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Costs of the Next Due Base-Level Inspection During a Depot Visit

Thomas H. Browning, I. K. Cohen, and John Y. Lu

A Report prepared for

UNITED STATES AIR FORCE PROJECT RAND

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An outline and illustration of a method for estimating the incremental man-hour costs of doing a base-level inspection during a depot visit as a means to reduce total system costs (base and depot). It is expected that the depot can perform the base-level inspection more economically because the depot performs most of the base-level inspection in conjunction with any Programmed Depot Maintenance (PDM) and Modifications (MOD), and only a small incremental cost would be required to do the few additional tasks needed. This report discusses a simple insight based on depot maintenance procedures which reduces the forecast of the unpredictable workload to a minor problem; the predictable work can be obtained from DART (Daily Automatic Rescheduling Technique). Given an adequate sample of histories to acquire the predictable and unpredictable estimates, the results from the method described are judged to be adequate for decisionmaking. This method, illustrated in this report for the F-4 case, is believed to be applicable to other weapon systems undergoing PDM/MODs at other Air Logistics Centers. (BG)

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PREFACE

One part of Rand's logistics research under Air Force Project RAND concerns the more effective vertical integration of levels of aircraft scheduled maintenance. Improved integration can be achieved by greater use of economic criteria in deciding where particular work will be performed, thus minimizing redundancy in the work now performed at depots and bases.

At this writing there is considerable Air Force interest in making the "next due" base-level inspection of an aircraft during Programmed Depot Maintenance (PDM) and Modifications (MOD). There is also interest in Rand's suggestion for repackaging certain base-level inspections for the F-4 weapon system to reduce redundancy when the depot performs the next due inspection. Policies that reduce inspection redundancy between bases and depots would produce such benefits as increases in airframe availability and decreases in maintenance manpower costs.

Decreases in maintenance manpower costs are expected for the following reason. If the depot were to perform the next due base-level inspection of an aircraft during its regularly scheduled depot visit, additional (incremental) costs to the depot would be expected to be smaller than the costs of performing the same inspection later at the base. This report attempts to estimate these additional costs at the depot. For a variety of reasons, such estimates have been so difficult to make that some investigators have even suggested field tests. The present authors believe, however, that field tests are not necessary to measure the costs. Instead, in this report, they propose a simple cost-quantification procedure. As to base-level inspection costs at the base, recourse was had to a recently completed joint Air Force/Rand study on scheduled aircraft maintenance policies.* That study estimates potential overall savings in manpower costs (as well as other benefits) from a policy

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*Ralph Elwell (Ogden Air Logistics Center) and Chris Roach, "Test of Alternative Scheduled Maintenance Policies at Holloman AFB," The Rand Corporation, forthcoming.

of making next due base-level inspections at the depot. The estimate covers the entire F-4 force.

Rand has collaborated on much of its scheduled maintenance research with the Ogden Air Logistics Center. In the present study, a joint effort was conducted with Mr. Thomas H. Browning, a member of the Engineering Branch of the Aircraft Division at Ogden. This research was performed as part of the Project RAND research project entitled "Operations and Support: Alternative Policies and Structures."

SUMMARY

Previous Ogden Air Logistics Center/Rand studies have shown that during an aircraft's visit to a depot a considerable amount of base-level work is accomplished. Furthermore, much of what is accomplished in base-level inspections is unnecessarily duplicated during the depot visit. Current policy prescribes that the depot perform only that work for which it has unique skills and equipment. To effect this policy, however, is virtually impossible because it is extremely difficult to distinguish between the work that goes on at these levels; as a matter of fact, from an economic point of view, it may be desirable and preferable for the depot to do what is commonly thought to be base maintenance. This suggests that economic criteria might play an increasing role in determining where work is to be performed. It has been hypothesized that the total system costs (base and depot) would be reduced if the next due base-level inspection on an aircraft were to be performed at the depot in conjunction with the aircraft's visit to the depot for depot level work such as Programmed Depot Maintenance (PDM) and Modifications (MOD). This expectation that the depot can perform the base-level inspection more economically if it is done at the time of an aircraft's depot visit is based on the following facts: The depot performs most of the base-level inspection in conjunction with any PDM/MOD work, and only a small incremental cost would be required to do these few tasks in order for the depot to take credit for doing the base-level inspection.

The base-level inspection of the F-4 aircraft has been under a phased inspection system for some time. The system consists of six sets (phases) of inspection tasks over an inspection cycle which is currently 600 flying hours. The content of each of these phases is relatively small and is more or less equal in size. If the depot were to perform the next due phase, the expected benefits would still be there, but they would not be substantial because each phase is a relatively small work package, and the potential for reducing base-depot redundancy is small.

Rand has suggested that the inspection workload over the entire inspection cycle be repackaged into a Periodic Inspection System. The work packaging of the Periodic Inspection System is such that it creates a smaller number of dockings than the Phased System. The largest set of inspection tasks in the Periodic System, called a PE, represents about 66 percent of the work in the inspection cycle, while under the phased inspection system the largest phase represents only about 25 percent, and the smallest phase about 8 percent. Hence, if the depot could perform the PE portion of the Periodic System, it would be much more beneficial than if it performed just one of the phases. This suggestion to change the current Phased Inspection System to a Periodic Inspection System so that credit for the PE could be taken at the depot has been labeled "Quick Fix" by Rand.

Aside from the F-4, there has been increasing interest in reducing base-depot redundancies by performing the next due base-level inspection for other aircraft types. That interest has been based on the inference that the incremental cost for accomplishing the inspection at the depot would be less than the cost of performing the inspection at the base. However, some of the estimated costs have been higher than expected, and for the same weapon system, the estimated costs have varied considerably over time. In some cases limited field tests have been sponsored in an attempt to obtain more accurate and consistent estimates of the incremental costs.

Cost estimates differ for a variety of reasons. For example, it is difficult to forecast the portion of inspection workload that is "unpredictable" (i.e., discovering those defects that need to be repaired, and repairing them). We have seen estimates of what will be found and repaired multiplied by 10 in order to hedge against the uncertainty of what will be found and fixed. In contrast, there is little uncertainty about forecasting incremental man-hour requirements for the component of inspection work that is "predictable," i.e., the scheduled removal and installation of doors and components, "look" and "do" type inspections to determine serviceability, and the operation of a system to ensure its serviceability.

This report discusses a simple insight based on depot maintenance procedures which reduces the forecast of the unpredictable workload to a minor problem. After a teardown (or disassembly) of an aircraft at the depot, inspectors presently write up *all* defects that are visible to them, regardless of what is to be repaired according to the work contract contents.* All noted defects are then categorized, and decisions are made about which defects will be repaired. This decision process is determined by depot policy guidelines for contract interpretation, as well as by the guideline requiring the depot to repair the defect if it is safety- and/or mission-related. The net effect of these guidelines is that *all* defects related to the base-level inspection would probably be repaired under the depot work package *except* those defects documented in the so-called Carry Forward lists sent to the using organization for *their* repair action. Thus, an examination of an adequate sample of past Carry Forward lists will identify the subset of defects that were discovered at the depot and related to the next base-level inspection. For such identified defects, estimates of the number of standard man-hours required for the repair were made by technical estimators. The availability of data through historical PDM/MOD files turns the otherwise difficult problem of forecasting the probability of discovering defects into a trivial accounting and man-hour estimating problem.

Information regarding the "predictable" work can, with minor exceptions, be obtained from DART (Daily Automatic Rescheduling Technique), which has on file a "complete" inventory of jobs, standard hours to accomplish, and the work packages that include those jobs. Thus, it is only necessary to translate the base-level inspection item into a DART job in order to make our estimate of the cost for this category of work.

The above estimated costs (measured in terms of man-hours) are derived from the average incremental costs calculated over all the aircraft going to the depot for a given period of time. This is accomplished by:

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*Since depot teardowns are typically more extensive than base-level teardowns, the recorded defects by depot inspectors probably include those that would be found during base-level inspections.

1. Identifying all of the base-level inspection work requirements.
2. Dividing the work requirements into:
   a. "Predictable" inspection and servicing actions.
   b. "Unpredictable" defects that need to be repaired.
3. Identifying those "predictable" and "unpredictable" requirements that will not have been accomplished in each PDM/MOD package.
4. Estimating the total man-hours required to accomplish the incremental sum of the "predictable" and "unpredictable" work for each work package.

Having estimated the total work time for performing the base-level inspection for each work package, we calculate the weighted average of these totals with the weight being the number of aircraft in each work package. Finally, from such totals, estimates of flowtime are made to determine if the additional workload needed to take credit for the base-level inspection at the depot would unduly increase the amount of time an aircraft has to spend at the depot.

Using the above method, we find that the average incremental cost across all F-4 MDSs for accomplishing a PE is 169 man-hours and that the average cost for accomplishing Phase 6 for the F-4E is 62 man-hours. These estimates compare very favorably with the number of man-hours required to perform the same tasks at the base. According to the recently completed field test of scheduled aircraft maintenance policies at Holloman Air Force Base, it took 514 man-hours to perform a PE and 311 man-hours to perform a Phase.* As to the flowtime, no appreciable increase is expected in either the PE or phase cases.

Given an adequate sample of histories to acquire the "predictable" and "unpredictable" estimates, the results from the method described are judged to be adequate for decisionmaking. This method, illustrated for

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*The requirements for base-level inspections in this study were different from those in the Holloman test. In the Holloman test, inspection items across all six phases had been reduced by 43 percent from the original inspection package which was the basis for estimation in the current study (Elwell and Roach, op. cit., p. 6). If we were to use this reduced version of inspection deck in this study, the comparison would be even more favorable.

the F-4 case, is believed to be applicable to other weapon systems undergoing PDM/MODs at other Air Logistics Centers.

Finally, the report suggests that these small incremental costs might be absorbed within the current level of depot funding and refers to an earlier Rand report on the range of benefits that may be expected of the Periodic Inspection System over the Phased System of Inspections. More up-to-date information about some of these benefits is available from the test just completed at Holloman AFB.*

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*Elwell and Roach, op. cit.

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This study could not have been conducted without the interest and support provided by G. Val Lofgreen, Chief of the Engineering Branch of the Aircraft Division at the Ogden Air Logistics Center. Joseph Broadbent and Norman Wilde at the Ogden ALC deserve special mention for their participation in developing the illustrations described in the report. Stephen M. Drezner, Milton Kamins, and William E. Mooz at Rand reviewed the report and provided valuable comments.

CONTENTS

TABLES

ABBREVIATIONS

ACI	Analytical Condition Inspection
CF	Carry Forward
DART	Daily Automatic Rescheduling Technique
DPSH	Direct Product Standard Hours
E&I	Examination and Inventory
ECR	Electrical Connector Replacement
HPO	Hourly Postflight Inspection
LES	Leading Edge Slat
MOD	Modification
MPIP	Maintenance Posture Improvement Program
MRT	Materiel Review Team
MTM	Methods Time Measurement
NDI	Non-Destructive Inspection
PAO	Project Administration Office
PDM	Programmed Depot Maintenance
PE	Periodic (The largest inspection in the Periodic Inspection System. It takes place at the end of the total inspection cycle.)
PERT	Project Evaluation Review Technique
PR	Project Required
SAI	Satisfactory As Is
SM	System Manager
SOF	Safety of Flight
TCTO	Time Compliance Tech Order

I. INTRODUCTION

The scheduled maintenance of aircraft consumes a good portion of maintenance resources of the Air Force and is an important factor that affects the number of aircraft available to meet mission requirements. In recent years, Rand has reviewed the Air Force's scheduled aircraft inspection programs and has suggested many options to improve its use of maintenance resources, such as reducing inspection content, extending inspection intervals, reducing inspection redundancy between work done at the base and depot, and improving the scheduling to inspection docks at base level so that aircraft are not inspected sooner than required. In this report we are concerned with some cost issues associated with reducing inspection redundancy between base and depot so that increased airframe availability and reduced man-hour costs result.

BACKGROUND

In 1972 Ogden Air Logistics Center and Rand conducted what we call the "Defect Study," in which the characteristics of defects found and repaired at bases and depots were examined. Several important observations emerged. One finding especially relevant to this report was that only a few of the defects that were found during depot inspection and repaired by depot resources could not be found and repaired at the base as well.* This strongly suggests that inspection work packages performed at the depot cannot be justified solely on the basis of requiring unique depot skills and equipment. Thus, current policies that emphasize moving jobs to the depot because of such uniqueness need reexamination. It is likely that economic considerations should play an increasing role in determining inspection locations and inspection strategies, because under many circumstancs, applying economic criteria will make more productive use of depot resources.

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*For more details about the results of this study, see T. S. Donaldson and E. C. Poggio, *Depot Inspection and Repair Capability: Unique or Redundant?*, The Rand Corporation, R-1503-PR, November 1974.

In addition to determining that depots do work that could be done equally well at the bases, the extent of redundancy between base-level inspections and depot-level inspections was also determined. It was found that for the F-4 aircraft, 80 percent of the work required to accomplish *all* the base-level phase-inspection items in the "dash six"* was being done during an aircraft visit to the depot for Programmed Depot Maintenance (PDM). Typically, there is considerable teardown of an aircraft during PDM--more than one observes in base-level inspections. This suggests that the defects discovered at the base are likely to be a subset of the defects discovered during PDM. Given the increased visibility of defects at the depot and given prevailing policies about fixing safety- and mission-related defects,† it is inevitable that considerable overlap will exist between base-level inspections and depot work at the time of PDM.

One means for reducing this duplication is for the PDM to include the requirements to accomplish the next due base-level inspection. This means that where a weapon system is on a phased system of inspections, only the inspection and repair work required by one of the several phases would be done. In the F-4 case, for example, only one of the six phases would be accomplished. However, it has been estimated that about *50 percent of the workload of all six phases is duplicated in a PDM*. Thus performing the work done in the next phase deals with only a small portion of the duplication. If, however, a Periodic Inspection System at base level were to replace the Phased System, it would be possible to eliminate a greater proportion of the duplication. Figure 1 is a conceptual illustration of the Phased Inspection System and the Periodic Inspection System. The total amount of work that is done under each of these inspection systems is the same, but it is scheduled differently.

The Phased System attempts to equalize the amount of work to be done in each phase. As shown in Fig. 1, items to be worked every 75

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*The "dash-six" (–6) is a shorthand notation for T.O. IF-4C-6, Scheduled Inspection and Maintenance Requirements, and Work Cards, IF-4C-6wC-2.

†For a discussion of the repair policies at the depot, see pp. 17-18.

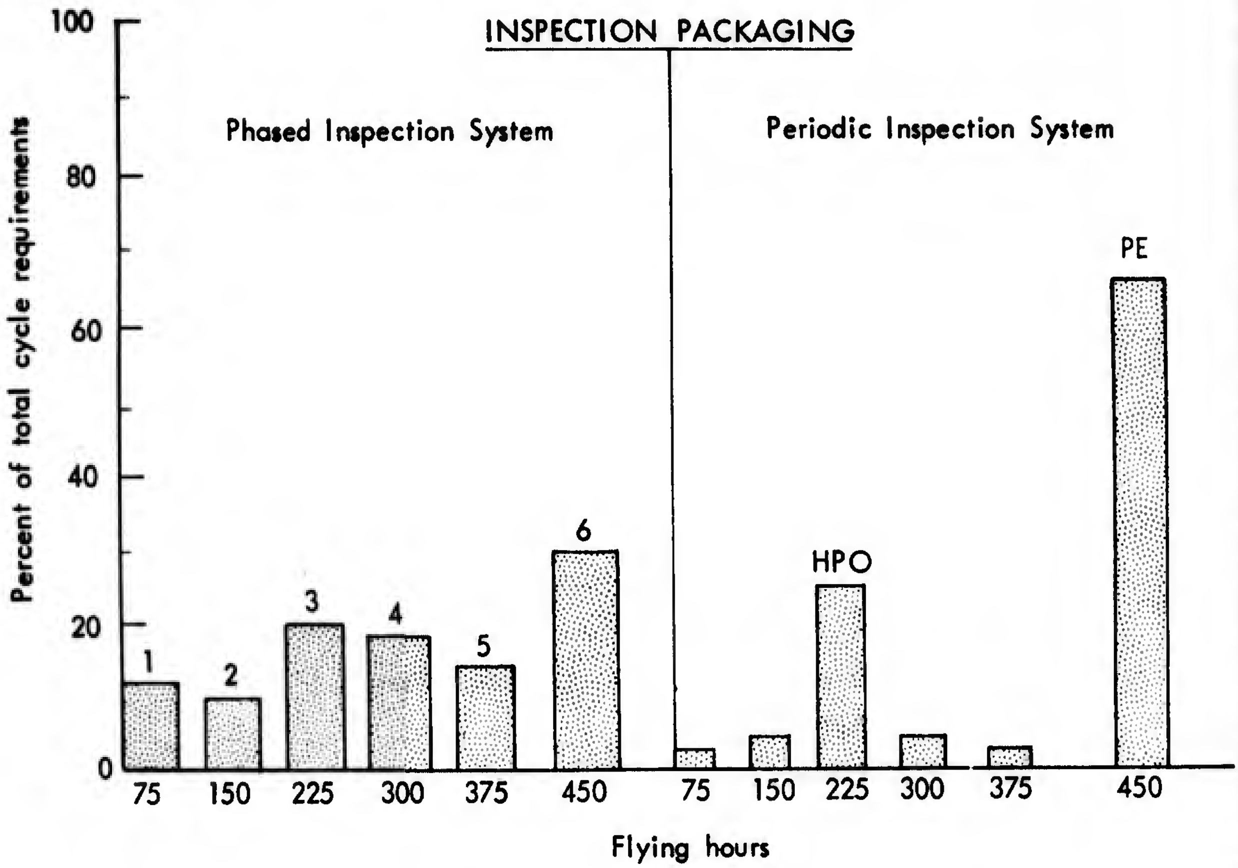

Fig. 1 -- Comparison of two inspection systems

flying hours would, of course, be accomplished during every phase. The 150-, 225-, 300-, 375-, and 450-hour items would be allocated to particular phases to achieve the objectives of work equalization in all phases consistent with realities of access and interference. Thus, these items might be found in any phase. This does not mean that the frequency of inspecting an item would deviate from what is required; it does mean that, for example, a 150-hour item might appear in Phases 1, 3, and 5, while another 150-hour item might appear in Phases 2, 4, and 6.

In the Periodic Inspection System the objective of the work packaging is to maximize the amount of work required in a minimum number of dockings, and to minimize the work required between the major dockings. Thus, as shown in Fig. 1, a relatively small amount of work is required on the flightline at the 75-, 150-, 300-, and 375-flying-hour intervals. A large hourly postflight (HPO) takes place in a dock at the 225-fly-hour interval, and the Periodic (PE) takes place in the dock at 450 hours. The PE in this illustration might represent about two-thirds of the entire inspection workload, while the largest phase in the Phased System (Phase 6) might represent only 25 percent of the total workload.

QUICK FIX

To further reduce the duplication between base and depot inspections, we suggested a concept called Quick Fix,* a name deliberately selected to underscore that the concept is developed for a particular environmemt. As the environment changes dramatically, the economic attractiveness of the concept would, of course, have to be reevaluated. For example, base and depot inspection intervals might be so extended as to make duplication a trivial problem.

Quick Fix encourages the depot to complete a base-level inspection when it is economical to do so. Credit is taken for performing the base-level inspection in the depot, and the base is not required to do the same inspection. To do so would be duplication.

Quick Fix basically employs the periodic system for the F-4. It recommends that the same inspection items prescribed by the -6 be repackaged under a periodic inspection concept and that the PE portion of the Periodic System of inspections be carried out in conjunction with every aircraft visit to the depot for the PDM/MOD work. Since Quick Fix recommends a change from a phase inspection program to the periodic inspection program, some additional comments about phase inspections are in order.

PHASED VS. PERIODIC INSPECTION SYSTEMS

As currently practiced, the phase affects the system in a way opposite to its original justification, which included the intent to

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*Milton Kamins, *Quick Fix: Reducing Aircraft Inspection Redundancy Between Base and Depot*, The Rand Corporation, R-1177-PR, April 1973.

accomplish a phase during the "normal" ground time of an aircraft, i.e., overnight. Considerable empirical evidence, however, indicates that turnaround of aircraft is delayed far beyond normal gound time.* There seems to be a teardown threshold beyond which considerable ground time is required to accomplish the work required, and current practice seems to exceed this threshold in all phases. Beyond this threshold, the penalties paid are not a linear function of the extent of teardown; more teardown appears to be associated with relatively less penalty. This observation suggests that teardown should be scheduled less frequently and that all possible required work be programmed into these fewer teardowns. The Periodic System seems more consistent with this objective than does the Phased System.

It turns out that some of the teardown and button-up are duplicated across phases which, in addition to affecting downtime, increases man-hour costs. This kind of duplication is less likely to occur in the Periodic System.

Extensive maintenance involves the risk of system unreliability induced by maintenance. It has been shown that transient negative effects are associated with operational flying that occurs immediately after a phased inspection. There are more dockings in the Phased System than in the Periodic System. Thus, more weapon system unreliability is associated with the Phased System.†

In a contingency of short duration, it may be desirable to defer some set of inspections so as to increase the airframe availability. The mix of service and inspection tasks in the phases as they are now constituted is not well suited for that. On the other hand, in the Periodic System the large teardowns can be deferred, if desired, while not discontinuing flightline service-oriented tasks. Thus, the Periodic System has a greater likelihood for making more aircraft available for emergency use.‡

Another problem of the Phased System is that the typically short intervals between phases discourages the use of centralized heavy

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*Ibid., p. 14.

†Ibid., p. 16.

‡Ibid., pp. 12-13.

aircraft maintenance within the operational commands. Ferry costs make the economics of centralization in such cases less attractive. Thus, some maintenance economies that the Operational Commands might seek to achieve through centralization are likely to be closed to them.

The foregoing discussion suggests that there are a number of reasons for judging that the Phased Inspection System as currently practiced has limitations over the Periodic Inspection System.

INCREMENTAL COSTS

In this report we are concerned with estimating the costs for performing the next due base-level inspection during an aircraft's depot visit and with defining a generally applicable method for estimating such costs. Estimated costs are costs that would be incurred beyond the normal PDM/MOD work. Hence, they are termed incremental costs.

The method is illustrated for the PE and the phases for the F-4 aircraft. Such illustrations permit a comparison of the incremental workload for doing a PE or a phase during a PDM/MOD, with the cost of doing the inspection at the base.

Estimating the incremental costs for doing the next due base-level inspection is not new. Over some period of time, we have observed a number of estimates, which have an unexpectedly wide variation. Some appear to be high--in the sense that given extensive disassembly of the aircraft during the average PDM/MOD, and given the policies about repairing observed consequential defects, we expected that the incremental costs would be small. Although all factors contributing to this wide variation in cost estimation are not known, one apparently pervasive problem concerned the discovery of defects that would result from the added inspection requirements. Forecasting the probability of discovering different kinds of defects is a difficult task. Because of the admittedly large uncertainty associated with the outcome of estimations, we have seen these estimates multiplied by a factor of 10 to hedge against the perceived uncertainty.

In this study, we view the estimation problem in the context of the depot policy regarding repairing of uncovered defects in a PDM/MOD visit and in the context of the management and information system in use at the depot. As will be shown, within such contexts the estimation problem becomes a simple matter. In view of the observed variation in estimates and the judged importance of the issue, we decided that it would be helpful to make explicit the "simple" solution for estimating the incremental costs to the depot of doing the next due base-level inspection.

MAINTENANCE POSTURE IMPROVEMENT PROGRAM (MPIP)

The need for an improved estimating method was further motivated by the Air Force's MPIP effort,* which includes the reevaluation of scheduled aircraft inspection policies. The MPIP Steering Group was interested in the general policy of performing the next due base-level inspection during a depot PDM/MOD in order to reduce base-depot duplication. As part of this effort, TAC was also interested in the Quick Fix concept to further decrease base-depot duplication as well as to realize the other benefits of the Periodic System discussed above.

In the F-4 case, MPIP sponsored a field test at Holloman AFB to evaluate a number of scheduled maintenance policy changes.†

Two basic options to the current scheduled inspection policies are being considered. The first option, based on the Phased System inspection approach, differs from the current system in that the inspection package content has been considerably reduced and the interval between phases has been extended from 75 to 100 flying hours. The second option has the same reduced content and extended intervals but repackages the work into a Periodic System with a 600-hour PE, a 300 HPO, and four small flightline inspections. The Ogden ALC portion of the test includes accomplishing a PE for four Holloman aircraft and the next due phase for two Holloman aircraft and a number of other aircraft while in the depot for PDM/MOD.

OVERVIEW OF ESTIMATION METHODOLOGY

In this report, all costs are measured in terms of the number of

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*PMD L-45028(1)MPIP, 9 September 1974.

†Ralph Elwell (Ogden Air Logistics Center) and Chris Roach, "Test of Alternative Scheduled Maintenance Policies at Holloman AFB," The Rand Corporation, forthcoming.

standard man-hours. The estimated costs are the average costs calculated over all the aircraft going to the depot for a given period of time. Flowtimes are also developed from the man-hour estimates.

We first take the projected FY 1976 PDM/MOD program for the F-4 aircraft at Ogden ALC.* We then determine the amount of additional work required to accomplish the PE and phase inspections with each work package in the program.

This is accomplished for each phase and PE by:

1. Identifying all of the work requirements, as described in the -6.†
2. Dividing the work requirements into:
    a. Those specified inspection and servicing actions (called "predictable").
    b. Those unknown defects that need to be repaired (called "unpredictable").
3. Identifying those "predictable" and "unpredictable" requirements that are not included in each PDM/MOD package.
4. Estimating the total man-hours required to accomplish the incremental sum of the "predictable" and "unpredictable" work for each work package.

Having obtained the total work time for accomplishing the PE and each phase for each work package, we calculate the weighted average of these totals with the weight being the number of aircraft in each work package. From such totals, estimates of flowtime are made.

The estimation of work times for "predictable" or known work is rather straightforward. However, there is more difficulty in estimating work times associated with the "unpredictable" repair.

Most of this report is concerned with providing details of the estimation methodology.

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*Based on projections made in March 1975.

†-6 change 4 dated 1 November 1974.

In Sec. II a discussion of work packages for aircraft visiting the depot is illustrated by the F-4E case for FY 76. Sections III and IV discuss procedures for estimating the incremental "predictable" and "unpredictable" standard man-hour costs for accomplishing a PE or any one of the phases during a PDM/MOD. Section V illustrates the total costs for a PE and a phase using the methods described. Concluding remarks are presented in Sec. VI.

II. WORK PACKAGES FOR AIRCRAFT VISITING THE DEPOT

Aircraft are sent to the depot for a depot-level inspection called PDM. Associated with the PDM are all open depot-level Time Compliance Tech Orders (TCTOs) or MODs. A small number of aircraft also require a special depot-level inspection called Analytical Condition Inspection (ACI), which is over and above the normal PDM inspection. The MOD requirements vary widely, but every aircraft undergoes some MOD work. For example, all small, open depot TCTOs and any field level TCTOs that the operating unit requests to be done are accomplished. These TCTOs are not costed separately, as in the major TCTOs described below, but are included under the time allotted to do the basic work package. Hence the term PDM/MOD. For FY 1976, major modifications for the F-4E aircraft going to Ogden ALC are as follows:

1. TCTO 1F-4-991. This is a new TCTO and all F-4 aircraft will require it. It is a major structural modification to the wings and centerline of the aircraft. This TCTO adds approximately 2800 man-hours to the basic work package.
2. TCTO 1F-4-986. This is generally known as the Electrical Connector Replacement (ECR) TCTO. The TCTO requires that all electrical connectors on the aircraft be replaced with special environmental connectors. It adds approximately 6700 man-hours to the basic work package.
3. TCTO 1F-4E-566. This is known as Leading Edge Slat (LES) TCTO. It is a major structural modification to the leading edge of the wings and replaces the existing flaps with a movable slat. It adds approximately 7600 man-hours to the basic work package.

To sum up, all aircraft will receive at least a basic PDM/MOD work package and any or all of the above-mentioned major TCTOs. The most expensive work package will be a MOD/PDM/ACI/LES/ECR/991 package requiring approximately 25,400 man-hours as compared to a basic work package requiring about 6700 man-hours. It is expected that the incremental cost for the next due base inspection will vary only slightly with the type of depot work package. More discussion on this topic is given on p. 17 below.

Table 1 illustrates the scheduled F-4E inputs for FY 1976. For each work package, it indicates the using command, the number of aircraft, the allotted man-hours (measured by DPSH, Direct Product Standard Hours), the allotted flow days, and the total number of actual man-hours required.

Table 1

PROJECTED FY 1976 DEPOT WORKLOAD FOR F-4E

Work Package	Command	Number of Aircraft	Man-hours (DPSH)	Flow Days	Total Man-hours
MOD/PDM	TAC	12	6,746	60	80,949
MOD/PDM/LES	TAC	7	13,024	85	91,166
MOD/PDM/LES/ECR	TAC	8	19,728	130	157,821
MOD/PDM/ACI/LES/ECR	TAC	3	22,571	125	67,712
MOD/PDM/ACI/LES/ECR/991	TAC	1	25,380	150	25,380
MOD/PDM/ECR	TAC	12	13,450	100	161,510
MOD/PDM/991	TAC	18	9,555	70	171,986
MOD/PDM/ECR/991	TAC	2	16,259	110	32,518
MOD/PDM/ACI/991	TAC	1	12,398	90	12,398
MOD/PDM/ACI/ECR/991	TAC	1	19,177	120	19,177
MOD/PDM	AAC	3	6,873	60	20,620
MOD/PDM/991	AAC	3	9,682	75	29,047
MOD/PDM/LES	AFSC	1	14,402	100	14,402
MOD/PDM/LES/ECR	AFSC	1	21,106	130	21,106
Total		73	12,407[a]	88[a]	905,680

[a]Average.

The F-4E illustration in Table 1 is intended to give the reader some sense of the magnitude of the man-hours and flow days expended for the various work packages and to provide a context in which the magnitude of the incremental costs for accomplishing a PE/phase can be judged.

Section III discusses how the "predictable" work component of the incremental cost of accomplishing a PE/phase is estimated.

III. DETERMINING THE "PREDICTABLE" REQUIREMENTS

The current phased inspection requirements as detailed in TO 1F-4C-6* deal only with specific inspection items and do not indicate the amount of disassembly required to gain access to perform the required inspections. The -6 also includes a large number of systems operational check requirements. However, it does not prescribe all the lubrication, cleaning, servicing, and filter changing requirements. These additional requirements are found only in the -6 work cards, which are divided into six decks covering the six phases. Repetition of requirements occurs in work card decks due to the various inspection and servicing intervals.

These "predictable" requirements for inspection and related tasks as specified in the -6 and -6 work cards can be found in the DART (Daily Automatic Rescheduling Technique) system which is currently utilized by ALCs to schedule the "predictable" work requirements for aircraft. Basically, each MDS has its own unique PERT (Project Evaluation Review Technique) network containing as many of the potentially known work requirements as possible. For example, all doors on the aircraft have a removal work card and an installation work card available, if required. (For the F-4 each network contains approximately 5500 jobs, and the average aircraft will require approximately 1600 jobs to complete its "predictable" requirements.)

For this analysis we first determine all specific requirements for each phase and for the PE of the Periodic System. For example, we know that there is a requirement for Door 33L to be removed for the first, third, and fifth phases, and also for the PE, and DART provides us with a job card for the removal of Door 33L. This job card contains all pertinent information about removal of 33L and, most importantly, the standard hours required to accomplish this job. DART also provides an identification of the PDM package requirements as well as the MOD requirements that require this door removal. In this particular case, DART will tell us that Door 33L is to be removed for PDM, the ECR MOD,

*Dated 1 November 1974.

the LES MOD, and ACI. Therefore, since this door removal takes place for all depot packages, there is no additional cost for doing it in connection with phases or PE. The reverse is true of Door 5R, which is removed for only the ECR MOD and/or the LES MOD. Its removal is required on the third and sixth phase and for a PE. Therefore, if an aircraft's work package is a PDM/MOD only, the depot would have to charge for this door's removal if a third or sixth phase is due or a PE is to be accomplished.

To discuss the incremental cost for a phase or PE we found it helpful to first group all individual -6 requirements into four major categories:

1. Removal and Installation of Doors. These are the numbered plates that cover up the aircraft interior and are mounted flush with the existing aircraft skin or contour. The doors are removed to gain access to areas of the aircraft that require inspection or servicing.
2. Removal and Installation of Components. Components are items other than numbered doors that are required to be removed for access, inspection, cleaning, lubrication, or servicing. Examples of the components range from an aircraft engine to the nose landing gear torque link knee bolt.
3. Inspections. These consist of specific numbered line items in the -6. The inspections are divided into two subcategories: "look" type and "do" type inspections. A "look" inspection is a visual check of an item to determine serviceability. A "do" inspection generates a certain type of Non-Destructive Inspection (NDI), i.e., magnaflux, dye penetrant, ultrasonic, etc.
4. Operationals. These are special types of inspections where a system is operated to ensure serviceability. These inspections range from testing landing gear to testing a camera system.

The individual -6 requirements and their associated DPSH, organized by the above-mentioned four categories, are given in App. C, along with the work packages for which each requirement applies.

Given that the -6 requirements for each phase and PE are known, and given the App. C information, it remains only to identify for each PDM/MOD work package those -6 requirements by phase and PE which are not required by the work package. The man-hours required to perform this incremental work represent the incremental cost of the "predictable" work for each phase and the PE.

The man-hours (DPSH) displayed for each work requirement in DART are engineered standard hours to accomplish the requirement. A large number of these are based on Methods Time Measurement (MTM); the remainder are derived from technical estimates made by depot engineers. If a "predictable" -6 requirement does not exist in the DART system, it is relatively straightforward to include it. The standard man-hours for such inclusions can be estimated by the MTM approach or through the technical estimation approach.

To illustrate how the man-hours are estimated, Table 2 presents estimates of the incremental work times by work category for the PE for each of the four MDSs. These estimates include the summation of *all* of the standard hours for all of the -6 PE predictable work requirements. These data provide some indication of the size of all the "predictable" work that the depot would have to do beyond its normal depot level work in order to complete a PE.

Table 2

INCREMENTAL DEPOT MAN-HOUR REQUIREMENTS FOR
ACCOMPLISHING -6 "PREDICTABLE" WORK

(In DPSH)

MDS	Doors	Components[a]	Inspections[b]	Operationals	Total
F-4C	16	33	17	53	119
F-4D	2	25	17	39	83
F-4E	10	29	19	58	116
RF-4C	12	28	19	67	126

[a]Includes lubrication and ejection seat removal and reinstallation.

[b]Includes inspection, disassembly, and lubrication requirements for the ejection seat. The depot standard for both doors and operationals contains some fix times.

IV. DETERMINING THE "UNPREDICTABLE" REQUIREMENTS

The method for estimating the incremental cost of "predictables" was discussed in Sec. III. In this section, we discuss the method for estimating the "unpredictable" cost. Typically, estimating this cost has been difficult. However, as will be shown in this case, the problem can be satisfactorily solved.

DISCOVERY AND CLASSIFICATION OF DEFECTS

On arrival at the depot, the aircraft undergoes some preliminary preparation and is towed to the main repair hangers where it is docked and opened up. The amount of open-up depends on the aircraft's work package. On completion, the Examination and Inventory (E&I) inspectors are brought onto the aircraft to inspect all open areas and document *all* the defects they observe. Every discovered defect is recorded on the 959 sheet (see App. A). Each inspector then classifies the defects he has discovered into one of the four following major categories:

1. Satisfactory As Is (SAI). These are exactly as specified--satisfactory as is. These defects are within Tech Order tolerances. Although they are documented, a listing of them is not returned to the using activity. The documentation is primarily to record a defect that has been noted but declared SAI.
2. Carry Forward (CF). Although these defects are beyond TO tolerance specifications, they are not required to be repaired by the depot work specification. They will not affect either the safety or mission of the aircraft. CF defects are documented and returned to the using activity on the 781K aircraft forms.
3. Project Required (PR). These defects are repaired by the depot because of specific requirements in the depot's work specification as prepared by the aircraft System Manager (SM).

There are too many provisions in the work specification to describe them all, but in general the depot will:

a. Repair anything that affects the mission of the aircraft, except those systems not required to be operational by work specification.

b. Correct any corrosion discovered.

c. Fix any carry forward type defects that would entail a major access penalty if they were to be repaired at a later date.

4. Safety of Flight (SOF). The depot will repair any defect that affects the safety of the aircraft.

Once the E&I inspector has made his classification of the defects, both his foreman and E&I quality control inspector verify his classification. The SAI and CF type defects are documented and left with the aircraft for future reference. The PR and SOF defects are transcribed onto 552 cards (work documents), and their work requirements are established. This information is forwarded to a Materiel Review Team (MRT) meeting where an E&I foreman, E&I quality control inspector, the aircraft foreman and scheduler, an engineering planner and time standard estimator, and a System Manager representative from the Project Administration Office (PAO) jointly verify the need for repair and decide on time required for performing the repair.

Defects discovered after E&I follow approximately the same cycle except they are not dealt with in a formal MRT meeting; the E&I inspector, aircraft foreman and scheduler, PAO official, and planning estimator must all approve the repair of the defect. The E&I inspector and E&I quality inspector may declare that the defect is SAI or CF, and that ends any further actions.

The defects classified as SOF or PR are repaired under the PDM/MOD policy guidelines. SAI type defects require no repair action. Thus the only remaining defect type is CF. These Carry Forward items may include defects that would be discovered and fixed in a particular phase or in the PE when the PE and phase open-up is a subset of the PDM/MOD open-up. *Thus, CF defects represent the outside number of* *"unpredictable" repairs that would have to be made in order to consider a phase or a PE accomplished.*

METHOD FOR ESTIMATING REPAIR TIMES OF CF TYPE DEFECTS

Records available from a recent 6-month period were used. After deleting those pertaining to the Air National Guard aircraft, speed line aircraft, and aircraft with missing documentation,* there were 30 valid aircraft records for analysis. Technical estimators then estimated the costs of repairing the relevant CF items for each individual aircraft. Table 3 shows the estimated average cost for these repairs by MDS, across all work package types.†

Table 3

ESTIMATED AVERAGE REPAIR HOURS FOR CF ITEMS[a]

MDS	Repair Hours (DPSH)
F-4C/D	50
F-4E	70
RF-4C	50

[a]Sample size = 30 aircraft.

To determine whether the CF repair hours vary as a function of work package, a statistical test was conducted. The test hypothesis states that the depot work package with minimum aircraft open-up (PDM/MOD) would generate fewer CF repair hours than those requiring maximum aircraft open-up. However, the data did not substantiate the hypothesis.‡ This suggests that all defects on an aircraft that need

*For Air National Guard aircraft, the depot repairs all CF defects. For aircraft arriving for Speed Line, the depot performs modifications and repairs SOF type defects, but everything else would be returned to the field.

†Details of the analysis are contained in App. B.

‡See App. B for details.

correction are discovered in all PDM/MOD packages. Additional open-ups due to more extensive MOD work do not seem to uncover more defects. Given that the PE typically opens up even less than a PDM/MOD, it can be expected that a depot visit for any work package will discover all defects that will be discovered in a PE (and more). This finding is consistent with the Quick Fix concept for performing the base-level inspection in conjunction with PDM/MOD.

The other side of this question is "Are there some CFs that would *not* have been discovered in a PE?" Interestingly enough the answer is "Not enough to worry about." The total amount of carry forward cost for all 13 F4-Es analyzed was 868 man-hours. Our comparison of a PE structured from the -6 requirements with the defects on the Carry Forward lists determined that the PE would not have discovered 14 man-hours of repair time, or less than 2 percent of the total.

To sum up, the repair times required by the depot to perform the "unpredictable" portion of a PE are basically the cost to repair the CF-type defects. Statistical analyses indicate that these costs are independent of *work package types* and *MDS*.

V. TOTAL INCREMENTAL COSTS FOR ACCOMPLISHING PEs AND PHASES

This section reports the outputs that result from applying the methods described in Secs. III and IV, provides the detailed man-hour costs for the PE and the costs for the Phase, and discusses aircraft flowtime.

THE PE

Table 4 shows the average incremental cost per aircraft for accomplishing a PE for each MDS, as well as the number of aircraft programmed for FY 1976 at Ogden ALC and the aggregate costs by MDS. From the data in Table 4, the average cost per aircraft across all MDSs is computed to

Table 4

PER AIRCRAFT AND TOTAL INCREMENTAL DEPOT MAN-HOUR REQUIREMENTS FOR ACCOMPLISHING THE PE, F-4 AIRCRAFT

(In DPSH)

MDS	Incremental "Predictable"	Average Incremental "Unpredictable"	Incremental Man-hours/ Aircraft	Number of Aircraft	Total
F-4C	119	50	169	85	14,365
F-4D	83	50	133	49	6,517
F-4E	116	70	186	73	13,578
RF-4C	126	50	176	71	12,496
Total	--	--	169[a]	278	46,956

[a]Weighted average, with the weight being the number of aircraft in each MDS.

be 169 man-hours, and for the 278 aircraft the total incremental man-hours are approximately 47,000. This average incremental cost compares very favorably with 514 man-hours required to perform a PE at the base.*

*Elwell and Roach, op. cit., p. 25. It should be noted that the estimate of 169 man-hours was based on the original -6 deck, whereas the 514 hours reported in the Elwell/Roach paper applied to a pared-down deck. If the incremental cost were to be estimated for the pared-down deck, it would be 10 to 15 percent lower than what is reported here.

To obtain some further sense about the magnitude of these costs, a comparison might be made with some of the numbers for the F-4E in Table 4 with numbers for this MDS appearing in Table 1. Seventy-three F-4E aircraft are programmed to receive over 900,000 man-hours in FY 1976. The incremental cost for accomplishing the PE for these 73 aircraft would be 13,600 man-hours, which is about 1-1/2 percent of the total cost. Those 13,600 man-hours are only slightly more than the 12,407 man-hours a single F-4E aircraft spent in a depot visit on the average. This underscores the fact that very little additional work is required for the deyot to perform the PE in conjunction with an aircraft's visit to depot for PDM/MOD.

THE PHASE

For the purpose of this report we elected to assemble the incremental man-hour cost data for Phase 6 of the F-4E only (see Table 5). Since the method is the same for assembling the cost of all phases for all MDSs, we felt that no useful purpose would be served by developing all of those sets of data. These data are presented in Table 5.

Table 5

PER AIRCRAFT AND TOTAL INCREMENTAL DEPOT MAN-HOUR REQUIREMENTS FOR PHASE 6 OF THE PHASED INSPECTION, F-4E AIRCRAFT

(In DPSH)

Incremental "predictable"	42
Average incremental "unpredictable"	20
Incremental man-hours/aircraft	62
Number of aircraft	73
Total man-hours	4526

The average total incremental cost for accomplishing Phase 6 is 62 man-hours. Since this is the largest of the six phases, this estimate is likely to be the upper bound for the average man-hour requirement for the other phases. For a phase such as Phase 2--judged to be about one-third the size of Phase 6--the cost is likely to be considerably less than 62 man-hours. Given that the average man-hours cost for performing depot work for one F-4E aircraft is 12,407 man-hours (Table 1), the phase incremental costs appear to be quite insignificant. According to a recent field test at Holloman AFB, base maintenance would require 311 man-hours to perform a phase.* Thus, if the depot performed the next due base-level phased inspection, it would still be an attractive proposition, even though the required inspection might be only one of the six phases.

Our closing comment is about the 20 hours of "unpredictable" work shown for the Phase 6. In a review of the carry forwards of the sample of aircraft involved, only defects that could be directly related to Phase 6 inspection card items were included in the incremental cost. In effect, the defects that could not be so related remained on the carry forward list. It is very doubtful that this strict interpretation of the -6 requirements is appropriate. Some defects not selected for repair would be visible during the accomplishment of the phase at the base. If visible, repair probably would take place even if the defect were not directly related to a card item. This is likely because quality control inspectors in the dock probably would not limit their inspection of the aircraft to -6 requirements. Thus, it may make sense for the completion of a phase to repair all carry forwards. Such a policy would nearly double the Phase 6 incremental cost to 112 man-hours.

Parenthetically, we were somewhat surprised by the relatively small number of man-hours represented by the carry forward lists. Given the concern we have encountered at some bases regarding these carry fowards, it perhaps would be desirable in any event to complete their repair at the depot. Even under such a policy, exceptions might take place because extenuating circumstances might indicate the economic desirability of fixing the defect at a later date.

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*Elwell and Roach, op. cit., p. 24. For the phased inspection, there was also a difference in the content of the deck between the Holloman test and the current cost estimation exercise. Ours was based on the old deck, whereas a pared-down deck was used at Holloman. This means that the reported figure would likely be even smaller if the pared-down deck were used in this study.

FLOWTIME

The networks provided by the DART system permit estimates to be made regarding the potential effect of added work on the average flowtime of the PDM/MOD work. Essentially, the attempt was made to assess whether this added work is or is not on the critical path of the PDM/MOD work. This kind of analysis could be performed for predictable items only, and the judgment reached that no increase in project flowtime was necessary.

Flowtime assessment for unpredictable work is more difficult. There are rules of thumb about the amount of work that can be accomplished in a day. Also, one can compute the average man-hours per flow day from data such as shown in Table 1, in which man-hours per flow day range from 100-160, with a mean of 125. Our incremental unpredictable data from the F-4C and the RF-4C are 50 man-hours; for the F-4E, 70 hours. It is judged that these relatively few hours would not affect the flowtime of an aircraft undergoing the PDM/MOD work.

VI. CONCLUDING REMARKS

The method outlined and illustrated in this report for estimating the incremental man-hour cost of doing a base-level inspection during a depot visit turns out to be rather straightforward. This method, worked out for the Ogden ALC F-4 situation, is applicable to other ALCs. Because the information system that provided the data used in the method is common to all ALCs, it is believed that the method can be generalized to other ALCs and the weapon systems they maintain, although some illustrations found for the F-4 will not necessarily transfer to other weapon systems. For example, the observation that all carry forward defects need to be repaired to satisfy the PE requirement is probably a finding that is specific to the F-4 situation.

Our method has some important and useful characteristics, among them the fact that the "predictable" work is largely identified in DART and that DART provides all necessary data. With regard to the "unpredictables," trying to predict the defects that will be discovered and their repair times is normally an extremely difficult task. However, given depot policy guidelines for the repair of observed defects, we find that *all* defects that are of interest are in carry forward lists. This makes the answer to what would otherwise be a difficult problem an easy one. All that one needs to do is review the defects on the carry forward lists for a sample of aircraft in history periods. Such reviews permit estimation of the amount of "unpredictable" work. Under some special circumstances, however, this approach may not be completely appropriate. If much of the added work occurs in parts of the aircraft that have not been torn down in any depot package to permit defect discovery experience, then predicting the probability of defect discovery continues to be a problem. However, it is unlikely that the teardown or visibility during a depot visit would be significantly less than the teardown and visibility in a base-level inspection.* Given

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*The worst case would probably be a speedline in which only a limited portion of the aircraft (e.g., cockpit) is torn down. Even in this case where man-hours may not be reduced significantly, it may be possible to complete the inspection without incurring the base-level's flowtime costs.

that the "predictable" work man-hours are obtained from DART, and given that the "unpredictable" man-hours come from aircraft histories, considerable confidence can be placed in these estimates. Thus, it does not seem necessary to conduct extensive field tests to provide the estimates--except perhaps where the sample aircraft in history is considered too small to obtain the unpredictable man-hour estimate of "unpredictables."

In normal depot operation, the man-hours required to perform a particular task are the standard man-hours provided by DART. Thus, without a change in the normal operation, a depot field test cannot improve the man-hour estimate; it may only identify procedural errors made in the process of performing the cost analysis. Test experience with an aircraft or two may be useful for spotting procedural errors and/or for permitting the operational command to observe the decision rules being used by depot maintenance, thus making sure that agreement exists on what should be done to take credit for the base-level inspection in question. The fact that the method uses the depot information system and the fact that additional test experience is not considered important for this kind of estimation are other important contributions of the method.

For the F-4 aircraft, the incremental costs of performing the PE and the Phase 6 seem to be quite small relative to the total man-hours required to perform the average PDM/MOD work. For such small incremental costs, one is led to speculate as to whether this incremental work can be done without additional manpower requirements. Obviously a slight increase in utilization rate of the current work force could absorb this small increment of work. Where this is not possible and where funds are not available to absorb this workload, aircraft can be rescheduled so that depot intervals are extended slightly and costs remain within acceptable ceilings.

The benefit to be derived from accomplishing the next due base-level inspection--phase or PE--was not the primary concern of this report; past assessments of the costs-benefits for Quick Fix are well covered in another report.* The Holloman AFB field test, which was

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*Kamins, op. cit.

completed recently, is expected to provide more detailed and up-to-date information for several scheduled maintenance policy changes, including the one used in this report: taking credit for the next due base-level inspection. In this context gains are expected whether the next due phase or the PE is completed during a depot. The larger gain is expected with the Periodic System of Inspection. Gains are expected in such dimensions as:

- Increased availability of air frames at base level.
- Decreased base inspection workload.
- Decreased base man-hours associated with inspections.
- Reduction in abort rate (and other kinds of unreliability) associated with the extensive teardown of aircraft due to the reduction in number of dockings.

Quantitative estimates of these gains are included in the report being prepared jointly by Ogden ALC and Rand.*

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*Elwell and Roach, op. cit., pp. 23-24.

Appendix A

SAMPLE E&I WORKSHEET

The information provided by the E&I worksheet (Fig. A.1) includes (reading from left to right): the area of the aircraft where the defect was discovered, a verbal description of the defect, the defect's classification, the E&I inspector's stamp number, his foreman's stamp number, and the E&I quality inspector's stamp number.

Approximately 280 defects per aircraft are documented in this manner.

WORK CONTROL DOCUMENT		PRODUCTION SECTION/SEC	PAGE OF
		SERIAL NO. F4C 64-0882	DATE 03/09/4
TECH DATA	PART NO.	FSN	PDN NO.
OPTIONAL			DATE SCHED
			DATE COMP
			ROUTE TAG NO.

	STEP/OP	CRITICAL STEPS/REMARKS	INSP TYPE	MECHANIC	"P"	"Q"
5f2a	5A	R+L Aux air door upper pads missing	SAI	00 EE18 03/09/4	00 EE41 03/09/4	OC 402
5f2a	5A	R+L Aux air door bulb seals torn	SAI	00 EE18 03/09/4	00 EE41 03/09/4	00 402
5f2a	5A	"T" bracket on access door # 82-L Loose, bolT missing. (MKd)	PR	00 EE18 03/09/4	00 EE41 03/09/4	00 402
5f2a	5A	Fwd center line Fairing stress plate damaged. (MKd)	PR	00 EE18 03/09/4	00 EE41 03/09/4	OC 402
5f2a	5A	Fuel manifold wiggens Fitting - Leaking up in access # 22.	SoF	00 EE18 03/09/4	00 EE41 03/09/4	00 402
5f2a	5A	R+L missile Fin doors out of adjustment.	CF	00 EE18 03/09/4	00 EE41 03/09/4	00 402
5f2a	5A	Bonding clamp around Fuel — manifold up in access # 22 Fwd area. [redacted] (MKd) (Loose)	SoF	00 EE18 03/09/4	00 EE41 03/09/4	00 402
5f2a	5A	Radar cooling mech red rubber - seal Loose up in access # 22	PR	00 EE18 03/09/4	00 EE41 03/09/4	OC 402

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Fig. A.1 -- E&I Worksheet

Appendix B

STATISTICAL ANALYSIS OF CARRY FORWARD REPAIR TIMES

This appendix discusses confidence intervals for estimated average CF repair times; relationships between CF repair times and the MDS; and relationships between CF repair times and the aircraft work package. Data used for the analyses are also presented.

CONFIDENCE INTERVAL

Table B.1 gives a point estimate of the average CF repair time for each MDS, as well as a 95 percent confidence interval. Because of the small sample size, the estimated confidence intervals have a large spread. However, even the upper limits of the estimated confidence intervals are small relative to man-hour requirements for the total work package.

Table B.1

ESTIMATES OF AVERAGE CF REPAIR TIMES

MDS	Sample Size	Point Estimate (hours)	95 Percent Confidence Interval (hours)
F-4D	11	46.4	6.2 ~ 86.8
F-4E	13	66.8	7.8 ~ 125.8
RF-4C	6	49.3	0 ~ 112.1

EFFECT OF MDS

To examine the effect, if any, of MDS on the amount of CF repair, an analysis of variance was performed. Table B.2 summarizes the results.

The ratio

$$F = \frac{1391.63}{567.22} = 2.45$$

Table B.2

ANALYSIS OF VARIANCE TABLE

Source of Variation	DF	Sum of Squares	Variance Estimate
Between samples	2	2,783.26	1,391.63
Within samples	27	15,314.93	567.22
Total	29	18,988.19	--

has the F distribution with values of DF = 2 and 27. The value of the F distribution for 2 and 30 DF* at 95 percent significance level is 19.5. Since the computed ratio does not exceed 19.5, we conclude that MDS has no significant impact on the amount of repair time.

EFFECT OF WORK PACKAGE

To investigate the impact of different work packages on CF repair times, a t test was performed. Ideally, one would wish to examine the effect of each work package on CF repair time, but unfortunately we did not have a large enough sample to do that. Hence, work packages were categorized into only two groups according to the amount of access penalty involved. For the ECR TCTO, more panels and doors would have been opened compared to the other kinds of work packages. This implies that on the average, the ECR TCTO would have a smaller access penalty than the rest of the work packages. Table B.3 summarizes the results.

Under the null hypothesis that the two means are equal, the ratio t has the t distribution with 28 degrees of freedom:

$$t = \frac{(50.22 - 64.18)\sqrt{(18 \times 12)/30}}{\sqrt{20,805.75/28}}$$

$$= -1.374 .$$

*The table of F does not include values of DF = 2 and 27. The nearest is DF = 2 and 30 which is satisfactory for this analysis.

Table B.3

SUMMARY OF STATISTICS FOR t-TEST

Statistics	TCTO	
	ECR	Others
Sample size	18	12
Sample mean	50.22	64.18
Sum of squares	10,786.65	10,019.10

Since the significance level at the 95 percent point for the above t distribution is - 1.701, we conclude that the effect of the work package on the amount of CF repair time is not significant according to the following data.

DATA

The data used for the above analysis are presented in Tables B.4 through B.6.

Table B.4

CF REPAIR TIME DATA BY TAIL NUMBER, F-4D

Tail Number	CF	CF Hours	Work Package	SAI
667718	31	50.1	MOD/PDM	83
667638	15	48.3	MOD/PDM	70
667458	20	21.9	MOD/PDM/ECR	91
650617	14	28.7	MOD/PDM/ECR/ACI	60
667640	40	42.9	MOD/PDM	69
668698	24	26.7	MOD/PDM/ECR	55
667660	24	22.6	MOD/PDM/ECR	0
667726	25	81.2	MOD/PDM	59
667765	42	57.0	MOD/PDM/ECR/ACI	54
667731	52	73.1	MOD/PDM	41
667701	18	58.1	MOD/PDM/ECR	44
Total	305	510.6	--	626

Table B.5

CF REPAIR TIME DATA BY TAIL NUMBER, F-4E

Tail Number	CF	CF Hours	Work Package	SAI
660304	19	78.3	PDM/LES/ECR	52
670265	22	90.0	PDM/LES/ECR	37
670355	19	44.7	PDM/LES/ECR	27
670307	23	56.4	PDM/LES/ECR	52
670353	23	47.2	PDM/LES/ECR	51
670322	16	20.9	PDM/LES	52
670264	27	76.6	PDM/LES/ECR	18
670258	34	77.5	PDM/LES	51
680342	37	114.9	PDM/LES	36
680354	29	56.1	PDM/LES	43
680340	27	64.1	PDM/LES	33
680345	22	25.9	PDM/LES	46
680353	29	115.1	PDM/LES	34
Total	327	867.7	--	532

Table B.6

CF REPAIR TIME DATA BY TAIL NUMBER, RF-4C

Tail Number	CF	CF Hours	Work Package	SAI
670462	18	26.1	MOD/PDM/ECR	55
670455	28	36.9	MOD/PDM/ECR	74
650879	23	71.8	MOD/PDM/ECR	52
650896	25	100.4	MOD/PDM/ECR	51
660417	9	16.0	MOD/PDM/ECR	69
660463	22	44.3	MOD/PDM/ECR	58
Total	125	295.5	--	359

Appendix C

ANALYSIS FOR DETERMINING THE REDUNDANCY BETWEEN PE REQUIREMENTS AND DEPOT LEVEL WORKLOAD

Tables C.1-C.7 contain the worksheets developed to determine the net cost for each category. Reading from left to right, the first column contains the items listed under each category, the man-hours (DPSH) and then columns for PDM and the major TCTOs. An X in one of these columns indicates that this item would be covered under that type of work. For example, under the doors category, Door 89L required 2.4 man-hours to remove and reinstall. It was not a PDM requirement; it was a 986 TCTO requirement, a 991 TCTO requirement, a 566 TCTO requirement; it was not an ACI requirement. The last column indicates whether this requirement remains in the revised -6. These worksheets were used for both the analysis of the current -6 and the revised -6. In the example cited above, Door 89L would also be a revised -6 requirement.

Each category contains a complete listing of all periodic requirements under that category. The items are divided and sorted according to the following groupings:

1. Additional Requirements - Phase only. These requirements are completely new to the depot.
2. Non-PDM Requirements - These items would not occur under a straight PDM/MOD work package but will occur under one or more of the other work package options.
3. PDM Requirements - These items occur 100 percent of the time.

Tables C.8-C.11 summarize these data by category, with repair times.

The method used to calculate these numbers was as follows:

1. The work package was determined.

2. Once this was known, each category's man-hours were determined by reading down the columns as applicable. If an X was in the column, no time was charged. If all *applicable* columns were scanned and no X had occurred, the time was charged.
3. For the revised (new) -6, if an X appeared in this column, step 2 was applied; if no X appeared, this item was ignored.

Table C.1

DOORS, ALL MDS

Phase Req.	DPSH	PDM	TCTO 986	TCTO 991	TCTO 566	ACI	New Deck
Non-PDM Requirements							
5R	2.6	--	X	--	X	--	X
9L	3.9	--	X	--	X	--	X
40L	0.4	--	X	X	X	X	--
40R	0.4	--	X	X	X	X	--
41L	0.4	--	X	X	X	X	--
41R	0.4	--	X	X	X	X	--
42L	1.1	--	X	X	X	X	--
42R	1.1	--	X	X	X	X	--
54L	0.4	--	X	X	X	X	--
54R	0.4	--	X	X	X	X	--
89L	2.4	--	X	X	X	--	X
89R	2.4	--	X	X	X	--	X
PDM Requirements							
6R	3.8	X	X	--	X	--	X
15	Part of Door 22	X	X	--	X	--	X
16	1.2	X	X	--	X	--	X
19	2.0	X	X	--	X	X	--
21L	4.9	X	X	--	X	X	X
21R	4.9	X	X	--	X	X	X
22	3.8	X	X	--	X	X	X
23	0.7	X	X	--	X	--	X
30L	2.3	X	X	X	X	--	X
30R	2.3	X	X	X	X	--	X
33L	4.4	X	X	--	X	X	X
33R	4.4	X	X	--	X	X	X
34	4.6	X	X	X	--	X	X
39L	2.9	X	X	X	X	--	X
39R	2.9	X	X	X	X	--	X
45	3.1	X	X	--	X	X	X
48	7.2	X	X	X	X	X	X
51	2.5	X	X	--	X	--	--
63	3.6	X	X	X	--	X	X
64	5.8	X	X	X	--	X	X
65	3.5	X	X	X	--	X	X
66L	2.3	X	X	X	--	--	X
66R	2.3	X	X	X	--	--	X

(continued)

Table C.1--Continued

Phase Req.	DPSH	PDM	TCTO 986	TCTO 991	TCTO 566	ACI	New Deck
70	1.1	X	--	X	--	--	--
72L	4.0	X	X	--	--	--	X
72R	4.0	X	X	--	--	--	X
73L	0.4	X	X	X	X	X	X
73R	0.4	X	X	X	X	X	X
74L	0.9	X	X	X	X	X	X
74R	1.0	X	X	X	X	X	X
75L	1.6	X	X	X	X	--	--
75R	1.6	X	X	X	X	--	--
78	0.7	X	X	X	X	--	X
80	0.7	X	X	X	X	X	--
81L	Open	X	X	X	X	X	X
81R	Open	X	X	X	X	X	X
82L	1.9	X	X	X	X	X	X
82R	1.8	X	X	X	X	X	X
83L	3.3	X	X	X	X	X	X
83R	3.2	X	X	X	X	--	X
86L	5.6	X	X	X	--	--	X
86R	5.6	X	X	X	X	--	X
88L	5.2	X	X	X	X	--	X
88R	5.2	X	X	X	X	--	X
92L	1.8	X	X	X	X	--	X
92R	1.8	X	X	X	X	--	X
96L	3.1	X	X	X	X	--	X
96R	3.1	X	X	X	X	--	X
100L	0.8	X	--	X	--	--	X
100R	0.8	X	--	X	--	--	X
101L	10.8	X	X	X	X	--	X
101R	10.8	X	X	X	X	--	X
102L	7.8	X	--	X	X	--	X
102R	7.8	X	--	X	X	--	X
105L	1.1	X	--	--	X	--	X
105R	1.1	X	--	X	X	--	X
134	5.7	X	X	X	--	X	X
135	7.8	X	X	X	--	X	X
138	0.6	X	X	X	X	X	X
139	0.6	X	X	X	X	X	--
140	1.0	X	X	X	X	X	X

Table C.2

DOORS, F-4C/D/E

Phase Req.	DPSH	PDM	TCTO 986	TCTO 991	TCTO 566	ACI	New Deck
Non-PDM Requirements							
61	5.3	--	X	--	--	--	X
PDM Requirements							
1(E)	3.0	X	X	X	--	--	X
109L	0.4	X	--	--	--	X	X
109R	0.4	X	--	--	--	X	X
112L	1.5	X	--	--	--	X	X
112R	1.5	X	--	--	--	X	X
118L(E)	0.2	X	X	X	X	--	X
118R(E)	0.2	X	X	X	X	--	X
119L(E)	0.3	X	X	X	X	--	X
119R(E)	0.3	X	X	X	X	--	X

Table C.3

DOORS, F-4E

Phase Req.	DPSH	PDM	TCTO 986	TCTO 991	TCTO 566	ACI	New Deck
Non-PDM Requirements							
129L	1.2	--	X	--	--	--	X
129R	1.2	--	X	--	--	--	X
168	3.3	--	X	--	X	--	--
170	1.9	--	X	--	--	--	X
PDM Requirements							
61	5.2	X	X	X	--	--	X
122L	2.9	X	X	--	X	--	--
166	1.4	X	--	--	--	--	--
173	3.2	X	--	--	--	--	--
193/642L	2.3	X	--	--	X	--	--
193/642R	2.3	X	--	--	X	--	--
194/643L	3.5	X	--	--	X	--	--
194/643R	3.5	X	--	--	X	--	--
195/644L	3.0	X	--	--	X	--	--
195/644R	3.0	X	--	--	X	--	--
198/647L	4.7	X	--	--	X	--	--
198/647R	4.7	X	--	--	X	--	--
199/648L	4.4	X	--	--	X	--	--
199/648R	4.4	X	--	--	X	--	--

Table C.4

DOORS, RF-4C

Phase Req.	DPSH	PDM	TCTO 986	TCTO 991	TCTO 566	ACI	New Deck
			Non-PDM Requirements				
27L	1.8	--	X	--	--	--	X
27R	1.8	--	X	--	--	--	X
506L	0.7	--	X	X	--	--	--
506R	0.7	--	X	X	--	--	--
511L	2.3	--	X	--	--	--	--
511R	2.3	--	X	--	--	--	--
			PDM Requirements				
61	5.2	X	X	X	--	X	X
109L	1.3	X	--	--	--	X	X
109R	1.3	X	--	--	--	X	X
112L	1.5	X	--	--	--	X	X
112R	1.5	X	--	--	--	X	X
500L	0.5	X	X	--	--	--	--
500R	0.5	X	X	--	--	--	--
501	1.4	X	X	X	--	--	X
502	0.6	X	X	X	--	--	--
503	1.3	X	X	X	--	--	--
504L	0.6	X	X	X	--	--	--
504R	0.6	X	X	X	--	--	X
507L	0.8	X	X	X	--	--	--
507R	0.9	X	X	X	--	--	--
509	0.6	X	X	--	--	--	--
514L	0.4	X	--	--	--	--	X
514R	0.4	X	--	--	--	--	X

Table C.5

COMPONENTS

Item Description	DPSH	PDM	TCTO 986	TCTO 991	TCTO 566	ACI	New Deck
Additional Requirements - Phase Only							
1) Clean Bellmouth Filters	1.6	--	--	--	--	--	X
2) Replace Elec. Eq. Press. Chem. Drier	2.8	--	--	--	--	--	X
3) Replace Pneu. Sys. Chem. Drier	1.6	--	--	--	--	--	X
4) Clean CADC Inline Filter	0.4	--	--	--	--	--	X
5) Clean/Replace Canopy Aux. Air Filter	0.5	--	--	--	--	--	X
6) Replace CSD Filter	0.6	--	--	--	--	--	X
7) Clean/Replace Air Charge Pneu. Filter	0.8	--	--	--	--	--	X
8) Drain/Service/Clean Air Compressor	1.5	--	--	--	--	--	X
9) Clean Water Separator Coalescer	4.0	--	--	--	--	--	X
10) R/I N/L/G Torque Arm Bolt	0.5	--	--	--	--	--	--
11) R/I Airesearch Starter	4.3	--	--	--	--	--	X
Non-PDM Requirements							
1) R/I T/E Bleed Air Duct 2502119 & 2501669-7	2.4	--	--	X	X	X	X
2) R/I T/E Bleed Air Duct 2502117 & 2501668-7	2.4	--	--	X	X	X	X
3) R/I AERO-27A Panel/Fairing	4.3	--	X	--	--	--	X
4) R/I Inbd. L/E Slat Actuator (E)	2.6	--	--	--	X	--	--
5) R/I Drag Chute Door Latch Bellcrank	1.2	--	--	X	--	--	--
6) Replace N/L/G Follow-up Pot. Wrap	0.4	--	X	--	--	X	X
7) Dis/Con. L/E & T/E BLC Control Rods	1.2	--	--	X	X	X	X
8) R/I AERO-27A Bomb Rack	4.5	--	X	--	--	--	X
9) R/I KD26B Camera (C/D)	1.2	--	X	--	--	--	X
10) Drain Moisture; L/G and Canopy Bottles	0.6	--	--	X	X	--	X
PDM Requirements							
1) R/I Aft AERO-7A Launchers	4.4	X	X	X	X	X	X
2) Extend Variable Ramps	--	X	X	X	X	X	X
3) Extend Flaps	--	X	X	X	X	X	X
4) R/I Fwd & Aft Ejection Seats	42.4	X	X	X	X	X	X
5) R/I Fwd AERO-7A Launchers	4.4	X	X	X	X	X	X
6) R/Clean/Lub/I Airframe Throttle Cables	10.2	X	--	--	--	--	X
7) R/I Motion Pick-Up Transducer	1.2	X	X	--	X	--	X
8) R/I Stab. Cover Plates	3.1	X	--	X	--	X	X
9) R/I Inlet Duct Louvers	8.0	X	X	--	X	--	X
10) R/I RAT Nose Dome	4.1	X	--	--	--	--	X

(continued)

Table C.5--Continued

	Item Description	DPSH	PDM	TCTO 986	TCTO 991	TCTO 566	ACI	New Deck
11)	R/I Arresting Gear Fairing	3.6	X	--	X	--	--	X
12)	R/I Drag Chute Container	2.2	X	--	X	--	--	X
13)	R/I Talcone Heat Shield/Blankets	5.6	X	--	X	--	--	X
14)	R/I Outbd. Pylon Attach Mech.	2.8	X	--	--	--	--	X
15)	Ext/Retract Radar Package	1.7	X	X	X	--	--	X
16)	R/I Nose Gear Well Cover	1.5	X	--	--	--	--	X
17)	R/I Internal Flap Access Doors	3.0	X	--	--	--	--	X
18)	R/I Gun Muzzle Fairing (E)	1.3	X	--	X	--	--	--
19)	R/I CP-733 INS Computer	2.7	X	X	--	--	--	--
20)	R/I AM-3734 Nav. Computer	2.0	X	X	--	--	--	--
21)	R/I RT-793/ASQ	1.5	X	X	--	--	--	--
22)	R/I Auto Pilot Amp	1.5	X	X	--	--	--	--
23)	R/I C-6684/ASQ	0.5	X	X	--	--	--	X
24)	R/I CADC	3.8	X	X	--	--	--	--
25)	R/I #1 Misc. Relay Panel	1.8	X	X	--	--	--	--
26)	R/I R/C/P Radar Scope	1.8	X	X	--	--	--	--
27)	R/I LD58A/LD69A RRSC Cont	0.5	X	X	--	--	--	X
28)	R/I Ejector Rack (RF)	5.2	X	X	--	--	--	X
29)	R/I Fwd/Aft. Stick Well Covers	1.0	X	X	--	--	--	X

Table C.6

DO INSPECTIONS[a]

	Item Description	DPSH	TCTO	New Deck
1)	NDI #3 Fuel Cell Web P/N 32-32139	2.0	--	X
2)	NDI Area Under Shield P/N 53-69018 and P/N 53-69019	3.0	--	X
3)	NDI Connecting Bolt Upper/Lower Torque Arm Assy	1.0	--	--
4)	Inbd. L/E Slat Actuator Mount Bolts for Torque (E)	0.8	566	X
5)	NDI Inbd. L/E Slat Actuator Mount Bolts (E)	2.8	566	X
6)	Stabilator Looseness Check	0.8	991	X
7)	NDI Weld. Area of Bleed Air Cap, P/N 2502553	2.0	--	X
8)	Bleed Air Check Valve for Movement	0.2	--	X
9)	NDI Bleed Air Duct Mount Bracket	2.2	--	X
10)	Temp Compensating Cable Pulley for Wear/Damage (E)	0.5	--	X
11)	Inspect/Lube Air Research Starter	0.5	--	X
12)	Magnetic Sump Plug for Particles	1.0	--	X
13)	Rotary Actuator Arm Bolt for Security	0.5	--	X
14)	CSD Oil Filter for Leakage/Security	2.0	--	X
15)	Gap Check Between Hinge Bracket and Bolt	0.2	--	X
16)	RAT Blade Check	0.6	--	X
17)	Corrosion Check on C-6684/ASQ	0.5	--	X
18)	SLR Magazine for Bent Pins (RF)	0.4	--	--
19)	Inspect AERO 27A and AFT Adjust Mount Bolt	0.3	--	X
20)	Inspect MAU 12 Bomb Rack (Not Installed, PDM)	--	--	X
21)	Inspect KS72/87 Camera (RF) (If Installed)	0.3	--	X
22)	Inspect KA56 Camera (RF) (If Installed)	0.6	--	X
23)	Inspect KA56 Cassette (RF) (If Installed)	0.8	--	X

[a]Look inspections accomplished by PDM requirements.

Table C.7

OPERATIONALS

Item Description	DPSH	PDM	TCTO 986	TCTO 991	TCTO 566	ACI	New Deck
Additional Requirements - Phase Only							
1) Canopy Jettison Control Functional	7.7	--	--	--	--	--	X
2) Canopy Thruster Firing Circuit	1.7	--	--	--	--	--	X
3) Brake Pedal Force Return	1.2	--	--	--	--	--	X
4) Brake Interconnect Breakout Force	2.4	--	--	--	--	--	X
5) Venturi Heater Resistance	0.5	--	--	--	--	--	--
6) Flap Emerg. Check (C,D,R,F)	2.3	--	--	--	--	--	X
7) Engine Control Box Ware Check	5.4	--	--	--	--	--	X
8) Throttle Level Shift Breakout	0.5	--	--	--	--	--	--
9) Camera Comp. Defog (RF)	1.3	--	--	--	--	--	--
10) Static Ground Continuity[a]	0.5	--	--	--	--	--	X
11) Pitot/Static Drain and Purge	3.2	--	--	--	--	--	X
12) VGH Recorder Operational (RF)	3.8	--	--	--	--	--	--
Non-PDM Requirements							
1) L/G Emergency Check	2.8	--	X	X	--	X	X
2) Slat Emerg. Check (E)	8.7	--	--	--	X	--	X
3) Flap Normal Operational (C,D,RF)	3.1	--	X	X	--	X	X
4) Slat Normal Operational (E)	13.1	--	--	X	X	X	--
5) Fuel Pressure and Vent Check	12.8	--	--	X	--	X	X
6) Air Refueling Recp. Operational	2.7	--	X	--	--	X	X
7) Fuel Cell Interconnect Leak Check	2.4	--	--	X	--	X	X
8) Photoflash Ejector Functional (R/F)	7.0	--	X	--	--	--	X
9) KB25A Functional (E)	2.8	--	X	--	--	--	--
10) EGT Functional	17.4	--	X	--	X	X	X
11) Camera System Functional (RF)	21.7	--	X	--	--	--	X
PDM Requirements							
1) Canopy Emeg. Pneu. Functional	12.6	X	--	--	--	--	X
2) Anti-Skid Continuity Check[b]	13.3	X	X	X	--	--	X
3) L/G Functional	32.4	X	X	X	--	--	--
4) Borescope Stabilator[c]	3.2	X	--	--	--	--	--
5) Speed Brake Clearance Check[d]	2.0	X	--	--	--	--	--
6) Fwd/Aft Control Stick Looseness[e]	--	X	--	--	--	--	X

[a] Technical Estimate.

[b] Covered by Anti-Skid Operational.

[c] Not required after depot TCTO IF-4-969.

[d] Covered by Pre-Flight Inspection.

[e] E&I requirement.

Table C.7--Continued

	Item Description	DPSH	PDM	TCTO 986	TCTO 991	TCTO 566	ACI	New Deck
7)	Rudder Pedal Adjustment Binding[f]	--	X	X	X	X	X	X
8)	Stab APU Operational	2.1	X	X	X	--	--	X
9)	Lat., Stab, Rud, Control & Rigging[g]	43.0	X	X	X	--	--	X
10)	Eng. Control Rigging Check	25.0	X	X	X	X	X	X
11)	Eng. Nozzle Feedback Cable (C,D,R,F)[h]	--	X	X	X	X	X	X
12)	Eng. Run-Min. Performance[i]	--	X	X	X	X	X	X
13)	Eq. Cooling Operational (RF)	3.0	X	X	--	--	--	X
14)	Fuel Integral Wingtank Press.	5.7	X	--	X	X	--	X
15)	Jettison Switch & Stray Volt Check[j]	--	X	--	--	--	--	X
16)	Pressurization #4, 6 Hyd. Pump[k]	4.3	X	X	X	X	X	X
17)	Pitot/Static Min. Performance	6.6	X	X	--	--	--	X
18)	Altitude Encoder Operational	4.0	X	X	--	--	--	X
19)	Motion Pick-up Transducer Check[ℓ]	--	X	X	--	--	--	X
20)	Canopy Normal Functional	5.3	X	--	--	--	--	X
21)	AFSC Functional	23.0	X	X	X	--	--	X
22)	IFF Emeg. Operational	1.0	X	X	X	X	X	X
23)	Pylon Jettison & Stray Volt Check[m]	--	X	X	X	X	X	X
24)	KD26B Functional (C,D)	1.0	X	X	--	--	--	--
25)	KD42A Functional (E)	1.0	X	X	--	--	--	--
26)	Drag Chute Operational	1.0	X	--	X	--	--	X

[f] E&I requirement and flight check.

[g] Stabilator, Lateral and Rudder Control Operational and Rigging check.

[h] Part of engine run requirements and engine visual.

[i] Part of engine run requirements.

[j] Flight test requirement.

[k] Part of refuel operation.

[ℓ] Part of AFSC functional and flight check.

[m] Part of reinstallation check of pylons.

Table C.8

TOTAL INCREMENTAL DEPOT MAN-HOUR REQUIREMENTS
FOR ACCOMPLISHING THE PE, F-4C

Project	Predictables				Unpre-dictables (repair)[a]	Total	Number of Aircraft	FY 1976 Total
	Doors	Compon-ents	Inspec-tions	Opera-tions				
MOD/PDM	21	37	17	67	50	192	39	7,488
MOD/PDM/991	12	29	16	46	50	153	35	5,355
MOD/PDM/ACI	17	30	17	25	50	139	4	556
MOD/PDM/ACI/991	12	29	16	25	50	132	7	924
FY 1976 total	--	--	--	--	--	169[b]	85	14,323

[a]Based on a review of Carry Forward defects for 11 aircraft.

[b]Weighted average, with weight being the number of aircraft.

Table C.9

TOTAL INCREMENTAL DEPOT MAN-HOUR REQUIREMENTS
FOR ACCOMPLISHING THE PE, F-4D

Project	Predictables				Unpre-dictables (repair)[a]	Total	Number of Aircraft	FY 1976 Total
	Doors	Compon-ents	Inspec-tions	Opera-tions				
MOD/PDM/ECR	0.0	26	17	41	50	134	30	4020
MOD/PDM/ECR/991	0.0	19	16	25	50	110	7	770
MOD/PDM/991	12	29	16	46	50	153	10	1530
MOD/PDM/ACI/-ECR/991	0.0	19	16	25	50	110	2	220
FY 1976 total	--	--	--	--	--	133[b]	49	6540

[a]Based on a review of Carry Forward defects for 11 aircraft.

[b]Weighted average, with weight being the number of aircraft.

Table C.10

TOTAL INCREMENTAL DEPOT MAN-HOUR REQUIREMENTS
FOR ACCOMPLISHING THE PE, F-4E

Project	Predictables				Unpredictables (repair)[a]	Total	Number of Aircraft	FY 1976 Total
	Doors	Components	Inspections	Operations				
MOD/PDM	24	38	21	86	70	239	15	3,585
MOD/PDM/LES	4	29	17	64	70	184	8	1,472
MOD/PDM/LES/ECR	0.0	20	17	38	70	145	9	1,305
MOD/PDM/ACI/LES/ECR	0.0	20	17	23	70	130	3	390
MOD/PDM/ACI/LES/-ECR/991	0.0	19	17	23	70	129	1	129
MOD/PDM/ECR	0.0	29	21	60	70	180	12	2,160
MOD/PDM/991	14	30	20	55	70	189	21	3,969
MOD/PDM/ECR/991	0.0	21	20	32	70	143	2	286
MOD/PDM/ACI/991	14	30	20	35	70	169	1	169
MOD/PDM/ACI/ECR/991	0.0	21	20	32	70	143	1	143
FY 1976 total	--	--	--	--	--	186[b]	73	13,608

[a]Based on a review of Carry Forward defects for 13 aircraft.

[b]Weighted average, with weight being the number of aircraft.

Table C.11

TOTAL INCREMENTAL DEPOT MAN-HOUR REQUIREMENTS
FOR ACCOMPLISHING THE PE, RF-4C

Project	Predictables				Unpredictables (repair)[a]	Total	Number of Aircraft	FY 1976 Total
	Doors	Components	Inspections	Operations				
MOD/PDM	26	36	19	100	50	231	18	4,158
MOD/PDM/ECR	0.0	26	19	46	50	141	22	3,102
MOD/PDM/991	15	28	18	79	50	190	19	3,610
MOD/PDM/ECR/991	0.0	19	18	31	50	118	5	590
MOD/PDM/ACI/ECR	0.0	20	19	31	50	120	2	240
MOD/PDM/ACI	21	30	19	59	50	179	3	537
MOD/PDM/ACI/991	15	27	18	59	50	169	1	169
MOD/PDM/ACI/ECR/991	0.0	19	18	31	50	118	1	118
FY 1976 total	--	--	--	--	--	176[b]	--	12,524

[a]Based on a review of Carry Forward defects for 6 aircraft.

[b]Weighted average, with weight being the number of aircraft.

Appendix D

ANALYSIS TO DETERMINE ADDITIONAL COSTS TO DEPOT OF ACCOMPLISHING PHASE 6 ON F-4E AIRCRAFT

Tables D.1-D.5 contain the worksheets for the analysis of Phase 6 for the F-4E. These worksheets are exactly the same as those in App. C, except they contain only the Phase 6 requirements.

Table D.1

DOORS, PHASE 6

Old Phase	DPSH	PDM	TCTO 986	TCTO 991	TCTO 566	ACI	Equal Phase
1	3.0	X	X	X	--	--	X
5R	2.6	--	X	--	X	--	X
15	Part of door 22	X	X	--	--	--	X
16	1.2	X	X	--	X	--	X
19	2.0	X	X	--	X	X	--
22	3.8	X	X	--	X	X	X
23	0.7	X	X	--	X	--	X
30L	2.3	X	X	X	X	--	--
30R	2.3	X	X	X	X	--	X
39L	2.9	X	X	X	X	--	--
39R	2.9	X	X	X	X	--	--
61	5.3	X(E)	X	X	--	--	--
63	3.6	X	X	X	--	X	X
64	5.8	X	X	X	--	X	X
65	3.5	X	X	X	--	X	X
70	1.1	X	--	X	--	--	X
74L	0.9	X	X	X	X	X	--
74R	1.0	X	X	X	X	X	--
81L	Open	X	X	X	X	X	X
81R	Open	X	X	X	X	X	X
82L	1.9	X	X	X	X	X	--
82R	1.8	X	X	X	X	X	--
86L	5.6	X	X	X	--	--	X
86R	5.6	X	X	X	X	--	X
88L	5.2	X	X	X	X	--	X
88R	5.2	X	X	X	X	--	X
89L	2.4	--	X	X	X	--	X
89R	2.4	--	X	X	X	--	X
122L(E)	2.9	X	X	--	X	--	--
135	7.8	X	X	X	--	X	--
140	1.0	X	X	X	X	X	--
166(E)	1.4	X	--	--	--	--	--
168(E)	3.3	--	X	--	X	--	--
170(E)	1.9	--	X	--	--	--	X
647/198L(E)	4.7	X	--	--	X	--	--
647/198R(E)	4.7	X	--	--	X	--	--
507R(RF)	0.9	X	X	X	--	--	X

Table D.2

COMPONENTS, PHASE 6

Item Description	DPSH	PDM	TCTO 986	TCTO 991	TCTO 566	ACI	Equal Phase
1) R/I Gun Muzzle Fairing (E)	1.3	X	--	X	--	--	--
2) R/I Stab Cover Plates	3.1	X	--	X	--	X	X
3) R/I Nose Gear Well Cover	1.5	X	--	--	--	--	X
4) Replace Elect. Eq. Press Chem. Drier	2.8	--	--	--	--	--	X
5) Replace Prev. Sys. Chem. Drier	1.6	--	--	--	--	--	X
6) R/I Fwd. & Aft. Ejection Seats	--	X	X	X	X	X	X
7) R/I CP-733 Ins Computer	2.7	X	X	--	--	--	--
8) R/I AM-3734 Nav. Computer	2.0	X	X	--	--	--	--
9) R/I RI-793/ASQ	1.5	X	X	--	--	--	--
10) R/I Auto Pilot Amp.	1.5	X	X	--	--	--	--
11) R/I CADC	3.8	X	X	--	--	--	--
12) R/I #1 Misc. Relay Panel	1.8	X	X	--	--	--	--
13) R/I R/C/P Radar Scope	1.8	X	X	--	--	--	--
14) R/I Fwel/Aft Stick Well Covers	1.0	X	X	--	--	--	X
15) Ext./Retract Radar Package	1.7	X	X	X	--	--	--
16) R/I Motion Pick-up Transducer	1.2	X	X	--	X	--	--
17) Clean CADC Inline Filter	0.5	--	--	--	--	--	X
18) Drain/Service/Clean Air Compressor	1.5	--	--	--	--	--	--
19) R/I KD26B Camera (C/D)	1.2	--	X	--	--	--	X
20) R/I LD58A/LD69A RRSC Cont.	0.5	X	X	--	--	--	X
21) Clean/Replace Canopy Aux. Air Filter	0.5	--	--	--	--	--	X

Table D.3

DO INSPECTIONS, PHASE 6[a]

Item Description	DPSH	TCTO	Equal Phase
1) NDI #3 Fuel Cell Web P/N 30-32139	2.0	--	--
2) NDI Connecting Bolt Upper/Lower Torque Arm Assy.	1.0	--	--
3) Inbd-L/E Slat Actuator Mount Bolt for Torque (E)	0.9	566	--
4) Bleed Air Check Valve for Movement	0.2	--	--
5) Magnetic Sump Plug for Particles	1.0	--	--

[a]Look inspections accomplished by PDM requirements.

Table D.4

OPERATIONALS, PHASE 6

Item Description	DPSH	PDM	TCTO 986	TCTO 991	TCTO 566	ACI	Equal Phase
1) Break Interconnect Breakout Force	2.4	--	--	--	--	--	--
2) Speed Brake Clearance Check[a]	2.0	X	--	--	--	--	--
3) Anti-Skid Continuity Check[b]	13.3	X	X	X	--	--	X
4) Canopy Normal Functional	5.3	X	--	--	--	--	X
5) Canopy Jettison Control Functional	7.7	--	--	--	--	--	X
6) Canopy Thruster Firing Circuit	1.7	--	--	--	--	--	X
7) Canopy Emerg. Pneu Functional	12.6	X	--	--	--	--	X
8) Motion Pick-up Transducer Check[c]	--	X	X	X	--	--	--
9) AFSC Functional	23.0	X	X	X	--	--	--
10) Pitot/Static Min. Performance	6.6	X	X	--	--	--	--
11) VGH Recorder Operational (RF)	3.8	--	--	--	--	--	--
12) Fuel Pressure and Vent Check	12.8	--	--	X	--	X	--
13) Air Refueling Recp. Operational	2.7	--	X	--	--	X	--
14) Stab APV Operational	2.1	X	X	X	--	--	X
15) Camera System Functional (RF)	21.7	--	X	--	--	--	X
16) IFF Emerg. Operational	1.0	X	X	X	X	X	--
17) Pitot/Static Drain and Purge	3.8	--	--	--	--	--	X

[a]Covered by Pre-flight inspection.

[b]Covered by Anti-skid operational.

[c]Part of AFSC Functional and flight check.

Table D.5

TOTAL INCREMENTAL DEPOT MAN-HOUR REQUIREMENTS
FOR ACCOMPLISHING PHASE 6, F-4E

Project	Predictables				Unpredictables (repair)[a]	Total	Number of Aircraft	FY 1976 Total
	Doors	Components	Inspections	Operations				
MOD/PDM	13	7	5	31	20	76	15	1140
MOD/PDM/LES	2	7	4	31	20	64	8	512
MOD/PDM/LES/ECR	0.0	7	4	28	20	59	9	531
MOD/PDM/ACI/LES/ECR	0.0	7	4	16	20	47	3	141
MOD/PDM/ACI/LES/-ECR/991	0.0	7	4	16	20	47	1	47
MOD/PDM/ECR	0.0	7	5	28	20	60	12	720
MOD/PDM/991	8	7	5	18	20	58	21	1218
MOD/PDM/ECR/991	0.0	7	5	16	20	48	2	96
MOD/PDM/ACI/991	8	7	5	16	20	56	1	56
MOD/PDM/ACI/ECR/991	0.0	7	5	16	20	48	1	48
FY 1976 total	--	--	--	--	--	62[b]	73	4509

[a]Based on a review of Carry Forward defects for 13 aircraft.

[b]Weighted average, with weight being the number of aircraft.