AF Form 1040, or AFMEA Utility Option 5 to
print the data in a number of possible formats. For ease of
analysis, Utility Option 5 should be used to print the Option 1,
"All Columns" format and the Option 3, "Category Totals" format.
These 2 output products will be the easiest to work with. See
Tables 37 and 39 for examples of the products. These products
allow the MEO or technician to see the relative magnitude of the
reported man-hours from each input location and identify areas
where problems might exist, but that is all the data is good for.
At no time should anyone, regardless of experience level, attempt
to perform data analysis with just these 2 products. Some people
euphemistically call it "analysis by inspection," but most refer
to it as the "evil-eye affliction" or "trial and error syndrome."
While it is tempting to try to refine a man-hour value which is
"obviously" an extreme value, no substantive basis exists at this
point on which to make an informed decision. In other words, mark
it for further investigation, but leave it alone until the analy-
sis is complete.

   Category Analysis. Once the base line man-hour data has been
obtained, analysis of the data can begin in earnest. The first
step is called category analysis. As implied by its name, the
emphasis here is to analyze the category man-hours. The MEO
should analyze each category of work from two aspects. First,
determine how each category of work compares to other categories
of work within the same work center at the same location. Table
59 shows a sample of the category man-hours for Barksdale AFB in
the Electronic Countermeasures (ECM 2413) work center which were
obtained using Utility Option 5, Option 3, "Category Totals."

<div align="center">*****</div>

<div align="center">
One of the MEO's main jobs
is to keep the study on track!!
</div>

```
LOCATION: BARKSDALE    WORKCENTER: ECM2413    05 OCT 84    15.07


                        CATEGORY  1  TOTAL  :  4031.53 :


                        CATEGORY  2  TOTAL  :   278.00 :


                        CATEGORY  3  TOTAL  :     8.00 :


                        CATEGORY  4  TOTAL  :    48.00 :

                                        DIRECT MAN-HOUR TOTAL    4365.53


                        CATEGORY  5  TOTAL  :   199.38 :


                        CATEGORY  6  TOTAL  :    60.81 :


                        CATEGORY  7  TOTAL  :    45.44 :


                        CATEGORY  8  TOTAL  :   122.50 :


                        CATEGORY  9  TOTAL  :   397.85 :


                        CATEGORY  10 TOTAL  :    84.51 :


                        CATEGORY  11 TOTAL  :   140.38 :

                                      INDIRECT MAN-HOUR TOTAL    1050.87


                                          TOTAL MAN-HOURS    5416.40
                                          TOTAL MANPOWER       37.303
```

Table 59.   Sample Category Man-hours

     The MEO should note from the output in Table 59: the relative
magnitude of each category's man-hours in relationship to the
other categories; the relative value of the direct, indirect, and
total man-hours reported; and finally, the total manpower measured
by the input SACMET.   Next the MEO should compare the category

man-hour totals for all locations. While this step in the
analysis is simple, the MEO should not treat it lightly.   This
little bit of analysis is similar to reconnaissance, it gives the
MEO a lay of the land.   It helps identify any large disparities in
the reported data and gives the MEO an opportunity to note any
special analysis requirements to be performed by the technicians.

     The next step in category analysis is to convert the raw man-
hour data to a relative measure that will help the MEO determine
whether or not a particular category man-hour total is an extreme
value.   Table 60 shows the output from MSDS Processing Menu
18, "Category Man-hour Ratio Analysis."   Since analysis always
begins with the direct categories of workload, that is the only
part shown in the example.   The analysis of indirect categories
will be discussed later.

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*****

THE DATA ANALYSIS PROCESS

</div>
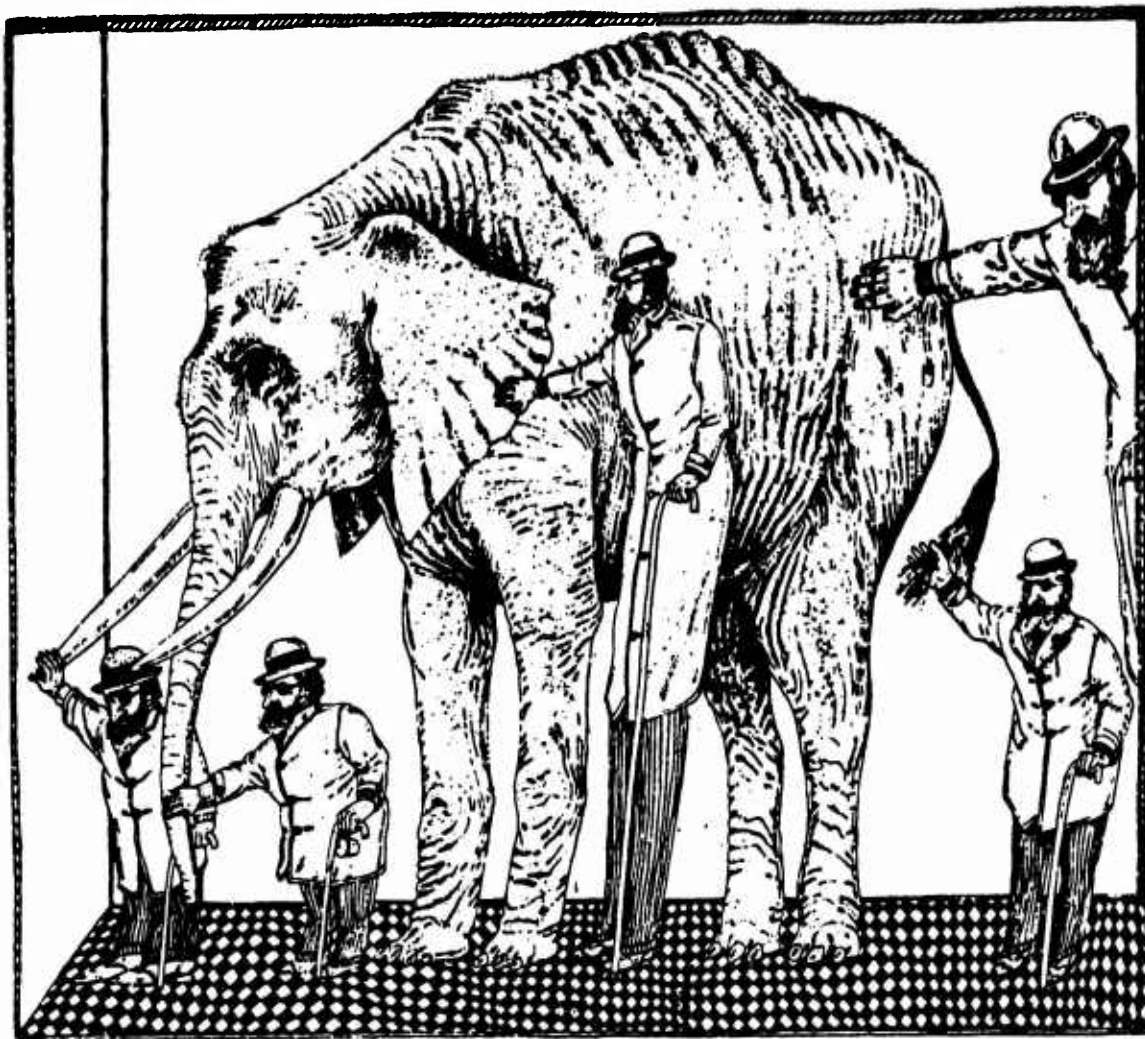
```
                  ELECTRONIC COUNTERMEASURES


                                              ①    TOTAL MONTHLY ALLOWED MAN-HOURS
        05 OCT84 14.498 EST                         PBARS TO TOTAL PRODUCTIVE MAN-HOURS
                                                    PBARS TO DIRECT OR INDIRECT MAN-HOURS

    CATEGORY   BARKSDAL CARSWELL CASTLE  ELLSWORT FAIRCHIL GRAND FO GRIFFISS MINOT    MEAN    STD DEV
                  1        2       3        4        5        6        7        8
```

CATEGORY	BARKSDAL 1	CARSWELL 2	CASTLE 3	ELLSWORT 4	FAIRCHIL 5	GRAND FO 6	GRIFFISS 7	MINOT 8	MEAN	STD DEV
*1. B-52 AIR	4031.53	4255.93	5440.78	3183.69	1943.63	1977.06	2100.86	2308.43		
	0.7443	0.6821	0.7425	0.6795	0.6331	0.7446	0.6293	0.6683	0.6905	0.0482
	0.8832	0.8808	0.8701	0.7968	0.8525	0.8629	0.8153	0.8760	0.8547	0.0320
*2. SUPERVI	278.00	195.96	341.00	309.00	47.74	121.00	229.00	138.00		
	0.0513	0.0314	0.0465	0.0660	0.0156	0.0456	0.0686	0.0400	0.0456	0.0174
	0.0609	0.0406	0.0545	0.0773	0.0209	0.0528	0.0889	0.0524	0.0560	0.0209
3. ALTERNA	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00		
	0.0015	0.0013	0.0011	0.0017	0.0026	0.0030	0.0024	0.0023	0.0020	0.0007
	0.0018	0.0017	0.0013	0.0020	0.0035	0.0035	0.0031	0.0030	0.0025	0.0009
4. FUNCTIO	48.00	102.00	232.00	180.00	133.00	21.00	60.00	13.50		
	0.0089	0.0163	0.0317	0.0384	0.0433	0.0079	0.0180	0.0039	0.0210	0.0149
	0.0105	0.0211	0.0371	0.0451	0.0583	0.0092	0.0233	0.0051	0.0262	0.0190
*II. SUPERV	199.38	270.26	231.57	314.73	147.62	164.20	179.00	167.28		
	0.0368	0.0433	0.0316	0.0672	0.0481	0.0618	0.0536	0.0484	0.0489	0.0120
	0.0437	0.0559	0.0370	0.0788	0.0647	0.0717	0.0695	0.0635	0.0606	0.0142
TOTAL DIRECT	4564.91	4832.15	6253.35	3995.42	2279.99	2291.26	2576.85	2635.21		
	0.8428	0.7745	0.8533	0.8528	0.7427	0.8629	0.7718	0.7629	0.8080	0.0493
	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000		

Table 60.   Sample Category Man-hour Analysis

        While the title for Processing Menu 18 refers to "ratio"
analysis which is technically accurate, the term "ratio analysis"
in this handbook is reserved for those relative measures computed
by dividing man-hours by work counts. The relative measures shown
in Table 60 are "PBARS" or percentages, i.e., man-hours divided by
man-hours. The numbered comments below refer to the numbered
items in Table 60:

        1. The legend lists the order in which the numbers are
presented. The first line of numbers for Category 1, "B-52 AIR,"
is the "TOTAL MONTHLY ALLOWED MAN-HOURS" reported by each of the
locations shown. The second line of numbers is the percentage, or
PBAR, obtained by dividing the category man-hours by total
productive man-hours (4031.53 ÷ 5416.40 = .7443). The third line
of numbers is the PBAR obtained by dividing the category man-hours

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by total direct man-hours (4031.53 ÷ 4564.91 = .8832). If indirect category PBARS are being computed, the indirect category man-hours are divided by total indirect man-hours--not direct man-hours.

2. The output also shows the mean and standard deviation for each set of PBARs. In this example the mean PBAR to total productive man-hours is .6905. The mean PBAR to direct man-hours is .8547.

When analyzing this data, the MEO should look for significant varia :es from the mean PBAR. For instance, the Fairchild PBARs (.015_ and .0209) for Category 2, Supervision, appear to be quite low compared to the mean PBARs (.0456 and .0560). The MEO should mark this category for special emphasis during subsequent analysis. In addition, the MEO should mark Category 4 for special emphasis. The PBARs for this category are widely dispersed and do not appear to show any consistency with respect to the relative position of each location's other category PBARs. While the MEO may have noticed this from the print-out of Utility Option 5, "Category Totals," there is no way of looking at raw man-hour data and determining whether or not a particular data point is an extreme value. With this relative measure (PBAR), however, the MEO can be a little bit more sure something is wrong or needs to be checked. There's still not enough information to make a decision, however, because no consideration has been given to the level of workload being performed or conditions at a particular location that might impact the effort required to perform that level of workload. An example of this might be Category 3 where all locations reported 8.00 total monthly man-hours. This category of work is probably required to be performed at all locations and does not vary in relation to the other categories of work, but the MEO needs to know that for sure before making a decision.

One way of getting more definitive data for category-level analysis is to use Processing Menu 21, "Ratio Analysis," to obtain a ratio of category man-hours to a selected work count. This program produces a print-out of the locations, category man-hour totals, and a ratio or "work unit time standard" for use in comparative analysis. Table 29 contains a sample of the output. While the MEO might want to use this menu for Category 3, Processing Menu 18 produces enough information for most category-level analysis.

One last note with respect to Category 3 can also be applied to other categories of similar magnitude. While Category 3 should still be investigated to make sure the reported man-hours are correct, the MEO should eliminate this category from further analysis. The primary reason for this suggestion is that Category 3 constitutes only 8.00 man-hours out of the more than 2,000 direct man-hours. Assuming the 8 man-hours is an accurate figure, any further analysis would be counterproductive. The 8 man-hours

is less than 1 percent of total direct man-hours and any minor refinements found during task analysis wouldn't change the correlation and regression results. The rule-of-thumb usually applied in cases such as this is to eliminate from further analysis those direct categories which are less than 1 percent of total direct man-hours. The same rule applies to indirect categories with respect to total indirect man-hours. In fact, the MEO should probably go one step further and eliminate the category entirely by making it a task and including it in one of the other categories. Eight man-hours per month is hardly what one could call a major category of work.

The same basic procedures should be used to analyze the indirect categories. In addition, there is another rule-of-thumb the MEO can use with indirect workload. The rule is: Total indirect man-hours should not exceed 30 percent of total productive man-hours. The 30 percent figure is not poured in concrete, it changes depending on the type of function being studied. Some maintenance work centers with high proficiency training and personnel evaluation requirements might exceed this member. On the other hand, a vehicle operations work center would probably measure less than 15 percent total indirect man-hours. The MEO should pay particular attention to the percent of total indirect to total productive man-hours and be prepared to defend the measurement data if the percentage is too high for the function under study.

The discussion about indirect man-hour analysis will probably be a moot period in the near future. The Air Staff is currently considering a proposal by AFMEA to authorize the use of "Standard Indirect Adjustment Factors (SIAFs). A SIAF is a percentage based on the number of total direct man-hours measured. Once the direct man-hours are totalled, the SIAF will be used to determine how many indirect man-hours will be allowed. The use of SIAFs will negate the need to measure indirect workload; thus, there will be nothing to analyze except which SIAF to use for a particular function. Whether the indirect man-hours are measured and analyzed or are determined through the use of a SIAF, no analysis of indirect workload requirements can begin in earnest until all of the direct man-hours have been analyzed and refined from the sub-element level all the way back up to the category level.

Task Analysis. While category-level analysis might show the MEO where some problems are, it can't possibly show where all the problems are. This is because most problems with measured man-hours occur at task level and below. Some "engineers" believe that if the category-level analysis doesn't disclose any extreme values, no refinements are necessary. Table 61 shows an actual case of measured man-hours that passed category-level analysis. The man-hour values have been rounded off to whole numbers and only the direct categories are shown. The names of the locations have been changed to protect the ignorant.

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```
BASE      CAT 1      CAT 2      CAT 3      TOTAL
  A        959        102        61        1122
  B       1004        118        58        1180
  C        992        108        68        1168
```

Table 61.   Sample Extreme Values - Category

Obviously, category-level analysis of the data presented in
Table 61 would not show any extreme values or problem areas.   In
fact, a point to remember before proceeding to Table 62 is that
the man-hours shown in both Table 61 and Table 62 were the result
of a "same-eyes" measurement.   Table 62 shows the task man-hour
totals for Category 1 for all three bases.


```
BASE      TASK 1      TASK 2      TASK 3      CAT 1 TOTAL
  A        448         426         85           959
  B        792         108        104          1004
  C        109         790         93           992
```

Table 62.   Sample Extreme Values - Task

While there's not enough information presented in Table 62 to
make a determination that extreme values exist, there are enough
disparities in the task man-hour totals to warrant further inves-
tigation.   There are definitely too many unanswered questions to
accept the category-level analysis and proceed with correlation
and regression analysis.   The management engineering officer who
submitted this data had noticed the differences between the tasks,
but concluded that since category analysis was good and the cor-
relation and regression analysis produced acceptable statistics,
it didn't make any difference.   Fortunately or unfortunately,
depending on whose view is taken, the lead team MEO performed task
analysis and found gross measurement errors in both the measured
man-hours and the work counts submitted by the input team.
Actually, this case turned out fortunate for everyone concerned.
The mistakes were corrected and the resultant manpower standard
was praised by the headquarters functional manager.   As for the
input team MEO and technician, they learned a valuable lesson--the
hard way, but still valuable.

In the old days when technicians had to crunch the numbers
with a stubby pencil and a Singer "calculator," they used to pray
for good task-level analysis results so they wouldn't have to go

to sub-task, element, and sub-element level. Even with the inception of the MSDS, only category-level analysis could be performed by the computer. Now, however, AFMEA Utility Option 8 allows the technician to have the computer crunch the numbers for analyzing each and every line number in the operational audit input data file. The computer will also compute ratios for ratio analysis and statistics for statistical analysis of all prime data elements. Table 49 in Chapter 1 shows the 4 options available to the user of Utility Option 8, but each option will be discussed more in-depth here.

Option 1 allows the user to analyze a range of tasks using statistical analysis. The mean and standard deviation are automatically computed for the frequency, per accomplishment time and monthly man-hours. No ratios are provided. Some technicians like to use this option first to identify questionable areas, then use another option to do ratio analysis. The same data presented by Option 1 is printed by the other options, so there's no difference in the data. Technicians who use this option just like it for its simplicity--not so much data all at once.

Option 2 allows the user to analyze a range of tasks using statistical and ratio analysis. This option gives the user the same data as presented by Option 1, but it also computes a maximum of three ratios. The ratios are computed using either the frequency, per accomplishment time, or monthly man-hours as the numerator and any 1 of 4 possible work counts as the denominator. The user must specify how each ratio is to be computed. This option also provides a statistical analysis of each ratio and annotates any value in any data element that exceeds 1 or 2 standard deviations. While some technicians who use this option for the first time are overwhelmed by the amount of data displayed at one time, the second or third time they use it the more comfortable they are with it.

Option 3 produces exactly the same data as Option 1, but it also allows the user to delete an input from the data and rerun the analysis. This option allows the user to see what impact the elimination of an extreme value would have on the analysis results.

Option 4 allows the user to do everything the other 3 options do. It provides statistical analysis, computes ratios, performs statistical analysis on the ratios, and allows the user to delete an input to see what impact there would be. It is the "Cadillac" of all the options for task analysis. The MEO and technicians should become as familiar with this option as thoroughly and as quickly as possible.

Now that the basic tools for performing task analysis have been discussed, it's time to move on to the actual analysis.

Table 63 shows an example of an Option 4 print-out. The procedures for obtaining this print-out are contained in Tables 49 & 50 in Chapter 1.

```
• INDICATES POINT IS BEYOND 1 STD DEV FROM THE MEAN.  ①
•• INDICATES POINT IS BEYOND 2 STD DEV FROM THE MEAN.


WORK CENTER:  ECM2413



•••• NO BASES MEASURED FOR TASK WITH••••   ②
•••• REF. NO.  3010 AND TITLE •1. B-52 AIRCRAFT MAINTENANCE:      •••••



•••• NO BASES MEASURED FOR TASK WITH••••   ②
•••• REF. NO.  3020 AND TITLE •1.1. PERFORMS FLIGHTLINE MAINTENANCE:  •••••



•••• NO BASES MEASURED FOR TASK WITH••••   ②
•••• REF. NO.  3030 AND TITLE •1.1.1. PERFORMS MAINT ON AN/ALQ-117:  •••••



TASK REF. NO.:  3040
TASK TITLE:   1.1.1.1. MAINT CONT EMO CONSOLE, C-0071           ③        ③
WORKLOAD FACTOR TITLES USED IN RATIOS---->            AN AIRCRAFT   A FLYING HOU   A SORTIE FLO

      BASE      FREQUENCY/CC  ACCOMP TIME   MONTHLY MANHOURS  NO. MHRS/WL 1  NO. MHRS/WL 2  FREQ/WLF 3
   BARKSDALE      6.00/MO ••    0.64000 •      3.84000          0.1445         0.0046         0.0522
   CASTLE         1.00/MO   ④   3.72000 •      3.72000          0.1617         0.0030         0.0059
   ELLSWORTH     11.00/YR       3.35000        3.07071          0.1406         0.0042   ⑥     0.1142 ••
   FAIRCHILD      2.00/MO       2.96000        5.92000 •        0.4204 ••      0.0137 ••      0.0344
   GRAND FORKS    1.00/MO       2.10000        2.10000  ⑤       0.1249   ⑤    0.0048   ⑤    0.0153
   GRIFFISS       2.00/YR       0.93000 •      0.15499 •        0.0087 •       0.0003 •       0.0342
   MINOT          1.00/MO       2.79000        2.79000          0.1641         0.0059         0.0147

      MEAN          MEAN          MEAN           MEAN            MEAN           MEAN           MEAN
   MONTHLY FREQ   ACCOMP TIME  MONTHLY MANHOURS  NO. MHRS/WLF1  NO. MHRS/WLF2  FREQ/WLF 3
      1.77          2.35571       3.08510         0.1664         0.0052   ⑤   0.0307

   STD DEV        STD DEV       STD DEV         STD DEV         STD DEV        STD DEV        STD DEV
   MONTHLY FREQ   ACCOMP TIME  MONTHLY MANHOURS  NO. MHRS/WLF1  NO. MHRS/WLF2  FREQ/WLF 3
      1.96          1.18641       1.76318         0.1240         0.0041         0.0368

      NOTE - THESE BASE NUMBERS NOT ANALYZED - 2
```

Table 63.   Sample Task Analysis

The numbered comments below refer to the numbered items in Table 63:

1.   Any item marked with 1 asterisk is identified as exceeding the mean by at least 1, but less than 2 standard deviations.   Any item with 2 asterisks exceeds the mean by 2 standard deviations or more.

2.   Line numbers 3010, 3020, and 3030 were not analyzed
because no bases measured man-hours for these tasks. Of course,
these line numbers were for the category, task, and subtask titles
and shouldn't have been measured. However, even if only one input
base reports man-hours for a line number, it will be printed. Of
course, the computer must have at least two inputs to compute a
mean and standard deviation. Technicians must beware of a dif-
ferent problem--one the computer doesn't tell the user about.
This occurs when all of the input bases but 1 or 2 report man-
hours for a line number. The computer prints the data for the
other 6 or 7 bases, but doesn't identify the base(s) that didn't
report any man-hours. The technician must ensure all input bases
are represented or know why no man-hours were reported for a
particular base. The input SACMET should have indicated the
reason in the work center comments of the MEAS-REP. If not, mark
the task for further investigation. The only time the computer
will tell the user when a base is missing is when the delete
option has been used. Then the computer will identify the base or
bases not analyzed by its location number.

3.   In this example the technician has chosen to develop
ratios for monthly man-hours per aircraft assigned, monthly man-
hours per flying hour flown, and frequency per sortie flown.

4.   Here the computer has identified Barksdale's fre-
quency (6.00/MO) as exceeding the mean (1.73/MO) by 2 standard
deviations or more (1.96 X 2 = 3.92 + 1.73 = 5.65). Barksdale's
per accomplishment time (.6400) exceeds the mean by 1 standard
deviation or more, but less than 2 standard deviations. If no
ratio data had been requested by the technician using Option 2 or
Option 4, there would not be enough information to make a decision
about Barksdale's frequency. This particular entry is a perfect
example of having all the information before making a decision.
If the technician had used Option 1 or Option 3, no ratios would
have been computed. A lot of technicians have been taught or
think on their own that any data element that exceeds 2 standard
deviations must be refined. As an old XPMET quality assurance
evaluator used to say, "Horse feathers!" Although a frequency of
6 per month for maintaining an EWO console is high compared to the
frequencies at the other bases and the .6400 per accomplishment
time is very low, a review of the ratios shows that the monthly
man-hours are right in line with the mean ratios. Based on that
information the technician shouldn't request any change to the
dat.. However, the technician should investigate enough to make
sure there are no significant differences in equipment, tools, or
procedures involved in maintaining Barksdale's EWO consoles. In
summary, just because the computer identifies a value as exceeding
2 standard deviations, that doesn't mean the value must be
refined. It does mean the technician needs to investigate further
before making a decision.

5. Ratio analysis is as close as the MEO and technician can get to a crystal ball. It is the most powerful form of analysis available today. A ratio of frequency or man-hours to a relatable work count is the best relative measure with which to make decisions. The work count must relate to the task being analyzed, however, or the analysis results will be useless. For instance, the monthly man-hours reported by Fairchild (5.92000) exceed 1 standard deviation and ratio's 1 and 2 exceed 2 standard deviations. However, Fairchild's ratio number 3 (.0344) is very close to the mean (.0387). This is where a technician's knowledge of the work, the work center, and the three work counts used to compute the ratios come into play. Most electronic components used in today's weapon systems will work for years without a failure if they are turned on and left on. However, every time power is applied and turned off the failure rate increases. This means that an aircraft that flies 1,000 hours without stopping (1 sortie) will have very few electronic component failures. However, if the aircraft flew only 2 hours at a time and flew a total of 1,000 hours (500 sorties), the number of failures would increase because each time the plane takes off and lands the electronic equipment is turned on and off. If the technician has learned this through work center familiarization and coordination with functional experts, then no attempt is made to change the data based on the first two ratios. Secondarily if the technician reviewed the work count values for Fairchild, it would be clear that this base has the fewest number of aircraft assigned in the study, but one of the highest ratios of flying hours per aircraft.

6. With respect to Ellsworth's ratio number 3, frequency per sortie flown, subsequent investigation revealed that the sortie work count for Ellsworth was in error. This amplifies the reason why the work count analysis must precede man-hour analysis and must be done correctly. Otherwise, the results of the ratio analysis will be useless.

The same basic procedures discussed above must be used for each of the line numbers containing reported man-hours. With the help of the computer, however, this job has been made a lot easier. Hopefully, the MEO and technician can appreciate more fully the critical requirement for accurate work counts and why so much emphasis is placed on establishing the work count collection system during the earliest part of the study. If no work counts exist, input data analysis and subsequent refinement turns into an exercise similar to trying to solve 3 rubic cubes at once. When all of the direct man-hours have been analyzed, the real fun begins--trying to find out why a value is extreme.

Refinement Procedures. The MEO must always remember that the purpose of input data analysis is to identify extreme values and eliminate them or accommodate them. Accommodation of legitimate extreme values is accomplished by developing exceptions to the basic manpower standard. The development of exceptions has been

cussed and discussed so much recently that it will not be
addressed here. The elimination of extreme values is accomplished
through refinement of the data elements (frequency, per accom-
plishment, and/or work count) or through arbitrary adjustment. A
refinement is defined as any change to the original measurement
data that is concurred with by the base-level or HQ SAC functional
manager, the input SACMET, or the XPMED Project Manager. For
every refinement made to the data, there is a reason. Arbitrary
adjustments on the other hand are changes to the original measure-
ment data for which no reason has been found other than data
analysis results. Suffice it to say, only refinements are allowed
in the SACMEP except in rare cases. Lastly, the MEO must always
guard against the penchant to eliminate all variance in the data.
The operational audit methodology is based on the theory that if
enough functional experts are interviewed concerning the work
being performed, their technical estimates of the time required to
perform the work, when combined and averaged, will approximate the
true average or mean time. The reason refinements are sometimes
needed is because each person involved in the interview brings a
different background and frame of reference into the communication
chain. Due to a bias against management engineering, the func-
tional manager may estimate the man-hour requirements higher than
what it actually is. If the input technician misunderstands the
lead SACMET's written measurement instructions, another extreme
value may appear. The point is, there is almost always a reason
for an extreme value. If no reason can be found, that doesn't
necessarily mean the extreme value needs to be adjusted.

Coordination. To find the reason for an extreme value,
the technician, more often than not, has to go back to the source
of the data--the input SACMET. After the MEO has reviewed and
approved the extreme values identified during input data analysis,
the technician is ready to begin coordinating the results of the
analysis. To do this the technician must be both a detective and
a diplomat. The technician needs to remember that SACMET tech-
nicians take pride in doing a good job. More often than not the
fault lies with the functional manager, the input technician, the
lead SACMET technician, and yes, even the MEOs. The answer is to
stress the identification and resolution of the refinement and not
whose fault it is. In like manner, the input SACMET technician
must remember the lead SACMET technician has a difficult job to do
and needs all the help possible.

In discussing a particular discrepancy in the measurement
data, don't discuss the magnitude of man-hours needed to bring the
extreme value within the control limits. Discuss only whether the
value exceeded the upper or lower control limit and the possible
reason for the discrepancy. The technician should have an idea
whether the culprit is frequency, per accomplishment time, or
both. The objective of this coordination is to get the input
SACMET and the functional manager at that location to look at the
identified task again and either remeasure it or find a reason why

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that location's man-hour estimate is so much higher or lower than the estimates of the other locations. The lead SACMET technician should provide as much additional information as possible to help the input technician find the reason or propose a refinement to the data. Allow the input technician as much time as possible to investigate, but keep the master schedule in mind when setting suspenses. If the schedule becomes compressed at the end of the phase, the MEO might consider communicating directly with the functional manager at an input location after coordinating that decision with the responsible input SACMET MEO. Once all of the input SACMETs have replied to the lead SACMET's questions, the technician must determine whether or not the refinement proposed by the input SACMET is appropriate. There are many ways to do this, but some are quicker and more accurate than others.

Utility Option 8. The most accurate and quickest method of determining what the refinement needs to be is to use Option 4 of the Utility Option 8 program to delete the extreme value or values and recompute the statistical data. This does two things for the technician. First, the affect of the extreme value on the mean and standard deviation is eliminated. Then, the remaining data elements are analyzed once again for extreme values. At this point, it's a judgement call whether or not any new extreme values should be identified for investigation and possible refinement. If the extreme value or values identified during this second iteration of analysis are not significantly beyond the 2 standard deviation control limits, leave them alone. With respect to the extreme value or values identified during the first analysis, the technician can determine an acceptable refinement value by computing control limits from the second iteration and using the control limit as the acceptable refinement value. If this had been done for the task analysis shown in Table 63, the technician would have deleted Fairchild from the analysis and would have rerun option 4 again. Table 64 shows what the results would have been for ratio number 1, monthly man-hours per aircraft assigned.

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Base	Freq	PAT	Mo. Mhrs	Mo.Mhrs/wl1
Barksdale	6.00/Mo**	0.64	3.84	0.1445
Castle	1.00/Mo	3.72	3.72	0.1617
Ellsworth	11.00/Yr	3.35	2.07	0.1406
Grand Forks	1.00/Mo	2.10	2.10	0.1249
Griffiss	2.00/Yr	0.93	0.15	0.0087
Minot	1.00/Mo	2.79	2.79	0.1641
Mean	1.68/Mo	2.26	2.61	.1241
Std Dev	2.14	1.27	1.36	.0583
UCL	5.96	4.80	5.33	.2407
LCL	0.00	0.00	0.00	.0075

Table 64.   Sample Refinement Analysis

Based on the data shown in Table 64, the only value that would
have exceeded 2 standard deviations was Barksdale's frequency.
This is an example of one of those extreme values which barely
exceeds the control limit and should not be refined further. Now,
for demonstration purposes assume the input team and functional
manager agreed that the total man-hours were too high and were
willing to change the per accomplishment time (PAT) to 2.50. The
technician must decide whether or not this is an acceptable
number. To do that the technician should first compare the new
value to the refined control limits. In this case a PAT of 2.50
man-hours would not exceed the upper control limit for PATs (UCL =
4.80), but the original PAT (2.96) didn't exceed the UCL either.
Using a PAT of 2.50 at a frequency of 2/MO, the monthly man-hours
would be 5.00 which also doesn't exceed either of the two UCLs.
At 5.00 man-hours per month, however, the new ratio would be
.03550 which exceeds the refined UCL for ratio number 1 (.2407),
but doesn't exceed the original UCL (.4144). To resolve this
seeming dilemma, the following procedure should be used. First,
the technician must calculate the control limits for the ratio
being analyzed by using the refined statistics provided by the
refinement analysis (Table 64). In this case the control limits
have already been calculated. The UCL is .2407 and the lower
control limit is .0075. These are the control limits that must be
satisfied by the extreme value. In this case the UCL is .2407.
The technician then multiplies the UCL by the value of the work
count to determine the maximum acceptable man-hours per month.
The computations are shown in Table 65.

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```
Given:   Y = Monthly Man-hours
         X = Number of Aircraft Assigned
         R = Upper Control Limit (UCL) or Ratio
         X = 14.083
         R =    .2407

    Y = R
    X
    Y = R(X)
    Y =  .2407  (14.083)
    Y = 3.3897781 = 3.38


    Y = Frequency X PAT

PAT =Y_____
       Frequency

PAT = 3.38     =      3.38     = 1.69
      2(1.000)         2.000
```

Table 65.   Sample Refinement Computations

The resultant "Y" value is always truncated at 2 decimal
places to avoid exceeding the upper control limit. The
computations are the same for the lower control limit--just
substitute the LCL for the UCL. However the "Y" value must be
rounded up when working at the LCL to avoid exceeding it, i.e.,
3.3897 is rounded to 3.39 and 3.3819 is rounded to 3.39. To
determine what the PAT entry in the operational audit data file
should be the technician must divide the monthly man-hours by the
frequency per month, assuming it has not changed. In this case
the frequency was 2 per month which converts to 2.000. The
computed man-hours per accomplishment time is 1.69. This is the
highest PAT the technician can accommodate.

Two points must be addressed to clear up any confusion the
technician might have about this methodology versus older
methodologies that used the original control limits or mean as the
target ratio for refinement. Until the advent of the computer,
the old methodology was used extensively because it was easier to
compute and took less time. Statistically, however, this
methodology was not and is not accurate. Both the original mean
and the original control limits were biased by the extreme value
or values. Therefore, use of those statistics as the target
values allowed far too much variance in the measurement data. By
excluding the extreme value and recomputing the mean and standard
deviation, the statistics more closely approximate the population
mean and standard deviation. Lastly, by using the recomputed mean

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as a target value, the technician would be removing too much
variance from the data.

As long as the input SACMET and functional manager concur with
a value somewhere in between the UCL and LCL, the technician has
accomplished the job. Once all direct man-hours have been
analyzed and refined where necessary, the same procedures are used
for the indirect man-hours. However, few indirect tasks have
relatable work counts. That's where the direct man-hours as a
work count come in handy. If no relatable work count exists, use
the direct man-hours as the work count. The resultant ratio is a
fairly accurate analysis tool since direct man-hours drive most of
a work center's manpower and a significant portion of the indirect
man-hours are personnel-generated. When all indirect tasks have
been analyzed the same coordination and refinement procedures are
used one last time. The MEO then reviews and approves the
coordinated changes to the data and the changes are entered into
the operational audit input data file. Once the files are up to
date, the MEO requests that XPMET zero out the master man-hour
file. When that is done, the technician runs MSDS Processing Menu
8 one last time to ensure the data changes were entered properly.
Then the master man-hour file is loaded and the lead SACMET is
ready to compute the manpower standard equation.

Computation

The actual computation of the manpower standard equation is
really a very short and fairly simple process considering the
amount of time and effort spent doing data analysis. The only
thing the technician has to determine initially is what workload
factors (WLFs) to use for correlation and regression analysis. No
attempt will be made to give any lessons on statistical theory
here. The sole purpose of this section is to present the computer
products produced by the MSDS and explain what the MEO and
technician can learn from each product. Then a method for
evaluating the responsiveness of various equations will be
discussed. Lastly, the procedure for computing manpower tables
will be explained.

Bivariate Regression Analysis. Regardless what type of
equation and WLF the MEO and technicians think will work the best,
all potential WLFs should be run through bivariate regression
analysis. This procedure ensures that no acceptable WLFs are
overlooked. The programs don't take that long to run and the
information provided by the analysis may save the MEO many hours
of backtracking and frustration. Once again the operative motto
is: Don't assume anything and get all the data possible with
which to make a decision. As promised in Chapter 1, this section
will focus on the bivariate regression analysis products obtained
by running MSDS Processing Menu 15. Table 66 shows an example
bivariate analysis print-out. Since this discussion will deal

only with content, questions about format can be resolved by
reviewing Tables 15-19 in Chapter 1.

*****

| SEQU | LINE | | | |
NUMBERS		Y	X	①
1	1	5416.40	830.95	
2	2	7328.08	1242.22	
3	3	4685.28	729.06	
4~	4	3069.88	432.46	
5	5	2655.22	436.97	
6	6	3338.60	447.17	
7	7	3454.29	475.08	
MEAN		4278.25	656.27	
STD DEV		1654.22	303.83	

BIVARIATE MODELS ②
ELECTROIC COUNTERMEASURES, RUN #1

	MODEL 1 LINEAR	MODEL 2 POWER	MODEL 3 RATIO	MODEL 4 PARABOLA
R ③	0.99071	0.99155	0.99219	0.99231
R2	0.98151	0.98318	0.98444	0.98468
A	738.33569336	16.85136223	0.13074974	17.22380734
B	5.39396733	0.85503018	0.00003052	7.50569194
C				-0.00130390
SYX	246.38882	235.01319	226.02140	250.73751
V	0.05759	0.05493	0.05283	0.05861

TESTS ④				
REALISTIC	PASSES	PASSES	PASSES	PASSES
ECONOMIC	PASSES	PASSES	PASSES	PASSES
F	265.457	292.273	316.396	128.579
LEV SIG	0.000016	0.000013	0.000010	0.000235
TB				3.201
LEV SIG				0.032877
TC				0.910
LEV SIG				0.414311
EXTREME VALUES	R-LOWER= 0.006	R-UPPER= 0.508		

LOWER/UPPER LIMITS				
Y-LOWER	1787.536	1739.596	1720.804	1735.803
Y-UPPER	8722.305	8681.482*	8434.742*	8288.318*
X-LOWER	194.514	226.597	237.466	238.884
X-UPPER	1480.166	1485.148	1485.148	1485.148

FOR THE PARABOLA X-APEX =   2878.17

Table 66.   Sample Bivariate Regression Analysis

The numbered comments below refer to the numbered items in Table 66:

1. This particular analysis regresses flying hours flown against the refined monthly man-hours.

2. The technician's task and eventually the MEO's responsibility is to first determine which manpower model passes the statistical criteria established by AFR 25-5, Vol I, Chapter 6. Then the model which shows the strongest correlation and least variation must be chosen. If for any reason, no one model shows sufficient relatability or responsiveness to the workload requirements, multivariate analysis must be considered.

3. These are the symbols used to denote the various statistics used to perform a comparative analysis of the models and determine whether or not the statistical criteria in AFR 25-5 have been satisfied. The "R" stands for the coefficient of correlation. The "R" value is an index number which has no units attached to it, so the "R" value can be used to compare different equations. The "R2" stands for the coefficient of determination. This statistic tells the technician how much of the total variation between the actual man-hours and the computed mean man-hours is explained or accounted for by the regression line or predicted man-hours. The more variation the regression line explains, the closer the R2 value gets to 1.000. Of course, the objective is to find an equation that has an R2 value as close to 1.000 as possible. The "A," "B," and "C" stand for the coefficients in the equation, i.e., $Y = a + b(x)$ or $Y = a + b(x) + c(x)^2$. The symbol "SYX" stands for the standard error of the estimate. This value represents the square root of the total unexplained variation divided by the degrees of freedom. This statistic is expressed in terms of the dependent variable, man-hours, and can be used for comparing the different models. The object is to find the model with the lowest "SYX" or unexplained variation. However, the SYX can only be used to compare equations with the same dependent variable. The "V" stands for the coefficient of variation. This value is computed by dividing the standard error of the estimate (SYX) by the average or mean man-hour value. This makes the "V" statistic a relative measure which can be used to compare different equations regardless of what variables were used.

4. The bivariate analysis program also performs various tests on the equations and data so the technician and MEO can make sure the statistics and models presented are valid for use as manpower equations. The "REALISTIC" test is a "pass or fail" test that determines whether or not the model provides positive man-hour values for all values of workload within the extrapolation range and there is no net loss of man-hours for an increase in workload. In other words, the slope of the equation must be positive throughout the applicable range of the model. The

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"ECONOMIC" criterion tests whether or not a unit increase in
workload at any point in the model causes a constant or lesser
increase in man-hours when compared to all previous per unit
changes.   This means the slope must be constantly positive in the
case of the linear model or in the case of a curvilinear model,
the model is useable up to the apex of the equation. The computer
does all the work. All the MEO has to know is that the model
"passed" both tests. If the model fails either test, delete it
from consideration. The "F" test is the most important signifi-
cance test. It is possible to pass the other tests and not pass
the "F" test. The "F" test is used to determine whether or not
the regression model and WLF combined account for more of the
variation in the man-hours than is left unexplained. Obviously,
if they don't, then the model is not an accurate predictor of
manpower requirements. The larger the value of the "F" statistic,
the more powerful a predictor the model is. The "LEV SIG" stands
for level of significance and refers to the significance of the
"F" statistic. For a Type I or engineered standard the level of
significance must not exceed .050. For a Type II standard the
level of significance must not exceed .100. The MEO should be
looking for the model with the lowest level of significance during
comparative analysis. The last test is called the "T" test. This
test is only applied when the model equation has more than one
independent variable (multivariate analysis) or one or more dif-
ferently ordered terms such as the "X" terms in the parabola model
$(Y = a + bx + cx^2)$. The "T" test is performed on each term to
determine whether or not the term or variable adds anything to the
value or predictability of the equation. Again the MEO should
look for the largest "T" values during comparison. After each "T"
value is another level of significance statistic which is used to
determine whether or not the "T" value is acceptable. The value
of the level of significance must not exceed .2000. If it does,
the particular value which was being tested can't be used. In the
case of a parabola model, that means the model can't be used. In
a multivariate model, it means that particular WLF doesn't add
anything to the equation and should be deleted.

   Comparative Analysis. Now that the various terms have been
explained, it's time to compare the models and select the best
one. The first assumption that must be made is that the most
logical and relatable WLFs have been chosen for bivariate
regression analysis. While the price of gold from 1946 through
1982 might correlate well with the measured man-hours, it's not
logical to expect that one has anything to do with the other.
Referring back to Table 66, the first statistic that must be
considered is the "F" test and it's associated level of
significance, "LEV SIG." All 4 models pass the "F" test with a
level of significance less than .1000 and the ratio model has the
largest "F" statistic. The next statistic to consider is the "T"
test for each term in the parabola model ("TB" and "TC"). While
"TB" passes with a level of significance less than .2000
(.032877), "TC" doesn't pass the test (.414311). Therefore, the

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parabola model is excluded from further consideration. If none of
the models can pass the "F" and "T" tests, there is no point in
proceeding with a comparative analysis of this particular
bivariate regression analysis--start over with a new WLF. Since 3
of the 4 models in Table 66 have passed the tests, the comparative
analysis will continue. The next thing to compare is the results
of the "REALISTIC" and "ECONOMIC" tests. If a model fails either
of these two tests, delete it from further comparison. So far,
all 3 models are still being considered with the ratio model
ranked number 1, the power model ranked number 2, and the linear
model ranked number 3 based on the results of the "F" test. Next
the coefficient of variation must be considered. Once again, the
ratio model is the best with a "V" value of .05283 compared to
.05493 for the power model and .05759 for the linear model. To
meet AFR 25-5 statistical criteria for a Type I standard, the "V"
value can't exceed .15. For a Type II standard, the maximum
allowable "V" value is .25. Again, all 3 remaining models pass
the test. The next statistic to consider is the "R" or "R2"
value. The closer the "R2" value is to 1.000, the more variation
is explained by the model. Once again the ratio model is the best
with an "R2" value of .98444, the power model is second with
.98318, and the linear model is third with .98151. CAUTION: Don't
                                                      CAUTION:
expect "R2" values this high on every bivariate or multivariate
analysis and for the sake of integrity don't consciously try to
make the data produce such statistics. AFR 25-5 only requires
that the "R2" value for a Type I standard exceed .75 and for a
Type II standard the "R2" must exceed .50. Last, but certainly
not least, the "SYX" or standard error of the estimate must be
considered. The MEO should be looking for the lowest value. Here
also the ratio model comes out on top with a value of 226.02140,
the power model is next with 235.01319, and the linear model is
last with 246.38882. The overall winner is the ratio model.
However, when the overall statistics for 2 or more equations are
close in value, the simplest equation form is chosen. In this
case the linear statistics are close enough to the more complex
curvilinear models to be chosen as the manpower standard equation.
Before making a final decision, however, the MEO should compare
the 3 equations using the Utility Option 7, Compute Man-hours--
Compare Equations, program which will be discussed later in this
section. Right now it's time to move on to multivariate analysis.

     Multivariate Regression Analysis. There is one fact to
remember about multivariate regression analysis: The more
variables (WLFs) that are used in multivariate regression
analysis, the better the "R2" statistic will be. In fact, if
enough WLFs are used, the "R2" value will eventually reach perfect
correlation and explain all the variation. Another fact the MEO
needs to keep in mind is that the number of coefficients ("a" and
"b" values) can never equal the number of input locations;
otherwise no significance testing can be performed. The example
in Table 67 shows a sample of the multivariate regression analysis
print-out produced by MSDS Processing Menu 16. Since this

discussion will deal only with the content of the print-out, questions about format can be resolved by reviewing Tables 20-23 in Chapter 1.

```
SEQU   LINE                      ①
  NUMBERS        Y       X 1       X 2       X 3
    1      1   5416.400   26.58    830.95    114.83
    2      2   7328.080   23.00   1242.22    170.82
    3      3   4685.280   21.83    729.06     96.33
    4      4   3069.880   14.08    432.46     58.17
    5      5   2655.220   16.82    436.97     65.25
    6      6   3338.600   17.75    447.17     58.42
    7      7   3454.290   17.00    475.08     67.92

MEAN           4278.250   19.58    656.27     90.25
STD DEV        1654.225    4.35    303.83     41.43
                                                    ②
            TABLE OF R VALUES BETWEEN VARIABLES

(R) OF    TO Y     TO X 1    TO X 2    TO X 3


  X 1    0.7937   1.0000
  X 2    0.9907   0.7660    1.0000
  X 3    0.9820   0.7604    0.9971    1.0000


                                                      ③
    X ORDER OF ENTRY    INTERMEDIATE R VALUES   R2 VALUES


        X 2                 0.9907               0.9815
        X 1                 0.9922               0.9845
  ④     X 3                 0.9949               0.9899
      A          R         R2          SY        V           F
   418.4336   0.9949     0.9899     235.6147   0.0551     97.5858


         ⑤
X(I)    B(I)         T(I)     SIG LEV


  1    29.03712559   0.842    0.461377

  2    10.36594141   2.444    0.092130

  3   -38.91049384  -1.264    0.295510
```

Table 67.   Sample Multivariate Regression Analysis

The numbered comments below refer to the numbered items in Table 67:

1.   This time the MEO chose to regress all 3 WLFs against man-hours. Remember the resultant multivariate equation will have an "a" coefficient plus a "b" coefficient for each WLF tested. That means this equation will have 4 coefficients. There are only 7 input locations, so a maximum of 2 more WLFs is all the program can handle. The WLFs being regressed are: X1, aircraft assigned; X2, flying hours flown; and X3, sorties flown.

2.   When more than one variable is regressed at a time, it becomes difficult to determine to what degree each variable adds to the overall correlation between the dependent variable (Y) and the independent variable (X). However, with the help of the "Table of R Values Between Variables," the task is now at least manageable. From this table the MEO can determine which "X" value has the highest correlation with the "Y" variable and which "X" values have a high degree of correlation between each other. In this case, the WLF X2 has the highest correlation to the "Y" value (.9907). The X3 variable has the next highest with .9820 and X1 has the lowest correlation to "Y" with .7937. The MEO should also notice that variable X1 shows the least correlation with variables X2 and X3 (.7660 and .7604), while X2 and X3 show the highest correlation to each other (.9971).

3.   This table tells the MEO which "X" value was entered into regression analysis first. The intermediate "R" values tell how much the coefficient of correlation increased with the addition of each variable. The order of entry was determined by entering the "X" variable with the highest correlation to the "Y". Based on the Table of R Values, that was the X2 variable at .9907 correlation. The next value entered was X1, not because it had the next highest correlation with the "Y" variable, but because it had the least correlation with the other two "X" variables. As can be seen from the chart, the X1 variable added only .0015 to the value of "R" (.9922 - .9907 = .0015). Then X3 was entered into the analysis which raised the "R" value from .9922 to .9949, an increase of .0027.

4.   The symbols on this line are the same as those used in the bivariate analysis with the exception of "SY" which stands for the Standard Deviation of Y. The "SY" statistic is used in the same way the "SYX" statistic was used in bivariate analysis. In comparing various multivariate equations, however, it is best to use the "V" or coefficient of variation since it is a relative measure and the "SY" statistic isn't. The "R", "V", and "F" statistics must pass the same statistical criteria as cited for the bivariate analysis. However, the multivariate program doesn't compute a level of significance for the "F" statistic, so the MEO will have to use the statistical table in AFR 25-5 to determine whether or not it passes the criteria.

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5. This part of the analysis shows the regression coefficients or "B(I)" value for each "X" variable and the results of the "T" test for each "B(I)" value. Again, the same criteria apply here as for bivariate analysis--the level of significance for "T(I)" values can't exceed .2000. If the limit is exceeded, the variable should be deleted from the analysis because it doesn't add anything significant to the equation. In this case, both X1 with a significance level of .461377 and X3 with a significance level of .295510 should be deleted.

In the final analysis the "X2" variable has the highest correlation with the "Y" variable and bivariate regression analysis should be run if it hasn't been already. The MEO should also run "X3" in a bivariate regression analysis and compare the two resulting models. As for "X1", the number of aircraft assigned, it can be permanently excluded from consideration.

Equation Comparison. Once the MEO has identified the possible manpower standard equations to be considered, one last comparison between the competing equations should be performed to help narrow the field or reconfirm the decision. Comparison of equations is simply a process of computing each equation at varying levels of workload to see how the man-hours change with a change in the WLF value. For an example of this process see Tables 43 and 44 in Chapter 1. The MEO should test each equation over the entire range of its extrapolation limits.

Manpower Table. While the MSDS Processing Menu 22 has the capability to produce a manpower table for bivariate equations, no such capability exists for multivariate equations. However, AFMEA Utility Option 6 allows the user to obtain a manpower table and extrapolation limits. The program output even shows how the extrapolation limits were computed in accordance with AFR 25-5. This option works for all of the bivariate models and multivariate or modular equations as well. See Tables 41 and 42 for instructions on how to use this program.

Conclusion.

At this point in the handbook, the MEO and technician alike should at least have an appreciation for the MSDS and AFMEA Utility Subsystem. Hopefully, that appreciation is also linked to an understanding of the highly complex and demanding data analysis and computation phase. If the MEO and lead technician set the ground rules and establish good interim suspenses, the process will get off to a good start. The two things needed to keep it going, however, are communication and documentation. The technicians working on the study must be kept informed and they in turn must document every change to the original measurement data so the audit trail isn't broken. Lastly, each phase of data analysis and correlation and regression analysis must be performed

with one thought in mind: Computers won't give the answer or make the decision for you--you have to do that yourself.

*****

Chapter Three

POTPOURRI

INTRODUCTION

The following are a few thoughts, experiences, and axioms which are offered to the reader in the hope they might serve him or her as well as they have served the author. While most of these remarks are directly related to the management engineering officer (MEO) and the SAC Management Engineering Program (SACMEP), they were of great value to the author as an enlisted man, an officer, a commander, and a staff weenie.

EXPERTISE

Management Engineering Officers at a SACMET have one of the most important, demanding, and thankless jobs in the Air Force. Of course, the Commander and the technicians don't have it any better with maybe one or two exceptions. They may have learned how to tap dance out of a tense situation or how to keep from getting killed while work sampling on the flightline. There is one other thing—it can also be one of the most rewarding jobs in the Air Force. Whether it is rewarding or not is largely up to the MEO. One aspect of a SACMET that may be true in other work centers, but not nearly as prevalent, is the importance attached to expertise or job knowledge. While a SACMET is still a military organization and the rank structure is alive and well, the person with the most expertise on the team is accorded an unusual amount of respect and leadership potential by the rest of the team members. The lesson the MEO needs to learn from this is simple. If the MEO is to assume a position of leadership and respect within the team, the MEO must become the management engineering expert. The MEO must know AFR 25-5 forward and backward, but more importantly, must be able to demonstrate that expertise in day-to-day situations. ·This means getting out from behind the desk and putting that book knowledge to work in a work center. It also means learning from your technicians, especially the "expert." Eventually, by applying those lessons learned in similar situations and being there when the technicians need you, you will become the team "expert." Without expertise, the MEO is just a manager. With expertise, there are no boundaries on your potential.

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TRAINING

To be successful any unit, especially a SACMET, must have a
viable, on-going training program. While the SACMET commander is
ultimately responsible for ensuring the unit is trained to accom-
plish the mission in the most efficient and effective manner
possible, the MEO and senior noncommissioned officers share in
that responsibility. There are three keys to developing and
maintaining a productive, meaningful training program. The first
key is for the commander and MEO to commit themselves and the team
to having a good program. The training schedule must be reg-
ularized. At least 2 hours a week should be set aside for
training, preferably on the same day every week and at the same
time. This way the technicians will be able to schedule their
work in advance. To those who say they can't afford time for
training, my answer is, you can't afford not to take time for
training. If you don't make time for training, no training will
ever get done. With no training program, the constant exodus of
trained personnel coupled with the steady influx of technical
school graduates will turn the SACMET into a disaster. Once this
happens, the effort required to turn the individuals into a prop-
erly functioning team is exponentially greater than the effort
required to maintain a good training program.

The second key to having a good training program that will
actually teach the team something involves the "trainer." Some
commanders and MEOs have argued it doesn't matter who does the
training. They assign a particular subject to an individual
without knowing whether or not that person knows anything about
the subject matter. Some people defend this "sink or swim"
training philosophy with the argument that if the person didn't
know anything about the subject before, that person will after the
training exercise. While the person tasked with giving the
training might have learned something, the people who were sup-
posed to be trained probably didn't learn anything. If they did,
it certainly wasn't as much as they could have learned from a
person who had extensive experience or expert knowledge of the
subject. If there aren't any experts on the team, the task of
becoming an expert falls to the commander or the MEO. For the
training program to work, the trainer must know more about the
subject than the trainees.

The third key to having a good training program is to keep it
interesting. That doesn't mean art films and field trips. It
means staying away from the old lecture method of instruction for
sure. There is no quicker way to lose the trainees' interest than
to lecture to them, especially in the late afternoon. Structure
the training sessions around one particular objective. It doesn't
have to be an entire process such as correlation and regression
analysis. It can be something as short and to the point as com-
puting extrapolation limits. But, here's the crux of the problem.
Have you ever seen anyone read the 4 pages on extrapolation limits

in AFR 25-5, then close the book and perform the task satisfac-
torily? The key to keeping the trainees interested, awake, and
productive is to emphasize "hands-on" training. If they are going
to be trained how to compute extrapolation limits, prepare some
handouts with the step by step procedures outlined. Then give
them some sample data to work with. Next take them through the
procedures one step at a time and give them time to actually
perform each step of the computations. When they are through with
the sample, give them a new set of data and let them go through
the entire process by themselves. Lastly, check each technician's
work to make sure the training was effective. If 2 or 3 tech-
nicians missed the same points in the process, go back over it
with the entire group, otherwise go over each technician's mis-
takes individually to make sure they understand. The amount of
time it takes to prepare hands-on training material isn't nearly
as much as is required to prepare for a 2-hour lecture. In addi-
tion, this methodology involves as many of the technicians' senses
as possible and retention of the material is much better than with
the lecture method. If the subject matter doesn't lend itself to
demonstrated performance or hands-on training, another way to keep
the individuals interested is to have a seminar or guided discus-
sion moderated by a knowledgeable individual. Better yet, it
should be led by the commander or MEO. Either way, the commander
and MEO should always attend the training sessions regardless of
who is doing the training. Not only will you learn something, but
it shows top level support for the importance of training.

THE QUESTIONING ATTITUDE

The one quality that invariably separates the great MEOs and
technicians from the good ones is a questioning attitude. Chills
go up and down a SACMET commander's spine each time these fateful
words are spoken: "I thought . . . I assumed . . . . The OPR
didn't tell me . . . ." This is especially true if the MEO is the
person speaking, although the results are usually the same no
matter who is speaking. In the words of the SAC Director of
Manpower and Organization, Colonel James E. Roberts, a few years
ago, ". . . many commanders and managers have developed a 'resis-
tance level' to effective manpower management . . . . even if they
know they are not using some resources effectively or efficiently,
they see no reason to inform their manpower servicing staffs . . .
. The tendency is to keep unneeded resources until higher head-
quarters directs the next [arbitrary] reduction." Based on that
evaluation alone, you can see the need for developing a ques-
tioning attitude. That doesn't mean you have to get belligerent.
Persistent is a better word for it. While some people are born
with this talent, most people are not. Most people, especially
people involved in investigative work like auditors, the police
and SACMET MEOs and technicians, must train themselves to develop
this questioning attitude. One of the saddest statements ever
made by a MEO was, "My people are reporters. They just report

what the OPR says." This was the same day a management engi-
neering product was being returned to the team with 40 pounds of
paper clips on its nages. Let's put to rest once and for all the
contention that MEOs and management engineering technicians are
just gossip column reporters reporting what they are told. Even
newspaper reporters try not to rely on just one source of informa-
tion, especially when the subject matter is something as sensitive
as a functional manager's manpower resources. That brings to mind
one of my axioms for success in the management engineering disci-
pline: "Never rely on just one source of information." While it
may not always be possible to get the same data or explanation
from more than one source, there is always related information
that can be used to verify the subject information.

    The next subject to tackle is how to develop a questioning
attitude. It's a fairly simple process, but it takes awhile to
form the habit. All you have to do is write the following 6 words
on a note card or piece of paper and commit them to memory: WHO,
WHAT, WHEN, WHERE, WHY, and HOW. These 6 words asked enough times
in any order will almost always get the information you need to do
your job right the first time. The reason I say almost is because
you can't disregard the possibility, however remote, of ques-
tioning 2 intentionally uninformed people about the same subject.
In closing, I leave you with a poem that I use to remind myself to
keep that questioning attitude.

         I had six honest men--
         They taught me all I knew:
         Their names were Where and What and When--
         and Why and How and Who.
                         --Rudyard Kipling

*The author after his
first lead team study.*

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