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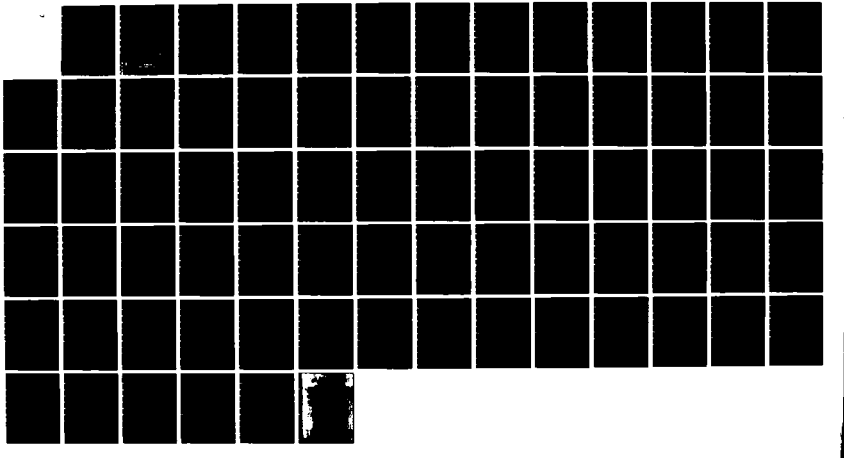

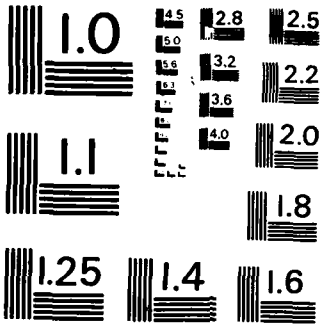

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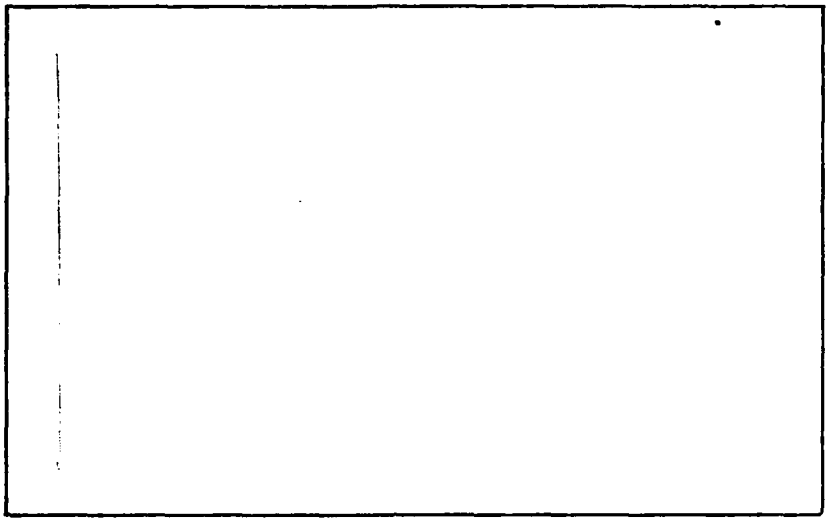

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This report is the fourth in a series of volumes by Desmatics, Inc. which review procedures used in the Weapon System Support Cost (WSSC) subsystem of the Air Force Visibility and Management of Operating and Support Costs (VAMOSC) system to allocate operating and support costs to USAF aircraft weapon systems. This volume presents the results of an examination of the algorithms and data used by WSSC to allocate below depot maintenance costs.

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Because data is not available to show directly the below depot maintenance costs incurred by each MDS (mission-design-series), it is necessary for WSSC to allocate the costs which are available at the command/base level. WSSC uses maintenance direct labor hour (DLH) data as the basis for allocation. Although the DLH data is subject to reporting errors of omission and inflation, the analysis in this report indicates that the resulting inaccuracies do not vitiate allocation based on that data.

Desmatics makes several specific recommendations for changes in WSSC processing, and raises several questions for review by Office of VAMOSC personnel pursuant to possible development of additional changes. Desmatics' conclusions and recommendations are listed in this report, together with accompanying comments from the Office of VAMOSC.

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Applied Research in Statistics - Mathematics - Operations Research

AN EVALUATION OF THE WSSC COST ALLOCATION ALGORITHMS IV: BELOW DEPOT MAINTENANCE

by

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EXECUTIVE SUMMARY

This report is the fourth in a series of volumes by Desmatics, Inc. which review procedures used in the Weapon System Support Cost (WSSC) subsystem of the Air Force Visibility and Management of Operating and Support Costs (VAMOSC) System to allocate operating and support costs to USAF aircraft weapon systems. This volume presents the results of an examination of the algorithms and data used by WSSC to allocate below depot maintenance costs.

Because data is not available to show directly the below depot maintenance costs incurred by each MDS (mission-design-series), it is necessary for WSSC to allocate the costs which are available at the command/base level. WSSC uses maintenance direct labor hour (DLH) data as the basis for allocation. Although the DLH data is subject to reporting errors of omission and inflation, the analysis in this report indicates that the resulting inaccuracies do not vitiate allocation based on that data.

In addition to analyzing the DLH data, Desmatics reviewed samples of cost data from the Accounting and Budget Distribution (ABDS) system, and manpower data from the Military Personnel Center (MPC) system, which are the other WSSC sources of below depot maintenance information. These data sources were judged to be satisfactory for their purposes.

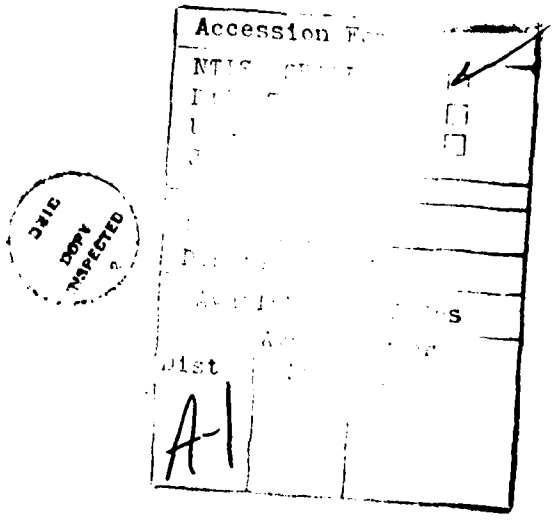
The categories used by WSSC for its USAF detail report constitute a heterogeneous structure, which is a hybrid of POMO (Production oriented maintenance organization) and non-POMO squadrons. Desmatics noted some difficulty in assigning cost data identified by squadron-level codes to the categories specified by the Cost Analysis Improvement Group (CAIG)

for the CAIG report. Specifically, some of the costs, such as for munitions maintenance, which are uniquely identified in non-POMO organized bases by a particular squadron code, are confounded within POMO squadrons and cannot be segregated. Desmatics recommends that WSSC take advantage of branch-level identification codes which are available in the ABDS, MPC and DLH data. At this more detailed level it would be possible to identify corresponding functions within POMO and non-POMO squadrons for representation in both USAF detail and CAIG reports.

While the use of branch-level codes would provide a method for achieving a consistent set of categories, another problem remains. Desmatics believes that the present USAF detail and CAIG format categories may be improved with respect to satisfaction of user needs. Specifically, Desmatics recommends consideration of the adoption of functional categories keyed to the primary subsystems of aircraft weapon systems. This report provides a description of such categories, based on work unit codes, and indicates how such a scheme might be implemented.

Desmatics has observed that many of the costs incurred by below depot maintenance are essentially of an indirect nature and should not be assessed directly against weapons systems. Also, the Military Airlift Command (MAC), since it is "industrially funded," and thus bills customers for its services, reports some costs as maintenance which are customarily regarded as installation support. It is recommended that indirect costs be identified and given separate visibility so that users may see the overhead burden being assessed against aircraft weapon systems. This would provide a clearer representation of the direct maintenance activity required. In those instances where MAC has assigned charges to maintenance

cost centers which are more appropriately considered as installation support, Desmatics recommends that further investigation be undertaken to determine whether these costs ought to be reclassified.



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I. INTRODUCTION

Desmatics, Inc. under Contract No. F33600-80-C-0554, is conducting an evaluation of the cost allocation algorithms employed in the Weapon System Support Cost (WSSC) subsystem of VAMOSC, the Air Force Visibility and Management of Operating and Support Costs system. This report is the fourth in a set of volumes which discuss the scope and findings of the Desmatics evaluation effort.

The purpose of this volume is to evaluate the WSSC procedures for allocating below depot maintenance costs and strengths to Air Force aircraft weapon systems. It examines the reasonableness of the data and procedures used in selecting, classifying, and allocating below depot maintenance costs and strengths to weapon systems, assessing whether they may be expected to provide equitable results. This volume also includes an assessment of the impact on the WSSC below depot maintenance algorithm of using maintenance man-hour data which has been shown to have certain inaccuracies.

Based on its research, Desmatics has made a number of specific recommendations which are enumerated in Section VI of this report. The corresponding responses and comments of the Office of VAMOSC accompany each recommendation.

The Statement of Work under which this Desmatics study was initiated calls for the evaluation of the WSSC system algorithms as set forth in system specifications dated June 1980. The WSSC system has evolved almost continually since that time, reflecting improvements that were made in virtually every aspect of the system logic prior to the first production

runs in April 1982. Additional modifications and enhancements were made to WSSC between the first production run in 1982 and the second run made in April 1983, and more are planned for the immediate future.

Desmatics recognizes that to restrict its evaluation to the June 1980 baseline would significantly limit the usefulness of its findings. Accordingly, Desmatics has kept pace with the evolution of the WSSC system, and has attempted to reflect the significant system changes in its study, specifically in those instances where a given cost was computed by different algorithms in two (or more) years. As a result, the documentation of Desmatics' findings is more complex than might otherwise be the case. The reader may expect frequent encounters with the phrases "for FY81," "for FY82" and "for FY83."

Desmatics has endeavored to have this volume reflect the current status of below depot maintenance cost allocation algorithms within the WSSC system. The authors feel that this has been accomplished. However, the reader must realize that should future WSSC system changes impact on the algorithms discussed, portions of this report may become outdated.

II. BACKGROUND

Below depot maintenance may be defined as activity performed by unit level personnel which keeps aircraft weapon systems operating and ready to fulfill their mission requirements. It is the activity that comes under the supervision of the deputy commander for maintenance (DCM). Two independent maintenance manpower organizational concepts are currently used in the Air Force. They are defined AFR 66-5 [12] and AFM 66-1 [7]. The former is referred to as a Production Oriented Maintenance Organization (POMO), while the latter is called non-POMO.

Throughout this report it is assumed that aircraft maintenance is organized into squadrons which are in turn composed of branches. Although this is not always the case, this assumption simplifies the ensuing discussion without any loss of generality. More specifically, "squadron" as used here refers to any work center defined by a Cost Center, Functional Account Code, or Work Center Code having a zero code in the third position; "branch" refers to any work center immediately subordinate to a squadron as here defined.

In general, each type of maintenance squadron is responsible for a specific aspect of maintenance such as component repair (POMO) or field maintenance (non-POMO). Small bases may sometimes have their aircraft maintenance organized into a single consolidated maintenance squadron (CAMS) rather than the three POMO or four non-POMO squadrons typically employed. In these instances, labor costs incurred at branch level are reported under the corresponding squadron cost centers. Only the commander and staff costs are reported under the consolidated maintenance cost center.

The organizational cost-reporting structure currently used in WSSC is described and evaluated in the following sections. In addition, the use of a functional cost-reporting structure is suggested.

III. PROCESS DESCRIPTION

Neither maintenance cost nor strength data is identified by MDS in the data available for input to WSSC; therefore, an allocation procedure must be used. This section describes WSSC's outputs, its inputs, and the algorithm used to allocate aggregated cost and strength data to the MDS level. Processes used by WSSC to select, classify, allocate and display maintenance costs are described in three source documents: WSSC Users Manual, AFM 400-31, Vol II [10]; WSSC System/Subsystem Specifications [4]; and VAMOH Subsystem Specifications [5].

A. OUTPUT

WSSC produces two standard report formats which include below depot maintenance information. The USAF detail report presents cost and strengths in terms of the maintenance organizational structure. Costs and strengths are reported as they are incurred by the maintenance squadrons listed in Table 1. This list represents a compilation by type of organization, which includes consolidated maintenance, POMO and non-POMO squadrons. For each line (squadron), costs are shown separately for labor pay and allowances, materiel, contract and other expenses. Officer, airman and civilian strengths are displayed separately.

CAIG defines below depot maintenance (unit level maintenance) in terms of only four elements: organizational (on-equipment), intermediate (off-equipment), ordnance and other [1]. WSSC, therefore, must aggregate costs across squadrons to meet the needs of the CAIG report. Only personnel

Chief of Maintenance (DCM)

Consolidated Aircraft Maintenance Squadron (CAMS)[1]

Avionics Maintenance Squadron (AMS)

Field Maintenance Squadron (FMS)

Munitions/Missile Maintenance Squadron (MMS)

Organizational Maintenance Squadron (OMS)

Aircraft Generation Squadron (AGS)

Component Repair Squadron (CRS)

Equipment Maintenance Squadron (EMS)

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[1] WSSC treats all CAMS costs as DCM

Table 1: Below Depot Maintenance Organizations

pay and allowances and materiel expenses are displayed. Table 2 shows how the WSSC report elements are grouped for the CAIG report.

B. INPUT DATA

Costs for below depot maintenance activity in FY81 were all extracted from the ABDS system. For FY82 all military labor costs were determined by applying pay tables to personnel counts. Cost records are selected and classified on the basis of the two-digit cost center (CC) portion of the RC/CC codes shown in Table 3. The EEICs used to further identify the nature of these costs are shown in Table 4. Personnel strength data is obtained from the MPC files. MPC records are selected and classified using the Functional Account Codes (FACs) noted in Table 5. Data for assigned strengths, available by quarter, is averaged to obtain an annual count.

WSSC uses maintenance direct labor hour data as the basis for allocation to MDS. Maintenance man-hours by Work Center Code (WCC), as shown in Table 6 and identified by CMD/GELOC/MDS, are selected from a maintenance data interface file for use in the allocation algorithms. In FY81 the source of maintenance man-hour data was AMMIS (E506). For FY82 the source was changed to the D056 system. The Work Center Code that WSSC uses is derived from the code reported into the Maintenance Data Collection System on AFTO Form 349 described in TO-00-20-2 [15]. WSSC uses the second digit of the 5-digit WCC code, preceded by a 2, so that they correspond in format to CCs and FACs.

CC code	USAF Detail Format	CAIG Format
22XX	Organizational Maintenance	Organizational/Intermediate Maintenance
23XX	Field Maintenance	
24XX	Avionics Maintenance	
2EXX	Equipment Maintenance	
2GXX	Aircraft Generation	
2RXX	Component Repair	
25XX	Ordnance Maintenance	Ordnance Maintenance
21XX[1,2]	Chief of Maintenance	Other Maintenance
	Materiel Element of Nine WSSC Functions	Maintenance Materiel

[1]Except 2130 and 2140, which are peculiar to SAC ICBM

[2]WSSC treats 20XX-coded costs (CAMS) as 21XX (DCM)

Table 2: WSSC Mapping of Air Force Below Depot Maintenance Functions to CAIG Functions

RC/CC	Function
XX20XX[1]	Consolidated Maintenance
XX21XX[2]	Chief of Maintenance
XX22XX	Organizational Maintenance
XX23XX	Field Maintenance
XX24XX	Avionics Maintenance
XX25XX	Munitions Maintenance
XX2EXX	Equipment Maintenance
XX2GXX	Aircraft Generation
XX2RXX	Component Repair

[1] XX20XX records are changed by WSSC to XX21XX

[2] XX2130 and XX2140 are excluded

Table 3: Cost Center Codes Used by WSSC to Select ABDS Below Depot Maintenance Records

EEIC	Description
20101	Officer Pay and Allowances[1]
20102	Airman Pay and Allowances[1]
391XX-394XX, 396XX	Civilian Pay and Allowances
51XXX-59XXX	Contract
60XXX-63XXX	Materiel
Remaining EEICs	Other

[1]For FY81 only. For FY82 military pay was computed by applying pay tables to manpower counts from the E300Z system.

Table 4: Expense Element Codes Used by WSSC to Classify ABDS Cost Records

FAC	Function
21XX[1]	Chief of Maintenance
22XX	Organizational Maintenance
23XX	Field Maintenance
24XX	Avionics Maintenance
25XX	Munitions Maintenance
2EXX	Equipment Maintenance
2GXX	Aircraft Generation
2RXX	Component Repair

[1] 2130 and 2140 are excluded

Table 5: Functional Account Codes Used by WSSC to Select MPC Below Depot Maintenance Records

WCC	Function
22XX	Organizational Maintenance
23XX	Field Maintenance
24XX	Avionics Maintenance
25XX	Munitions Maintenance
2EXX	Equipment Maintenance
2GXX	Aircraft Generation
2RXX	Component Repair

Table 6: Work Center Codes Used by WSSC to Select Direct Labor Hour Records for Below Depot Maintenance

C. WSSC ALGORITHM

For each below depot maintenance organization, costs and strengths are summed by command, base and expense element. These sums are then allocated to MDSs within each command/base combination using an allocation ratio unique to each organization. Using the maintenance man-hour data identified by CMD/GELOC/MDS, WSSC defines eight allocation ratios in the following format:

$$AR = \frac{\text{man-hours (CMD/GELOC/MDS)}}{\text{man-hours (CMD/GELOC)}} .$$

For the chief of maintenance (which includes commander and staff for consolidated maintenance), costs are allocated using the ratio

$$AR = \frac{\text{man-hours (all organizations/this MDS)}}{\text{man-hours (all organizations/all MDS)}} .$$

Costs and strengths for each command/base/expense element/organization combination are multiplied by these ratios. The results are the costs and strengths attributed to each MDS.

IV. QUALITATIVE EVALUATION

Desmatics reviewed three aspects of the WSSC process: (1) input data quality, and selection and classification criteria; (2) appropriateness of the output formats; and (3) the allocation algorithms. Documents used to support this review include: AFR 170-5 (Responsibility Center/Cost Center Codes) [13], ADE EL-191 of AFM 300-4 (Elements of Expense/Investment Accounts) [8], ADE FU-500 of AFM 300-4 (Functional Accounts) [9], and Aircraft Operating and Support Cost Development Guide (CAIG) [1].

A. INPUT DATA ASSESSMENT

To assess the accuracy and appropriateness of the WSSC below depot maintenance input data, Desmatics examined large samples of cost data from ABDS (H069R), personnel strength data from MPC (E300Z) and maintenance man-hour data from AMMIS (E506). Initially Desmatics reviewed raw FY81 ABDS data (as input to VAMOH) for MAC, SAC and TAC. Later Desmatics examined the entire WSSC ABDS file for FY82 as output from VAMOH, as well as the entire summed quarterly personnel files for FY81 and FY82. Desmatics also assessed the quality of the maintenance man-hour data available to WSSC and has reassessed the impact of man-hour inaccuracies on the validity of WSSC allocation algorithms.

Appendix B contains a tabulation of all FY82 maintenance costs by command and EEIC. As discussed in Volume I [2], ABDS data examined by Desmatics contained several instances of accounts which had negative

year-end balances. This is appropriate for reimbursable-type accounts such as those having an EEIC of 559, representing credits for sales of services. The occurrence of negative balances in other types of accounts (e.g., EEICs 432, 469, 471, and 612) is less easily explained; however, the amounts were small.

Numerous command-to-command differences were observed in the usage of EEICs, the most noteworthy of which were reported by MAC for types of expenditures that appear to be indirect in nature. For example, in FY82 MAC reported $12 million for purchased utilities (EEIC 480) against aircraft maintenance organizations. Similarly large amounts were reported by MAC for facility maintenance and repairs (EEICs 521 and 522), and minor construction (529). Lesser amounts were reported by MAC aircraft maintenance units for wire communication services (494) and other contract civil engineering services (533). The other relevant commands reported either no expenses in these EEICs or only negligible amounts.

These costs are the type expected to be reported against the host's civil engineering cost centers as installation support, portions of which would be allocated by WSSC to aircraft operations and maintenance. It appears that MAC either identifies portions of these base installation support costs to O&M cost centers or does some sort of allocation. The fact that MAC operates using revolving ("industrial") funds undoubtedly provides an insight into this problem.

The implications of MAC's coding anomolies cannot be completely estimated without knowing the full details of how MAC treats costs which one usually considered to be base installation support. MAC not only charged purchased utilities (EEIC 480) to maintenance cost centers (and,

incidentally, to unit operations cost centers as well), but also had substantial amounts of purchased utility expense reported as base level installation support. If the amount of purchased utilities charged to maintenance represents the full extent of such costs incurred on behalf of MAC aircraft maintenance units, then it would not be proper for WSSC to allocate any part of the installation support purchased utilities costs of MAC-hosted bases to MAC aircraft. However, the WSSC allocation algorithms as presently constituted will do just that. Thus there is a possibility that these costs will be overstated, depending on how MAC treats purchased utilities. The same may be said for other types of common costs, such as EEICs 521, 522, and 529.

The review of the ABDS data also showed that EEIC 604 (medical-dental AFSF supplies and materiel) and to a lesser degree EEIC 624 (medical-dental AFSF equipment) were used. It was not possible for Desmatics to determine precisely what these supplies were or how they were used. Therefore, Desmatics could only speculate at this point. WSSC determines the cost of providing health care to unit mission and support personnel using a cost factor supplied by the USAF Surgeon General and personnel counts supplied by the MPC system. If the medical expenses reported in the ABDS data for below depot maintenance are consumed directly, then there may be a duplicate accounting for medical expenses, and these EEICs ought to be excluded. If, however, the ABDS data records represent supplies for survival kits loaded on aircraft, for example, then these costs should legitimately be charged to the MDSs being maintained, since they would not duplicate any costs covered by the Surgeon General's factor. Desmatics suggests that the Office of VAMOSC determine the nature of EEIC 6X4 costs

reported by maintenance cost centers in order to resolve this dilemma.

A sample of MPC data for all command/bases for FY81 was reviewed. In general the data appeared to be satisfactory for its purpose, but there were some coding peculiarities within TAC. One record appeared in the sample with a FAC of 2H3? and one with 2T11 from Tyndall AFB. There is a question as to whether this is a coding error, misunderstanding of the coding manual or an approved code for TAC that does not appear in the documentation. According to AFR 170-5 and AFM 300-4, the only allowable alphabetic maintenance cost center codes and their corresponding FACs are 2GXX, 2EXX, and 2RXX. However, an AFR 170-5 TAC Supplement was noted to contain 2JXX entries, suggesting the possibility that commands may use additional codes. The occurrence of unexpected codes will not normally be observed in WSSC files, since VAMOH accepts only those records specified for inclusion. However, the FY81 MPC file reexamined by Desmatics was an intermediate file which had not been screened. It should be noted that if base level legitimate usage of additional codes occurs, this can only be detected by an examination of raw input files. Desmatics recommends that a continuing effort be made to determine how input data codes are assigned at command and base levels so that the selection logic can be kept up to date.

Desmatics also examined samples from FY81 summary files of maintenance man-hour data. By its nature such data is difficult to check for logical inconsistencies, since the record identification is limited to command, geographic location, MDS and work center at most. The data was evaluated to the extent possible and judged to be satisfactory for its intended purpose. As was discussed in Volume I, inaccuracies are

known to exist in reported maintenance man-hours, with some jobs going unreported and others being inflated. The impact of using this data to allocate costs to MDSs is discussed in detail in Appendix A of this report.

B. OUTPUT ASSESSMENT

WSSC's two standard report formats were reviewed in terms of the degree to which they meet user needs. The CAIG format was evaluated with respect to the guidelines and definitions provided by CAIG. CAIG says "Both cost and non-cost (number of people) estimates should be presented . . ." [1]. In addition, CAIG defines four elements of maintenance activity for which costs should be displayed: organizational, intermediate, ordnance and other. The current CAIG report format produced by WSSC does not display organizational and intermediate maintenance separately, nor was there provision in FY81 to display manpower data.

Other problems with the CAIG report format relate to the way WSSC aggregates and assigns costs to the four CAIG report maintenance categories. One problem occurs in costs reported for ordnance maintenance. Currently the only type of maintenance which WSSC includes in the CAIG ordnance maintenance category is that performed in non-POMO munitions maintenance squadrons (MMS) identified by 25XX cost center codes. Munitions labor costs at POMO bases, as represented by cost center codes 2E3X and 2G13, are currently reported with the rest of the equipment maintenance squadron (EMS) and the aircraft generation squadron (AGS) under organizational/ intermediate maintenance. This problem could be alleviated if WSSC

were to make use of branch level information provided by the third digit of the cost center code, which identifies branches within maintenance squadrons.

For similar reasons, costs that CAIG expects will be reported in "other", i.e., that are not expected to be found in organizational or intermediate, are not amenable to separate identification. Specifically, CAIG defines "other" costs to include support equipment maintenance, simulator maintenance and chief of maintenance costs. Some of the cost center codes shown in AFR 170-5 which fall into these categories include 21XX (chief of maintenance), 2230 (support equipment maintenance), 2340 (aerospace ground equipment maintenance), 2450 (PMEL), 2470 (avionics AGE) and 2R90 (aircrew training devices). Here again WSSC loses visibility by looking only at squadron level data and is thus unable to segregate these specific items in order to classify them according to the CAIG format.

A review of the EEIC's used by MAC, SAC, and TAC suggested another problem with the format of the WSSC output. Direct aircraft maintenance costs and indirect costs, those incurred in support of the maintenance organization, are combined in the costs that are reported by WSSC. Indirect, or overhead, costs include those for temporary duty expenses, shipping charges, purchased utilities, ground fuel, etc. The impact of this is that there is no way of knowing the extent to which an MDS required direct maintenance. This kind of information would be useful when future design or acquisition decisions are made. It may also be useful for projecting staffing or training needs. Rather than confound direct costs with indirect costs, it would be helpful to provide separate visibility for direct and indirect costs.

There are two additional types of costs incurred in below depot maintenance which are primarily of an overhead nature. These are: (1) base flight and transient aircraft maintenance, and (2) precision measurement equipment laboratory (PMEL). At present WSSC assesses all of these costs against the primary weapon systems assigned to the unit. A portion of these functions are in support of the entire base, and may occasionally support other organizations or services, particularly in the case of PMEL[1]. Thus, an argument can be made for treating a portion of them as BOS if a satisfactory means can be found for identifying the direct portions of the costs.

The foregoing calls into question the utility of reporting maintenance costs in terms of the organizational structure WSSC currently uses, which does not provide the user with information about the peculiar maintenance requirements of individual MDSs. Interpretation of the information provided by the present institutionally oriented categories, particularly at the worldwide MDS level, is complicated by the fact that the present breakdown is a hybrid of POMO, non-POMO and consolidated organizational elements.

As previously mentioned, WSSC currently considers only two-position cost center codes (a one-position "maintenance" code plus a one-position squadron-level "work center" code). As a result WSSC is only able to display costs to the squadron level. The same is true for manpower and man-hour data, since only two-position functional account codes are used with MPC data and two-position work center codes are used with maintenance man-hour data. One consequence is that all data is treated at a high

[1]See AFM 66-1, Vol. 2, paragraph 1-22 [7].

level of aggregation, with the result that much valuable information may be obscured.

Consider what might happen in the component repair squadron (CRS) of a POMO base which has two distinct MDSs, one requiring high avionics maintenance and low propulsion system maintenance, and the other experiencing the opposite pattern. Under the present squadron level identification, WSSC would lump all CRS engine and avionics costs (as well as accessory and other CRS maintenance costs) producing cost aggregations which mask the significant differences between the MDSs. These would then be further diffused when allocated among MDSs based on similarly aggregated maintenance man-hour data.

An alternative way of reporting base level aircraft maintenance costs is to portray costs in a functional structure, which would give the user information about maintenance activity as it relates to parts of the aircraft, e.g., the airframe, power plant, avionics, etc. Rather than knowing who did the maintenance, the user would know what kind of maintenance was performed. This type of information would show more directly where a weapon system is weak in design or performance and which of its systems are expensive to maintain. Section V of this report discusses the feasibility of implementing such a functional cost reporting structure in more detail.

C. ALGORITHM ASSESSMENT

As discussed previously, all below depot maintenance costs are allocated to MDSs on the basis of the direct labor hours, which are

reported by MDS in the AMMIS (FY81) or D056 (FY82) systems. It is reasonable to question whether man-hours is the appropriate indicator of maintenance costs and strengths, and whether use of man-hours in an allocation ratio produces the most equitable results. It is certainly appropriate to allocate pay and allowance costs and personnel strengths using man-hours. All of the variables involved relate to the manpower needed to perform required maintenance functions for an MDS.

With regard to maintenance materiel, the relationship to direct labor hours is less clear. The assumption is that the more man-hours spent maintaining a particular MDS, the more materiel costs would be incurred. This may be true to some extent. However, when an expensive part is replaced easily and quickly, the relationship does not hold. Desmatics understands that the Office of VAMOSC is aware of this problem and is pursuing the possibility of getting materiel costs by MDS from the base supply system via the CSCS (D160B) system.

There are, however, materiel, contract and other costs incurred by below depot maintenance organizations for other than directly aircraft-related activity. They are incurred in support of the maintenance organization. As support costs, they may be allocated to MDSs in proportion to the numbers of people, by MDS, they support. Since the number of people is itself the result of an allocation based on man-hours, it would be reasonable to allocate support costs on the basis of man-hours. However, to expect the relationship to hold at the squadron level or below may be beyond what the data can really support. It would be better to aggregate costs to the command/base level and the man-hours to the command/base/MDS level in order to perform the allocation. This possibility is discussed further in Section V.

V. SUGGESTED MODIFICATIONS

In the previous section it was pointed out that the current cost category structure used in WSSC USAF Detail reports, based on squadron-level cost centers, does not provide optimum visibility. Desmatics offers two solutions, favoring the use of functional categories which relate below depot maintenance costs to major aircraft subsystems. This method is described in Section A. An alternative, presented in Section B, provides a partial solution to the problem, but may be more easily implemented. Section C outlines another suggested modification relating to a different aspect of cost visibility, the discrete identification of indirect maintenance costs.

A. FUNCTIONAL CATEGORY STRUCTURE

It was pointed out earlier in this report that the nine subcategories of below depot maintenance shown in Table 1 constitute a listing of the major organizational units within which aircraft maintenance functions are performed, and is not entirely a functional breakdown into elements relating to the major subsystems common to all aircraft weapon systems. The avionics and munitions categories are each largely functional as well as organizational classifications, but the others are primarily organizational.

There would appear to be considerable value in using a functional rather than (or possibly in addition to) an organizational breakdown within below depot maintenance. A functional system of classification would

be more useful to cost analysts because it would relate cost and manpower expenditures to aircraft subsystems. It may be noted that the WSSC depot maintenance categories are functional rather than organizational, providing a precedent for using a functional classification in below depot maintenance as well.

The use of a mix of POMO and non-POMO categories results in incomplete and perhaps misleading visibility of some below depot maintenance costs in the current WSSC system. This is the case with respect to the display of munitions maintenance costs in the CAIG format report. As mentioned in the preceding section, the munitions maintenance costs reported in the CAIG format include only the costs from the non-POMO munitions maintenance squadrons. The equivalent costs in POMO-organized maintenance are confounded with the AGS, CMS and EMS squadrons and cannot currently be separately identified. This problem would be alleviated if functional categories were substituted for organizational ones, or if POMO work centers were mapped into the non-POMO structure, thus permitting a set of nonhybrid categories to be used.

1. Suggested Categories

WSSC already uses a set of categories for depot maintenance which are functionally related to major subsystems of aircraft. These are based on the work breakdown structure (WBS) codes used in the Weapon System Cost Retrieval System (WSCRS) for depot maintenance [16]. These WBS codes are similar but not identical to WBS codes used by the Maintenance Cost

System (MCS), as described in AFM 177-380 [11]. Table 3-1 in AFM 177-380 provides a list of WBS codes with associated grouping titles and a list of the work unit codes (WUC) which make up each WBS category. Both the WUC identification which comes into MCS and the WBS identification which is assigned by the Maintenance Data Collection System (MDCS) are passed forward in the labor data which is output by MCS. However, neither the WUC nor the WBS is available in the labor data currently input to WSSC.

Table 7 shows the WBS and WUC information extracted from Table 3-1 of AFM 177-380 as it pertains to the F15A aircraft. Descriptions were taken from the Work Unit Code Manual TO 1F-15A-06 [14]. Although Table 7 is peculiar to the F15A, it illustrates the principle of classifying work unit codes. No difficulty is anticipated in fitting the full set of WUCs, applying to all aircraft, into this structure satisfactorily.

Table 8 provides a comparison of the WBS codes used in AFM 177-380 with those used by the WSCRS system. As Table 8 shows there is considerable similarity in the WBS categories used by MCS for below depot maintenance and by WSCRS for depot maintenance labor hour reporting. The categories are functionally related to the major aircraft systems, and provide a good foundation for a functionally oriented, rather than organizationally oriented, structure of below depot maintenance subcategories. The MCS category labelled "aircraft" provides a necessary place to display costs and labor expenditures in the important "support general" categories associated with launch, recovery, inspections, ground handling, cleaning, arming/disarming and other on-equipment activity.

There is also a need to provide visibility for two other types of support activity performed by maintenance organizations--support equipment

WBS	GROUP	TWO-DIGIT WUC	DESCRIPTION
1	Aircraft	01-09	Support General
2	Airframe	11	Airframe
		14	Flight Control
3	Engine	23	Power Plant
		24	Secondary Power System
4	Accessories	12	Cockpit & Fuselage Compartments
		13	Landing Gear System
		41	Environment Control System
		42	Electrical System
		44	Lighting System
		45	Hydraulic System
		46	Fuel System
		47	Oxygen System
		49	Miscellaneous Utilities
		91	Emergency Equipment
5	Electronics	51	Instruments
		52	Autopilot
		55	Malfunction Analysis
		57	Integrated Guidance & Flight Control
		63	UHF Communications
		65	IFF System
		71	Radio Navigation
		74	Fire Control System
		76	Tactical Electronic Warfare
6	Armament	75	Weapons Delivery System
		97	Explosive Devices

Table 7: Maintenance Cost System Workload Breakdown Structure (WBS) and Work Unit Codes (WUCs) for the F15A Aircraft

MCS WBS Code	MCS Group	WSCRS WBS Code	WSCRS Group
1	Aircraft	----	----
2	Airframe	AX1	Airframe
3	Engine	AX2	Engine
4	Accessories	AX3	Other Components
5	Electronics	AX4	Avionics
6	Armament	AX5	Armament
----	----	AX6	Support Equipment

Table 8: Comparison of Workload Breakdown Structure (WBS) Codes as Used by MCS and WSCRS

maintenance and maintenance management. The latter includes all the maintenance training management, administration, inspection, quality control, maintenance control, job control, materiel control, planning, scheduling and related functions performed under the chief of maintenance organization or within consolidated maintenance.

Based on the structures shown in Tables 7 and 8, Desmatics has developed a suggested alternative to WSSC's current USAF detail report categories. Table 9 shows a set of nine functional categories which should provide useful visibility of aircraft below depot maintenance costs and labor utilization. The titles are mostly extensions of those used by MCS. Three more categories have been added: one is maintenance management, which is needed to reflect all the chief of maintenance functions; the second is support equipment maintenance, which provides a place on the USAF detail report to display maintenance performed on the equipment used in support of aircraft operations; and the third is indirect maintenance, which includes PMEL, base flight and transient activities.

Table 9 shows a proposed set of functional categories defined in part in terms of WUCs. The table shows one suggested way to classify WUCs, based on the full set of work unit codes. Accordingly, the title of one category, engine, has been changed to propulsion/power to accommodate rotors and propellers.

The categories shown in Table 9 may be used to supplement, or possibly to replace, those currently used by WSSC. If the Office of VAMOSC feels that the present categories are indispensible, then consideration should be given to using these functional categories in

Category	CC	Work Unit Code	Description
Aircraft	--	01-09	On-equipment support general
Airframe	--	11,14,16-18	Airframe, flight control
Propulsion/power	--	15,21-26,31-34	Power plant, secondary power, propellers, rotors
Accessories	--	12,13,41-49,91-96,98	Cockpit, fuselage compartments, landing gear, environment control, electric, lighting, hydraulics, fuel, oxygen, miscellaneous utilities, emergency system
Electronics	--	51-57,61-69,71-74,76-77, 81-89	Instruments, autopilot, fault analysis, IGS, UHF, IFF, radio navigation, fire control, TEWS
Armament	--	75,97	Weapons delivery systems, explosives
Management	2X0	--	Chief (DCM), consolidated and squadron maintainance management
Support Equipment	223,234, 247,2E1	--	Support equipment maintenance
Indirect Maintenance	225,245,249, 2G3,2R5,2R9	--	PMEL, base flight and transient aircraft maintenance, and aircrew training device maintenance

Table 9: Proposed Below Depot Maintenance Functional Categories

addition to the current ones, in which case they would provide another perspective for viewing below depot maintenance costs.

It is implicit in the concept underlying the categories shown in Table 9 that each is the sum of all maintenance activities within the named category, regardless of the organization within which the work is performed. Thus, the accessories category would provide visibility for maintenance activity applied to any of the aircraft accessory subsystems, defined in terms of a list of work unit codes, without regard to whether the work was performed under POMO by an AGS, CRS or EMS work center or under AFM 66-1 by a work center within the field maintenance squadron.

Data from these proposed USAF detail report functional categories must be mapped into the CAIG report categories. The functional categories for management, support equipment and indirect maintenance would map directly into the CAIG "other" category. The armament functional category corresponds directly with the CAIG ordnance maintenance category. The aircraft functional category is entirely on-equipment (organizational) maintenance. The remaining functional categories represent a mix of on- and off-equipment maintenance, however. These costs may be separated using additional information from the Maintenance Data Collection System that indicates whether the man-hours were spent in on- or off-equipment maintenance. WSSC would, therefore, need to accumulate and distribute costs simultaneously for the USAF and CAIG formats where the CAIG processing would use on- and off-equipment categories within the functional categories of airframe, engine, accessories and avionics.

2. Input Data Requirements

To provide functional category visibility, it would be necessary to perform allocation of the available ABDS costs using appropriate data. Maintenance direct labor hour data from the D056 system (AMMIS system in FY81) is used by WSSC to allocate base level maintenance costs to MDSs. This data is derived from base level man-hour data, which carries with it a WUC identification. This WUC information is not retained in the interface files currently supplied to WSSC. However, maintenance labor data identified by WUC and work center, as well as by MDS, can be made available from the D056 system.

A similar problem exists with respect to manpower information derived from the MPC system. The FAC codes employed in the MPC data identify work centers at the squadron level and cannot provide manpower visibility in terms of the functional categories proposed in the previous section. Here again it would be necessary to use maintenance direct labor data to allocate personnel to functional categories as well as to MDSs.

3. Algorithm Requirements

To achieve cost and manpower visibility with respect to the functionally-oriented categories proposed in Table 9 would require provision of an additional set of allocation algorithms. The costs and manpower to be allocated to functional categories would be essentially the same as currently employed by WSSC. However, instead of using maintenance direct labor hour data identified by squadron-level work center code to allocate

costs and manpower to the MDS level, a more extensive allocation would be required. Not only would it be necessary to allocate to MDS, but also to functional categories as well.

Table 10 shows the relationships between elements of the current organizational categories and the proposed functional categories. The codes along the left margin represent the current organizational categories, but they have been extended to the next available level of detail. This code structure is used in ABDS data to identify cost centers and in MPC data to identify functional accounts. Only three significant character positions are shown in the codes used in the table, corresponding to the first three (left-most) positions of the cost center (CC) code and the functional account code (FAC) The columns in this table represent the proposed functional categories, as defined primarily in terms of groups of work unit codes (see Table 8).

The body of Table 10 contains Xs which show the relationship between the existing organizational categories and the proposed functional categories. Each organizational category was assessed to determine which functional category or categories it represents, and Xs were entered in the table accordingly. This represents an assessment based on Desmatics' preliminary judgement of what functions are performed by the various cost centers. A more definitive specification would require the availability of sample data showing actual usage of work unit codes by each type of branch-level organization. If there is only one X in a given row, then the corresponding organizational category maps uniquely to a single functional category and no allocation among functional categories is required. However, if there are two or more Xs in a given row then the costs and

CODE	COST CENTER	Aircraft	Airframe	Engine	Accessories	Electronics	Armament	Management	Support Equip.	Indirect
200	Consolidated Maintenance							X		
210	Chief of Maintenance (DCM)							X		
220	Organizational Maintenance							X		
221	Flight Line	X								
222	Inspection	X								
223	Support Equipment								X	
224	Alert Force	X								
225	Base Flight & Transient									X
230	Field Maintenance							X		
231	Fabrication		X							
232	Propulsion			X						
233	Aerospace Systems				X	X				
234	Aerospace Ground Equipment								X	
240	Avionics Maintenance							X		
241	Communications-Navigation				X	X				
242	Automatic Flight Control				X	X				
243	Mission Systems				X	X				
244	Post-Attack CCS				X	X				
245	Precision Measurement Equipment Lab.									X
246	Avionics Shop				X	X				
247	Avionics AGE								X	
248	Airborne Missile						X			
249	Aircrew Training Devices									X
250	Munitions Maintenance							X		
251	Munitions Services						X			
252	Munitions Maintenance & Storage						X			
253	Explosive Ordnance Disposal						X			
254	SRAM						X			
255	Equipment Maintenance						X			
256	Preload						X			
257	Air Launched Decoy						X			
2E0	Equipment Maintenance							X		
2E1	Aerospace Ground Equipment								X	
2E2	Maintenance	X	X		X					
2E3	Munitions						X			
2G0	Aircraft Generation							X		
2G1	Aircraft	X	X	X	X	X	X			
2G3	Support									X
2G4	Alert	X								
2R0	Component Repair							X		
2R1	Conventional Avionics				X	X				
2R2	Propulsion			X						
2R3	Accessory				X	X				
2R4	Integrated Avionics				X	X				
2R5	Precision Measurement Equipment Lab.									X
2R9	Aircrew Training Devices									X

Table 10: Proposed Functional Categories Showing Relationships with Branch-Level Cost Centers

manpower for the given work center must be allocated among the functional categories indicated by the Xs.

In the development of Table 10 it was assumed that cost and manpower data at the squadron level (e.g., 220, 230, 2E0) account for management and support for all of the applicable lower levels beneath them (e.g., 221, 222, 223). Thus all of the squadron-level costs and personnel are treated as part of the management function.

Except for the management, support equipment and indirect maintenance functional categories, the allocation of costs and manpower (where required) would be accomplished on the basis of direct labor hours. Maintenance direct labor hour data, which is specified not only by MDS but also by work unit codes and branch-level work center identification, is available at base level.

The following illustrates the allocation process needed when the activities of a work center fall in two or more functional categories. The maintenance branch within the typical EMS of a POMO base is responsible for phase dock inspection, wheel and tire, accessories, egress, corrosion control, fuel systems, tank farm, repair and reclamation (R & R), base flight and transient. Most of these activities fall in the support general category but some relate directly to the airframe and to accessories. The costs and manpower should therefore be distributed among these three functional categories. This would be accomplished by computing three ratios based on the maintenance man-hours reported for the work unit codes which make up these three categories, as follows:

$$\text{"Accessories" Ratio} = \frac{\text{DLH(WUCs 12,13,41-49,91,96,98)}}{\text{DLH(WUCs 01-09,11-14,41-49,91-96,98)}}$$

$$\text{"Aircraft" Ratio} = \frac{\text{DLH(WUCs 01-09)}}{\text{DLH(WUCs 01-09,11-14,41-49,91-96,98)}}$$

$$\text{"Airframe" Ratio} = \frac{\text{DLH(WUCs 11,14)}}{\text{DLH(WUCs 01-09,11-14,41-49,91-96,98)}}$$

These ratios may then be applied to cost data from the ABDS files and personnel data from the MPC system. In this example the ratios would be applied to cost center code 2E2X costs and FAC 2E2X manpower. It is clearly appropriate to apply these ratios to maintenance manpower strengths and costs, but as was discussed earlier, their use as the basis for allocation of materiel, contract and other expenses is less easily defended.

It may be noted that the functional category called "management" would be composed primarily of chief of maintenance (DCM) and the corresponding consolidated (CAMS) function (200). The management-type activities which are reported in the squadron-level work centers (i.e., 220, 230, 240, 250, 2EO, 2GO, and 2RO) would also be assigned to the management function. The costs associated with the DCM and CAMS would be allocated to an MDS based on the total number of maintenance DLH reported for that MDS. However, to provide more precision, the management costs associated with a particular squadron-level work center would be allocated to an MDS based on the DLH reported for the branches in that squadron.

The current WSSC specifications do not show separate display of GSE maintenance costs and manpower, although earlier versions included separate visibility of this category of activity. However, if cost, manpower, and direct labor data are identified using CC, FAC, and WC codes at the branch level rather than the squadron level, it would then be possible to isolate support equipment maintenance with fairly good precision. Neverthe-

less, there remains an important problem: that of providing a firm basis for allocating the maintenance costs for ground support equipment among aircraft MDSs.

Under the current WSSC system, the costs which Desmatics terms support equipment maintenance are included within the costs of the various squadron-level cost centers by RC/CC and are allocated on the basis of aircraft maintenance man-hour ratios. Although an alternative would be to allocate on the basis of possessed hours or a flying operations ratio, the man-hour ratio basis is more intuitively appealing. Accordingly, Desmatics recommends that the costs in these functional categories continue to be allocated on the basis of aircraft maintenance man-hours.

B. BRANCH LEVEL IDENTIFICATION

Current WSSC below depot maintenance processing identifies costs within the ABDS data files using cost center codes which specify only squadron level work centers. Personnel data is likewise identified using only the squadron level portion of the functional account code. The maintenance man-hour data is also identified only at the squadron level using the work center code information in man-hour data records. As a result, the information which can be displayed in WSSC reports in the USAF detail format is limited to the squadron level, as was shown in Table 1. By using these squadron work centers it is not possible to merge POMO and non-POMO into a consistent structure, nor is it possible to map into the four CAIG report format categories of organizational,

intermediate, ordnance, and other. Moreover, it is impossible to provide separate visibility of support equipment maintenance.

Many of these shortcomings would be remedied if use were made of the more detailed information available within the ABDS, MPC and man-hour data by employing CC, FAC and WC codes identified to the branch level within each of the squadrons. At the branch level it is possible not only to identify the munitions activities within the munitions maintenance squadron, but also the missile maintenance activities within the avionics squadrons of non-POMO bases and the munitions branches of POMO equipment maintenance squadrons. This leaves only the munitions loading activities within aircraft generation squadrons which cannot be segregated on the basis of CC code alone.

Using branch level codes also permits segregation of support equipment maintenance. At the branch level it is possible to identify the support equipment branch within organizational maintenance squadrons, the avionics AGE branch within avionics maintenance squadrons and the AGE branch within equipment maintenance squadrons. This would provide separate visibility for most of the support equipment maintenance activities within both POMO and non-POMO maintenance organizations.

The use of branch rather than squadron level identification permits more accurate and complete mapping of below depot maintenance manpower costs into CAIG categories based on data reported for POMO and non-POMO organizations. Branch level data also provides the basis for integrating POMO and non-POMO functions into a single set of categories, while at the same time allowing separate visibility for those maintenance activities which are essentially of an overhead nature. Table 11 shows a proposed

Category	CC/FAC/WC Codes
Organizational Maintenance	
OMS (excluding Supervision, Transient, Support)	221,222,224
AGS (excluding Supervision)	2G1-2G4
Intermediate Maintenance	
FMS (excluding Supervision, AGE)	231-233
AMS (excluding Supervision, PMEL, AGE, Aircrew Training Device, Missile)	241-244,246
EMS (excluding Supervision, AGE, Munitions)	2E1,2E2
CRS (excluding Supervision, PMEL, Training Devices)	2R1-2R4
Munitions Maintenance (excluding Supervision)	248,251-257,2E3
Other Unit Maintenance Personnel	
Chief (DCM), Consolidated, Squadron Supervision	200,210(FAC 217),220,230, 240,250,2E0,2G0,2R0
Support Equipment	223,234,247,2E1
Transient and Base Flight (non-POMO only)	225
PMEL	245,2R5
Aircrew Training Device	249,2R9
Miscellaneous Overhead	All CC's as necessary (See Table 7)

Table 11: Proposed Below Depot Maintenance Categories Based on Branch Level Codes

alternative to the current WSSC categories used in the USAF detail report, in which the major headings correspond with those of the CAIG report. Certain functions of a general or overhead nature have been identified by branch level code designations, removed from organizational and intermediate type squadrons and displayed as unique line items under "other."

This branch approach is believed to be an improvement over the current WSSC categories; however, it must be noted that this is not an entirely satisfactory solution to the various problems associated with the display of below depot maintenance. For instance it is not possible to identify munitions functions within aircraft generation squadrons or transient activity within equipment maintenance squadrons using branch level codes exclusively.

C. INDIRECT MAINTENANCE COSTS

It was suggested in Section IV that maintenance organization overhead costs be displayed separately from direct labor and materiel costs. Classification of costs as direct or indirect may be made on the basis of the EEIC associated with the cost record. Costs for pay and allowances are considered direct costs and should be handled as WSSC does currently. Records with EEICs of 602 (Packaged aviation oils and lubricants), 603 (which includes breathing oxygen), 605 (System Support Division, AFSF, Supplies), and 609 (General Support Division, AFSF, Supplies) are in large measure costs for direct maintenance materiel. Because there is no way to separate these costs into direct and indirect components, the

entire amount may be considered direct. If a different source of input is found for maintenance materiel, then these records should be omitted from WSSC processing. The remaining materiel EEICs (6XX-63X, excluding 602, 603, 605 and 609), as well as the contract and "other" EEICs, identify indirect costs. They may be aggregated for all maintenance cost centers combined and displayed as miscellaneous maintenance overhead costs in separate headings for materiel, contract and other costs. ABDS data from MAC, SAC and TAC for FY81 was examined as a preliminary means of identifying the specific types of direct and indirect costs reported. The EEIC codes encountered are shown in Table 12. In a subsequent study, Desmatics tabulated maintenance costs reported in the FY82 ABDS files for all seven relevant commands. It was found that indirect costs ($126 million) were 4.4% of the total ($2.87 billion). The tables for direct and indirect costs, by EEIC, are shown in Appendix B.

As discussed earlier, certain of the costs reported against MAC aircraft maintenance cost centers have EEIC codes which typically are associated with installation support. If these costs ($16.98 million) are removed from below depot maintenance, the remaining indirect expense is only 3.8% of the total ($2.85 billion). Allocation of the remaining indirect costs could be done the same way chief of maintenance and consolidated maintenance are currently handled. Aggregation of these costs across squadrons (CC) makes man-hours more appropriate as the allocation variable. Man-hours at this level may be interpreted as an indicator of the general level of maintenance activity which drives the indirect costs incurred to support the maintenance organization itself.

EEIC	DIRECT LABOR, MATERIEL AND CONTRACT EXPENSE ELEMENTS
2XX	Military Personnel Pay and Allowances
391-396	Civilian Personnel Pay and Allowances
602	Packaged Aviation Oils and Lubricant
603	Miscellaneous Liquids and Gases
605	System Support Division, AFSF Supply Issues/Turn-Ins
609	General Support Division, AFSF Supply Issues/Turn-Ins
511,512	Foreign National Personnel, Indirect Hire and Separation Allowances
541	Aircraft Maintenance Purchased from DMIF
693	Aviation POL other than Flying

EEIC	INDIRECT LABOR, MATERIEL, CONTRACT AND OTHER EXPENSE ELEMENTS
383	Civilian Personnel Benefits to Former Employees
386	Separation Allowances for Foreign National Personnel
395	Civilian Moving Allowance
397	Civilian Labor Costs - BEAMS/VIMS
40X	Temporary Duty Expenses
421	PCS-Civilian Employees
43X	Rental of Passenger Vehicles
454,46X	Transportation of Property
471	Leased Space
472,473	Equipment Rental
480	Purchased Utilities
49X	Message Communications
501	Printing and Reproduction
514	Mobile Equipment Rental
515	BEAMS/VIMS Civilian Labor - Reimbursable
521	Facility Maintenance (Class M) Projects
522	Facility Repair (Class R) Projects
529	Minor Construction
531	Contract Custodial Services
533	Other Contract Civil Engineering Service
549	Equipment Maintenance
533	Contract Education and Training
569	Purchased Maintenance of non-DOD Equipment
570	Contract Operated Installations
584	Contract Eng. & Technical Services
585	Contract Logistic Support
591	Reimbursements to Other Military Services
592	Miscellaneous Contract Services
593	Laundry and Cleaning
598	Incentive Awards and Clothing Allowances
599	Reimbursements Received - credit
607	Commissary Division, AFSF, Supplies
61X	Non-AFSF Materiel for Direct Consumption
628	Expensed Equipment - General Support Division
63X	Base Procured Expensed Equipment
641	Fuels Division, AFSF, Bulk Ground Fuels
642	Fuels Division, AFSF, Utility Fuels
692	Insurance Claims and Indemnities

Table 12: Partitioning of EEICs into Direct and Indirect Costs Based on Data From the Seven Relevant Commands (FY82)

VI. CONCLUSIONS, RECOMMENDATIONS AND OFFICE OF VAMOSC COMMENTS

Although the costs for below depot maintenance are overshadowed by unit operations expenditures, they are of considerable significance in the visibility of operating and support functions because relatively large numbers of skilled personnel are employed. Indeed, it is the most labor-intensive of the major O&S categories. Based on its evaluation of the WSSC below depot maintenance processing, Desmatics has a number of specific comments, most of which relate to the output format. They are briefly summarized here.

A. SUMMARY

As has been noted, the current WSSC output format is arranged in the below depot maintenance organizational structure. As a consequence there is little information given to the user about the maintenance requirements of an MDS as they relate to its major subsystems. Desmatics recommends reporting costs and strengths using a functional breakdown rather than an organizational one.

A change from the current organizational categories to a more functionally oriented set of categories would yield more useful information about the kinds of maintenance performed on an MDS. It would require that the Office of VAMOSC negotiate agreements to have work unit code (WUC) information included in the maintenance man-hour interface and that modifications be made to the allocation algorithms.

If it is found that the input requirements for the above recommendations cannot be met, Desmatics suggests that the output format be changed to display cost and strength data at the branch level instead of the squadron level. This change would represent an improvement in functional visibility while using the current data sources. It would, however, require some internal changes in the way the input data is aggregated for allocation.

The input data employed by WSSC for the below depot maintenance function was generally found to be appropriate and largely accurate. There were a few anomalies found. However, as noted above, input requirements would change if the suggested functional breakdown were used. Regardless of whether or not any modifications suggested by Desmatics are incorporated into the WSSC below depot maintenance process, reported DLH would form the basic allocation variable. Although the reported DLH data has been found in previous studies to be plagued with inaccuracies, a quantitative analysis presented in Appendix A indicates that the impact of these inaccuracies on the resulting allocation is minimal, so long as they are not biased with respect to any MDS. This analysis serves as a basis for Recommendation No. 4 in Volume I [2] of this series of reports. That recommendation, with which the Office of VAMOSC concurred, is that allocation of below depot maintenance costs should continue to be based on DLH data.

B. RECOMMENDATIONS AND REPLIES

This section lists Desmatics' conclusions and recommendations with

respect to the WSSC algorithms for below depot maintenance costs. The responses provided by the Office of VAMOSC are also included.

1. Functional Cost Categories (See pages 23-34.)

Conclusion: The present set of below depot maintenance cost categories, based on squadron-level cost centers, does not provide as detailed and useful visibility as could be achieved.

Recommendation: The Office of VAMOSC should consider adopting a more functionally-oriented set of cost categories, related to the major aircraft subsystems, to replace the current squadron-oriented cost breakdown used in the USAF Detail format. This would also facilitate mapping into the categories of the CAIG report.

Office of VAMOSC Comments: "Concur. The functional orientation more nearly matches CAIG guidelines. This is a significant task. We expect design of this requirement be completed in FY85. Processing could begin with FY87 after a two-year development period."

2. Branch Level Cost Categories (See pages 35-38.)

Conclusion: If the functional cost categories described above cannot be implemented, the visibility of below depot maintenance can still be improved.

Recommendation: The Office of VAMOSC should alternatively consider the use of branch level organizational categories to replace the currently used squadron-based cost category breakdown. This would also facilitate mapping into the CAIG categories.

Office of VAMOSC Comments: "Concur. Pending results of our efforts regarding Recommendation 1, Volume IV, this report, no additional planning is required."

3. MAC Allocated Overhead Costs (See pages 15-16.)

Conclusion: MAC shows, within the maintenance cost categories,

expenses (such as purchased utilities and facility repairs) which traditionally are treated as installation support. By allocating additional shares of installation support to MAC aircraft, WSSC overburdens MAC for these costs.

Recommendation: The Office of VAMOSC should insure that this problem is reviewed during Phase II validation and verification of WSSC. Consideration should be given to transferring the amounts which MAC assigns to maintenance units to the installation support pool for allocation by WSSC. This would avoid the current uneven burdening of MAC aircraft at MAC-hosted bases.

Office of VAMOSC Comments: "Concur."

4. Allocation of Maintenance Materiel Costs (See page 22.)

Conclusion: While maintenance man-hours provide a good basis for allocating maintenance direct labor costs, their use in allocating materiel costs is less valid.

Recommendation: The Office of VAMOSC should continue to pursue the possibility of obtaining maintenance materiel cost data, by MDS, from the base supply system.

Office of VAMOSC Comments: "Concur. The consolidated input of supply data by WUC into the proposed common VAMOSC preprocessor should be done by FY85 processing. Until we see the results of this effort, further actions must be delayed."

5. Indirect Maintenance and Support (See pages 39-40.)

Conclusion: Part of the cost reported by WSSC for maintenance base level is of an indirect nature. However, the amounts are small relative to the cost of direct labor and materiel.

Recommendation: The Office of VAMOSC should consider the cost effectiveness of providing separate visibility for indirect expenses.

Office of VAMOSC Comments: "Concur. This visibility requires a history file reformat. We will accomplish this along with Recommendation 1."

6. Maintaining Up-to-Date Record Selection Criteria (See page 17.)

Conclusion: In the course of its research, Desmatics has encountered evidence in MPC and ABDS data of legitimate command-peculiar codes which are not currently accepted by VAMOH and WSSC logic.

Recommendation: The Office of VAMOSC should undertake a continuing effort to insure that VAMOH and WSSC selection logic reflects current command and base-level practices in assigning codes.

Office of VAMOSC Comments: "Concur. Each year the Office of VAMOSC will review the data provided by H069R and E300Z inputs which are not accepted by VAMOH and WSSC logic. Appropriate changes to the logic will be made as a result of this review."

7. Possible Double Costing of Certain Medical Costs (See page 16.)

Conclusion: Small amounts of cost for medical supplies were observed to be reported within aircraft maintenance organizations. The nature of these expenses is unclear, but they may overlap costs covered in the Surgeon General's factor.

Recommendation: The Office of VAMOSC should determine whether these expenses duplicate any costs covered by the Surgeon General's factor, and if so, exclude them.

Office of VAMOSC Comments: "Concur. We've already determined that these costs are not overlapping costs covered in the Surgeon General's factor. Medical supplies reported in aircraft maintenance include those used in first aid kits, buddy care training etc., and are costed to the maintenance organization."

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APPENDIX A. ASSESSMENT OF MAN-HOUR DATA QUALITY IMPACT ON ALGORITHM VALIDITY

The accuracy of reported below depot maintenance direct labor hour (DLH) data was briefly discussed in Volume I [2]. That discussion summarized a Desmatics study [6] in which independent observations were made of crew size and start/stop times for a total of 119 maintenance jobs at two TAC bases. The observations were based on a sampling plan designed to provide representation of jobs from various weeks, days, shifts, squadrons and workcenters. The findings from this study revealed a tendency for a number of maintenance jobs not to be reported through the Maintenance Data Collection system and an inflation of reported DLH data for those jobs which were reported.

To gauge the effect of this type of situation on the algorithm used to allocate below depot maintenance costs, some mathematical notation is required. Consider a number of maintenance tasks and let the true DLH expended on maintenance task i be denoted by μ_i. Also denote the reported DLH for that task by r_i. In the allocation of below depot maintenance costs, ratios of the type

$$R = \sum_{1}^{k} r_i / \sum_{1}^{N} r_i$$

are used for each command/base, where $r_1, \ldots, r_k$ denote the reported DLH for the maintenance tasks for a given MDS and $r_{k+1}, \ldots, r_N$ denote the reported DLH for maintenance tasks on all other MDSs. Of course, if there is only one MDS at the command/base, inaccuracy in the reported DLH

will have no effect because all costs will always be allocated to that MDS.

However, in the case where there is more than one MDS at a command/base, the observed ratio R may vary from the true ratio

$$U = \sum_{1}^{k} \mu_i / \sum_{1}^{N} \mu_i \ .$$

To assess the usefulness of the ratio R in this situation, a comparison must be made between the value of R and the value of U. To simplify the situation somewhat but still fit the findings summarized above, assume that for maintenance task i one of three possibilities occurs: (1) the reported DLH is inflated so that $r_i = A\mu_i$, where $A > 1$, or (2) the reported DLH is correct so that $r_i = \mu_i$, or (3) the DLH for the job is unreported, i.e., $r_i = 0$. Furthermore, assume that these three events occur with probabilities p_1, p_2, and p_3 respectively, where of course $p_1 + p_2 + p_3 = 1$.

In summary, r_i, the reported DLH for the $i^{\underline{th}}$ maintenance job, is a random variable with the following characteristics:

$$r_i = \begin{cases} A\mu_i \text{ with probability } p_1 \\ \mu_i \text{ with probability } p_2 \\ 0 \text{ with probability } 1-p_1-p_2 \ . \end{cases} \qquad (1)$$

It follows that the expected value (mean) and variance of r_i are, respectively,

$$E(r_i) = \mu_i(Ap_1 + p_2) \qquad (2)$$

$$\text{and} \quad V(r_i) = \mu_i^2[A^2p_1 + p_2 - (A^2p_1^2 + 2Ap_1p_2 + p_2^2)] \tag{3}$$

If there is more than one MDS at the command/base being considered, the best case is when $V(r_i)$ is a minimum, i.e., $V(r_i) = 0$. In this case the observed ratio R provides the true answer since

$$R = \sum_1^k r_i / \sum_1^N r_i = \sum_1^k \mu_i(Ap_1 + p_2) / \sum_1^N \mu_i(Ap_1 + p_2)$$

$$= \sum_1^k \mu_i / \sum_1^N \mu_i = U$$

At the other extreme, the worst case occurs when $V(r_i)$ is a maximum. The maximum is obtained by solving the quadratic programming problem:

Maximize $V(r_i) = \mu_i^2[A^2p_1 + p_2 - (A^2p_1^2 + 2Ap_1p_2 + p_2^2)]$ where $A > 1$

subject to the conditions $0 \leq p_1 + p_2 \leq 1$, $0 \leq p_1 \leq 1$, and $0 \leq p_2 \leq 1$.

The solution to this problem can be obtained by using the Kuhn-Tucker conditions of nonlinear programming [3], which yield the solution $p_1 = 0.5$ and $p_2 = 0$, which implies $p_3 = 0.5$. Thus (1) can be reexpressed for the worst case as

$$r_i = \begin{cases} A\mu_i \text{ with probability } 0.5 \\ 0 \text{ with probability } 0.5. \end{cases}$$

For this worst case, (2) and (3) become, respectively,

$$E(r_i) = 0.5\ A\mu_i$$

$$\text{and } V(r_i) = 0.25\ A^2\mu_i^2.$$

The effect of using the ratio R instead of U can now be examined in this worst case.

For ease of mathematical notation, let $X_1 = \sum_{1}^{k} r_i$ and $X_2 = \sum_{k+1}^{N} r_i$.

Then $R = X_1/(X_1 + X_2)$. Using a first-order Taylor series expansion,

$$R = X_1/(X_1 + X_2) \doteq E(X_1)/[E(X_1) + E(X_2)]$$
$$+ [X_1 - E(X_1)][E(X_2)/\{E(X_1) + E(X_2)\}^2]$$
$$+ [X_2 - E(X_2)][-E(X_1)/\{E(X_1) + E(X_2)\}^2]. \qquad (4)$$

From this it follows that

$$E(R) \doteq E(X_1)/[E(X_1) + E(X_2)] = \sum_{1}^{k}\mu_i/\sum_{1}^{N}\mu_i = U.$$

Thus, the expected value of the observed ratio is equal to the true ratio. Furthermore from (4), the variability about the true ratio is given by

$$V(R) \doteq V(X_1)[E(X_2)/\{E(X_1) + E(X_2)\}^2]^2$$
$$+ V(X_2)[E(X_1)/\{E(X_1) + E(X_2)\}^2]^2$$
$$= (\sum_{1}^{k}\mu_i^2)[\sum_{k+1}^{N}\mu_i/(\sum_{1}^{N}\mu_i)^2]^2 + (\sum_{k+1}^{N}\mu_i^2)[\sum_{1}^{k}\mu_i/(\sum_{1}^{N}\mu_i)^2]^2$$

Now, subject to the constraint that $\sum_{1}^{N}\mu_i$ is a constant, it can be shown that V(R) is a maximum if all μ_i are equal, say $\mu_i = \mu$. Thus, the maximum value of V(R), which is obtained by substituting $\mu_i = \mu$ in the above equation, is

$$V(R) = k(N-k)/N^3.$$

Furthermore, the worst value of k is k = N/2. Therefore, the overall maximum of V(R), obtained by substituting k = N/2 into the above equality, is 1/4N.

Using this maximum variance, a bound on the deviation of R from U can be obtained from a normal approximation which assumes that the value of N (the number of maintenance jobs on which the ratio is based) is large enough that the central limit theorem has taken effect. Table A1 provides the number of reported maintenance jobs M required to be 95% confident that the observed ratio R is less than a certain amount Δ from the true ratio U. (Note that $M \doteq N/2$.) In other words, for a given value of M, there is a 95% probability that R differs from U by less than Δ. In mathematical notation,

$$P(|R - U| < \Delta) = 95\%.$$

As can be seen from Table A1, for even a relatively small number of reported maintenance jobs (approximately 4,800 annually or 400 monthly) under worst case assumptions, there is a 95% probability that the allocation ratio used will be off by less than 0.01. Therefore, it can be concluded that the use of the below depot maintenance allocation ratios, even in the face of inaccuracies in the man-hour data, provides reasonably accurate results.

However, it must be noted that the computations in this section are based on an implicit assumption that, although there are inaccuracies due to misreporting, there is no bias in favor of one MDS over another at any command/base. Furthermore, to get a more accurate error bound than

Δ	Number of Required Maintenance Jobs
0.05	192
0.04	301
0.03	534
0.02	1,201
0.01	4,802
0.005	19,208
0.001	480,200

Table A1: The Number of Required Maintenance Jobs Such That $P(|R-U| < \Delta) = 95\%$

the 0.01 used for illustrative purposes, the number of maintenance jobs at any command/base of interest would have to be obtained and then used in conjunction with Table A1.

APPENDIX B. TABULATION OF FY82 BELOW DEPOT MAINTENANCE COSTS

Desmatics has tabulated the FY82 ABDS data for aircraft maintenance cost centers (RC/CCs 21XX, 22XX, 23XX, 24XX, 25XX, 2EXX, 2GXX, and 2RXX) by EEIC and command. The first table displays direct costs (EEICs 2XX, 391-394, 396, 511, 512, 541, 602, 603, 605, 609, and 693). The second table presents indirect costs, i.e., those with EEICs other than those defined as direct.

All costs are in thousands of dollars. Each cell of each table contains four numbers, the first of which is the cost to the nearest thousand. The next three numbers are percentages: (1) the percent which the dollar amount represents of the total for the entire table; (2) the row percent; and (3) the column percent. The numbers on the right are the row totals and the percent of each row total with respect to the whole table. The figures at the bottom of each table show the command totals and the grand total. Command percentages are also shown. For convenience of reference, the command totals have been repeated at the bottom of each page.

The following is an example of how these tables should be interpreted. The cell in the upper left-hand corner of the first page shows that $30.7 million was reported in the FY82 ABDS for the Alaskan Air Command for all military direct labor (EEIC 2XX). This is 1.56% of the military direct labor for all seven commands and is 72.11% of AAC's total direct expense, which was $42.6 million in FY82. The total for all commands for EEIC 2XX is $1.96 billion, which is 71.6% of all direct

expenditures for all seven commands ($2.74 billion total). AAC's $30.7 million is 1.12% of the seven command direct grand total.

The reader may note that there are certain command-to-command differences in various expenses shown in these tables, both in dollar amounts and percentages. For descriptions of the EEIC codes used here, see Table 12.

FY82 MAINTENCE COST CENTERS (20,21,22,23,24,25,2E,2G,2R)
NOTE -- COSTS ARE IN THOUSANDS OF DOLLARS
EXPENSE=DIRECT

TABLE OF EEIC BY CMD

EEIC CMD

FREQUENCY / PERCENT / ROW PCT / COL PCT	AAC	APE	ATC	MAC	PAF	SAC	TAC	TOTAL
2XX	30713	250027	99554	319851	118443	463322	682101	1964011
	1.12	9.12	3.63	11.66	4.32	16.89	24.87	71.60
	1.56	12.73	5.07	16.29	6.03	23.59	34.73	
	72.11	77.52	54.16	61.68	71.76	77.27	74.89	
391	23	2	250	273	48	99	113	807
	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.03
	2.81	0.19	30.97	33.78	5.99	12.25	14.00	
	0.05	0.00	0.14	0.05	0.03	0.02	0.01	
392	3618	356	23187	49148	6365	12097	23028	117799
	0.13	0.01	0.85	1.79	0.23	0.44	0.84	4.29
	3.07	0.30	19.68	41.72	5.40	10.27	19.55	
	8.50	0.11	12.61	9.48	3.86	2.02	2.53	
393	357	41	2424	4992	675	1261	2390	12140
	0.01	0.00	0.09	0.18	0.02	0.05	0.09	0.44
	2.94	0.34	19.97	41.12	5.56	10.39	19.69	
	0.84	0.01	1.32	0.96	0.41	0.21	0.26	
396	59	1	224	371	89	118	239	1101
	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.04
	5.35	0.13	20.36	33.71	8.08	10.70	21.67	
	0.14	0.00	0.12	0.07	0.05	0.02	0.03	
511	0	2226	0	641	872	0	0	3740
	0.00	0.08	0.00	0.02	0.03	0.00	0.00	0.14
	0.00	59.52	0.00	17.15	23.33	0.00	0.00	
	0.00	0.69	0.00	0.12	0.53	0.00	0.00	
512	0	0	0	2	56	0	0	58
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	3.88	96.12	0.00	0.00	
	0.00	0.00	0.00	0.00	0.03	0.00	0.00	
TOTAL	42590	322547	183829	518551	165049	599621	910811	2742997
	1.55	11.76	6.70	18.90	6.02	21.86	33.20	100.00

(CONTINUED)

FY82 MAINTENCE COST CENTERS (20,21,22,23,24,25,2E,2G,2R)
NOTE -- COSTS ARE IN THOUSANDS OF DOLLARS
EXPENSE=DIRECT

TABLE OF EEIC BY CMD

EEIC CMD

FREQUENCY / PERCENT / ROW PCT / COL PCT	AAC	AFE	ATC	MAC	PAF	SAC	TAC	TOTAL
541	0	108	0	0	0	0	9	117
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	92.32	0.00	0.00	0.00	0.00	7.68	
	0.00	0.03	0.00	0.00	0.00	0.00	0.00	
602	5	262	240	1070	93	1000	388	3058
	0.00	0.01	0.01	0.04	0.00	0.04	0.01	0.11
	0.15	8.58	7.86	34.98	3.04	32.72	12.68	
	0.01	0.08	0.13	0.21	0.06	0.17	0.04	
603	0	9	0	461	15	21	54	560
	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.02
	0.00	1.64	0.01	82.17	2.76	3.70	9.72	
	0.00	0.00	0.00	0.09	0.01	0.00	0.01	
605	2983	31541	40150	73236	19373	50957	102308	320549
	0.11	1.15	1.46	2.67	0.71	1.86	3.73	11.69
	0.93	9.84	12.53	22.85	6.04	15.90	31.92	
	7.00	9.78	21.84	14.12	11.74	8.50	11.23	
609	4283	29199	15320	56085	15662	54922	83224	258695
	0.16	1.06	0.56	2.04	0.57	2.00	3.03	9.43
	1.66	11.29	5.92	21.68	6.05	21.23	32.17	
	10.06	9.05	8.33	10.82	9.49	9.16	9.14	
693	549	8778	2480	12422	3356	15823	16958	60362
	0.02	0.32	0.09	0.45	0.12	0.58	0.62	2.20
	0.91	14.54	4.11	20.58	5.56	26.21	28.09	
	1.29	2.72	1.35	2.40	2.03	2.64	1.86	
TOTAL	42590	322547	183829	518551	165049	599621	910811	2742997
	1.55	11.76	6.70	18.90	6.02	21.86	33.20	100.00

FY82 MAINTENCE COST CENTERS (20,21,22,23,24,25,2?,2G,2B)
NOTE -- COSTS ARE IN THOUSANDS OF DOLLARS
EXPENSE=INDRCT

TABLE OF EEIC BY CMD

EEIC CMD

FREQUENCY / PERCENT / ROW PCT / COL PCT	AAC	APE	ATC	MAC	PAF	SAC	TAC	TOTAL
383	0	0	1	0	0	0	0	1
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	100.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
386	0	0	0	1	46	0	0	47
	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.04
	0.00	0.00	0.00	1.40	98.60	0.00	0.00	
	0.00	0.00	0.00	0.00	0.79	0.00	0.00	
395	0	0	0	0	0	0	3	3
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	100.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.01	
397	-66	0	0	23	0	25	38	20
	-0.05	0.00	0.00	0.02	0.00	0.02	0.03	0.02
	-322.18	0.00	0.00	112.40	0.00	123.05	186.73	
	-7.56	0.00	0.00	0.06	0.00	0.14	0.11	
404	0	12	0	20	159	1	8	200
	0.00	0.01	0.00	0.02	0.13	0.00	0.01	0.16
	0.00	5.99	0.00	9.85	79.75	0.62	3.79	
	0.00	0.13	0.00	0.05	2.72	0.01	0.02	
405	7	29	12	117	68	32	147	411
	0.01	0.02	0.01	0.09	0.05	0.02	0.12	0.33
	1.60	7.11	2.96	28.39	16.56	7.67	35.71	
	0.75	0.32	0.07	0.28	1.16	0.18	0.43	
406	2	26	8	87	112	28	89	349
	0.00	0.02	0.01	0.07	0.09	0.02	0.07	0.28
	0.56	7.54	2.22	24.99	32.18	6.94	25.58	
	0.23	0.29	0.04	0.21	1.92	0.14	0.26	
407	8	610	1	869	657	228	72	2446
	0.01	0.48	0.00	0.69	0.52	0.18	0.06	1.94
	0.33	24.94	0.05	35.55	26.88	9.33	2.92	
	0.93	6.75	0.01	2.09	11.21	1.31	0.21	
TOTAL	872	9040	17439	41643	5866	17476	33928	126263
	0.69	7.16	13.81	32.98	4.65	13.84	26.87	100.00

(CONTINUED)

FY82 MAINTENCE COST CENTERS (20,21,22,23,24,25,2E,2G,2R)
NOTE -- COSTS ARE IN THOUSANDS OF DOLLARS
EXPENSE=INDRCT

TABLE OF PEIC BY CMD

PEIC CMD

FREQUENCY PERCENT ROW PCT COL PCT	AAC	AFE	ATC	MAC	PAF	SAC	TAC	TOTAL
463	0 0.00 0.00 0.00	0 0.00 0.28 0.00	1 0.00 1.12 0.01	36 0.03 31.01 0.09	0 0.00 0.00 0.00	0 0.00 0.00 0.00	79 0.06 67.60 0.23	117 0.09
469	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	5 0.00 27.48 0.01	-1 -0.00 -4.57 -0.01	0 0.00 0.00 0.00	15 0.01 77.09 0.04	19 0.01
471	0 0.00 0.03 0.00	-0 -0.00 -2.93 -0.00	0 0.00 0.00 0.00	5 0.00 102.93 0.01	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	4 0.00
473	2 0.00 0.53 0.23	5 0.00 1.31 0.05	20 0.02 5.39 0.12	75 0.06 19.87 0.18	28 0.02 7.32 0.47	46 0.04 11.99 0.26	204 0.16 53.60 0.60	380 0.30
480	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	12009 9.51 100.00 28.84	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	12010 9.51
492	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	13 0.01 100.00 0.03	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	13 0.01
493	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 27.83 0.00	0 0.00 72.17 0.00	0 0.00
494	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	49 0.04 99.81 0.12	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.19 0.00	49 0.04
TOTAL	872 0.69	9040 7.16	17439 13.81	41643 32.98	5866 4.65	17476 13.84	33928 26.87	126263 100.00

(CONTINUED)

FY82 MAINTENCE COST CENTERS (20,21,22,23,24,25,2E,2G,2R)
NOTE -- COSTS ARE IN THOUSANDS OF DOLLARS
EXPENSE=INDRCT

TABLE OF EEIC BY CMD

EEIC CMD

FREQUENCY / PERCENT / ROW PCT / COL PCT	AAC	APE	ATC	MAC	PAF	SAC	TAC	TOTAL
495	0	0	0	5	0	0	0	5
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	100.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.01	0.00	0.00	0.00	
501	0	0	0	5	0	0	14	20
	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02
	0.00	1.94	0.00	25.67	0.00	0.00	72.40	
	0.00	0.00	0.00	0.01	0.00	0.00	0.04	
514	0	0	0	0	0	0	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	19.05	80.95	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
515	0	1	0	0	0	0	0	1
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	100.00	0.00	0.00	0.00	0.00	0.00	
	0.00	0.01	0.00	0.00	0.00	0.00	0.00	
521	0	0	0	3032	0	0	0	3032
	0.00	0.00	0.00	2.40	0.00	0.00	0.00	2.40
	0.00	0.00	0.00	100.00	0.00	0.00	0.00	
	0.00	0.00	0.00	7.28	0.00	0.00	0.00	
522	0	0	0	1254	0	0	0	1254
	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.99
	0.00	0.00	0.00	100.00	0.00	0.00	0.00	
	0.00	0.00	0.00	3.01	0.00	0.00	0.00	
529	0	0	0	686	0	0	0	686
	0.00	0.00	0.00	0.54	0.00	0.00	0.00	0.54
	0.00	0.00	0.00	99.93	0.00	0.07	0.00	
	0.00	0.00	0.00	1.65	0.00	0.00	0.00	
531	0	0	0	2	0	0	0	3
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	83.99	0.00	0.00	16.01	
	0.00	0.00	0.00	0.01	0.00	0.00	0.00	
TOTAL	872	9040	17439	41643	5866	17476	33928	126263
	0.69	7.16	13.81	32.98	4.65	13.84	26.87	100.00

(CONTINUED)

FY82 MAINTENCE COST CENTERS (20,21,22,23,24,25,2E,2G,2R)
NOTE -- COSTS ARE IN THOUSANDS OF DOLLARS
EXPENSE=INDRCT

TABLE OF EEIC BY CMD

EEIC CMD

FREQUENCY / PERCENT / ROW PCT / COL PCT	AAC	AFE	ATC	MAC	PAF	SAC	TAC	TOTAL
533	0	0	0	85	0	0	17	102
	0.00	0.00	0.00	0.07	0.00	0.00	0.01	0.08
	0.00	0.00	0.00	83.17	0.00	0.00	16.83	
	0.00	0.00	0.00	0.20	0.00	0.00	0.05	
549	8	24	0	0	0	0	391	423
	0.01	0.02	0.00	0.00	0.00	0.00	0.31	0.33
	2.01	5.60	0.00	0.00	0.00	0.00	92.39	
	0.97	0.26	0.00	0.00	0.00	0.00	1.15	
553	0	0	0	15	0	0	0	15
	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01
	0.00	0.00	0.23	99.58	0.00	0.00	0.20	
	0.00	0.00	0.00	0.04	0.00	0.00	0.00	
569	1	122	2070	5238	403	3221	6659	17714
	0.00	0.10	1.64	4.15	0.32	2.55	5.27	14.03
	0.01	0.69	11.69	29.57	2.27	18.18	37.59	
	0.13	1.35	11.87	12.58	6.86	18.43	19.63	
570	0	0	10324	0	0	0	0	10324
	0.00	0.00	8.18	0.00	0.00	0.00	0.00	8.18
	0.00	0.00	100.00	0.00	0.00	0.00	0.00	
	0.00	0.00	59.20	0.00	0.00	0.00	0.00	
584	0	0	0	0	0	0	7041	7041
	0.00	0.00	0.00	0.00	0.00	0.00	5.58	5.58
	0.00	0.00	0.00	0.00	0.00	0.00	100.00	
	0.00	0.00	0.00	0.00	0.00	0.00	20.75	
585	0	0	0	0	0	0	684	684
	0.00	0.00	0.00	0.00	0.00	0.00	0.54	0.54
	0.00	0.00	0.00	0.00	0.00	0.00	100.00	
	0.00	0.00	0.00	0.00	0.00	0.00	2.02	
591	0	2	0	1	1	0	76	80
	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.06
	0.00	2.21	0.00	1.54	1.31	0.00	94.95	
	0.00	0.02	0.00	0.00	0.02	0.00	0.22	
TOTAL	872	9040	17439	41643	5866	17476	33928	126263
	0.69	7.16	13.81	32.98	4.65	13.84	26.87	100.00

(CONTINUED)

FY82 MAINTENCE COST CENTERS (20,21,22,23,24,25,2E,2G,2R)
NOTE -- COSTS ARE IN THOUSANDS OF DOLLARS
EXPENSE=INDRCT

TABLE OF EEIC BY CMD

EEIC CMD

EEIC / FREQUENCY / PERCENT / ROW PCT / COL PCT	AAC	AFE	ATC	MAC	PAF	SAC	TAC	TOTAL
592	1	81	2845	2829	700	507	1307	8269
	0.00	0.06	2.25	2.24	0.55	0.40	1.04	6.55
	0.01	0.97	34.41	34.21	8.46	6.13	15.81	
	0.06	0.89	16.32	6.79	11.93	2.90	3.85	
598	1	2	0	25	0	0	1	29
	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.02
	2.16	6.23	0.00	86.24	0.35	0.00	3.01	
	0.07	0.02	0.00	0.06	0.00	0.00	0.00	
599	0	-3	-10	0	0	-1	0	-14
	.	.	.	.	.	.	.	-0.01
	.	.	.	.	.	.	.	
	.	.	.	.	.	.	.	
604	3	35	9	82	15	48	42	235
	0.00	0.03	0.01	0.07	0.01	0.04	0.03	0.19
	1.48	14.73	3.84	35.02	6.56	20.41	17.95	
	0.40	0.38	0.05	0.20	0.26	0.27	0.12	
607	1	4	15	7	6	3	50	85
	0.00	0.00	0.01	0.01	0.00	0.00	0.04	0.07
	0.98	4.28	17.66	7.71	6.86	4.10	58.41	
	0.10	0.04	0.09	0.02	0.10	0.02	0.15	
612	0	0	0	3	0	-0	0	3
	0.00	0.00	0.00	0.00	0.00	-0.00	0.00	0.00
	0.00	0.00	0.00	93.99	0.00	-8.42	14.44	
	0.00	0.00	0.00	0.01	0.00	-0.00	0.00	
614	0	0	0	0	0	0	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	100.00	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
618	0	3	4	7	2	8	25	49
	0.00	0.00	0.00	0.01	0.00	0.01	0.02	0.04
	0.09	5.08	8.68	14.14	4.88	16.91	50.21	
	0.01	0.03	0.02	0.02	0.04	0.05	0.07	
TOTAL	872	9040	17439	41643	5866	17476	33928	126263
	0.69	7.16	13.81	32.98	4.65	13.84	26.87	100.00

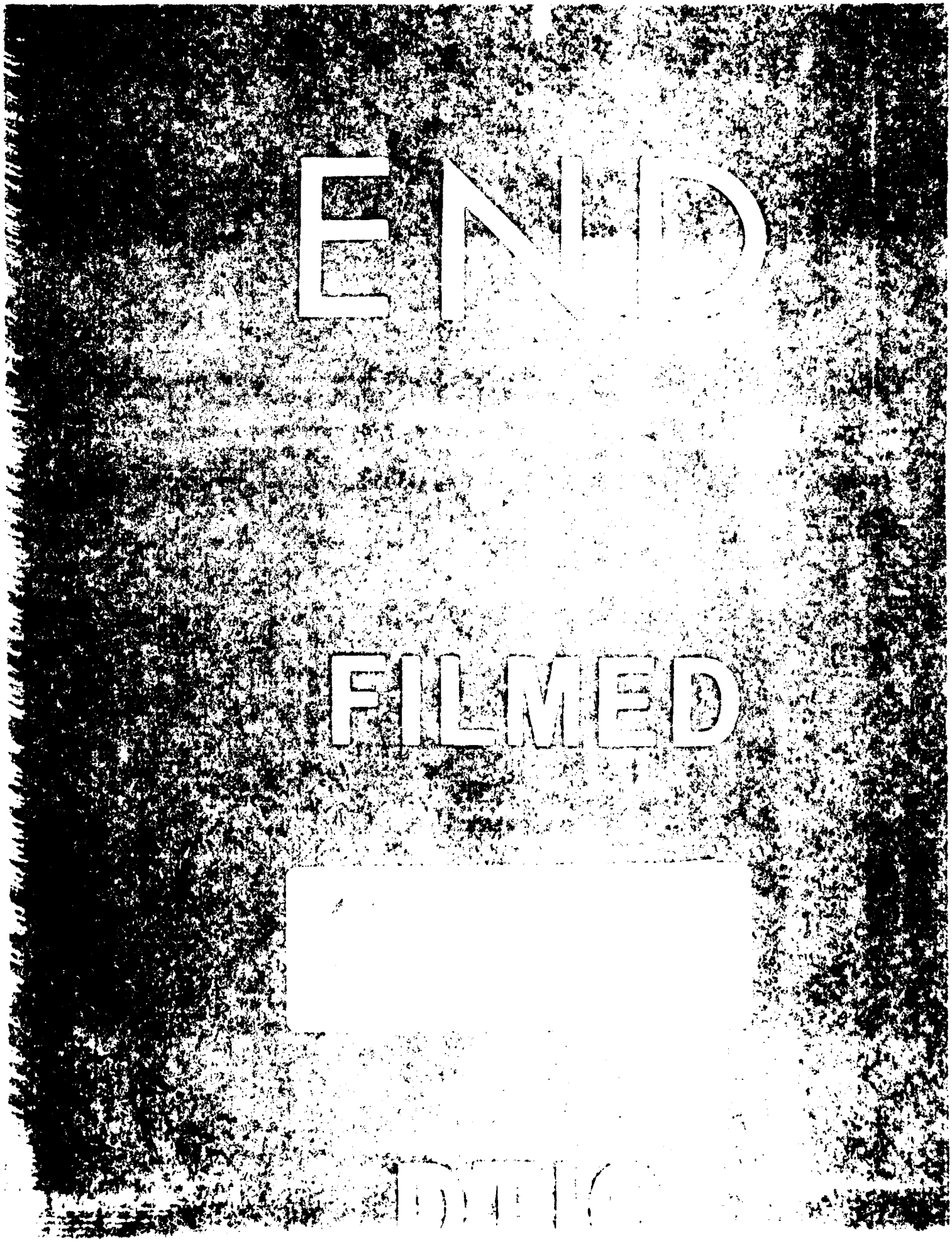
(CONTINUED)

FY82 MAINTENCE COST CENTERS (20,21,22,23,24,25,2E,2G,2R)
NOTE -- COSTS ARE IN THOUSANDS OF DOLLARS
EXPENSE=INDRCT

TABLE OF EEIC BY CMD

EEIC CMD

FREQUENCY / PERCENT / ROW PCT / COL PCT	AAC	AFE	ATC	MAC	PAF	SAC	TAC	TOTAL
619	5	14	26	929	11	355	1546	2885
	0.00	0.01	0.02	0.74	0.01	0.28	1.22	2.29
	0.19	0.47	0.89	32.20	0.37	12.30	53.58	
	0.62	0.15	0.15	2.23	0.18	2.03	4.56	
624	0	2	0	3	1	0	0	6
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	33.58	0.00	44.93	15.61	0.00	5.89	
	0.00	0.02	0.00	0.01	0.02	0.00	0.00	
628	231	1917	482	1140	767	1571	3391	9499
	0.18	1.52	0.38	0.90	0.61	1.24	2.69	7.52
	2.44	20.18	5.07	12.01	8.07	16.54	35.70	
	26.53	21.20	2.76	2.74	13.08	8.99	10.00	
635	0	0	0	0	0	0	9	9
	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
	0.00	0.00	0.00	0.00	0.00	0.00	100.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.03	
639	0	15	5	26	0	3	12	62
	0.00	0.01	0.00	0.02	0.00	0.00	0.01	0.05
	0.00	24.94	7.97	42.64	0.00	4.70	19.75	
	0.00	0.17	0.03	0.06	0.00	0.02	0.04	
641	473	2604	725	5863	1412	6040	5549	22666
	0.37	2.06	0.57	4.64	1.12	4.78	4.40	17.95
	2.09	11.49	3.20	25.87	6.23	26.65	24.48	
	54.26	28.80	4.16	14.08	24.08	34.56	16.36	
642	0	3	0	0	0	0	3	7
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	0.00	49.34	0.00	3.03	0.00	0.00	47.62	
	0.00	0.04	0.00	0.00	0.00	0.00	0.01	
692	0	0	0	0	0	0	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	100.00	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
TOTAL	872	9040	17439	41643	5866	17476	33928	126263
	0.69	7.16	13.81	32.98	4.65	13.84	26.87	100.00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