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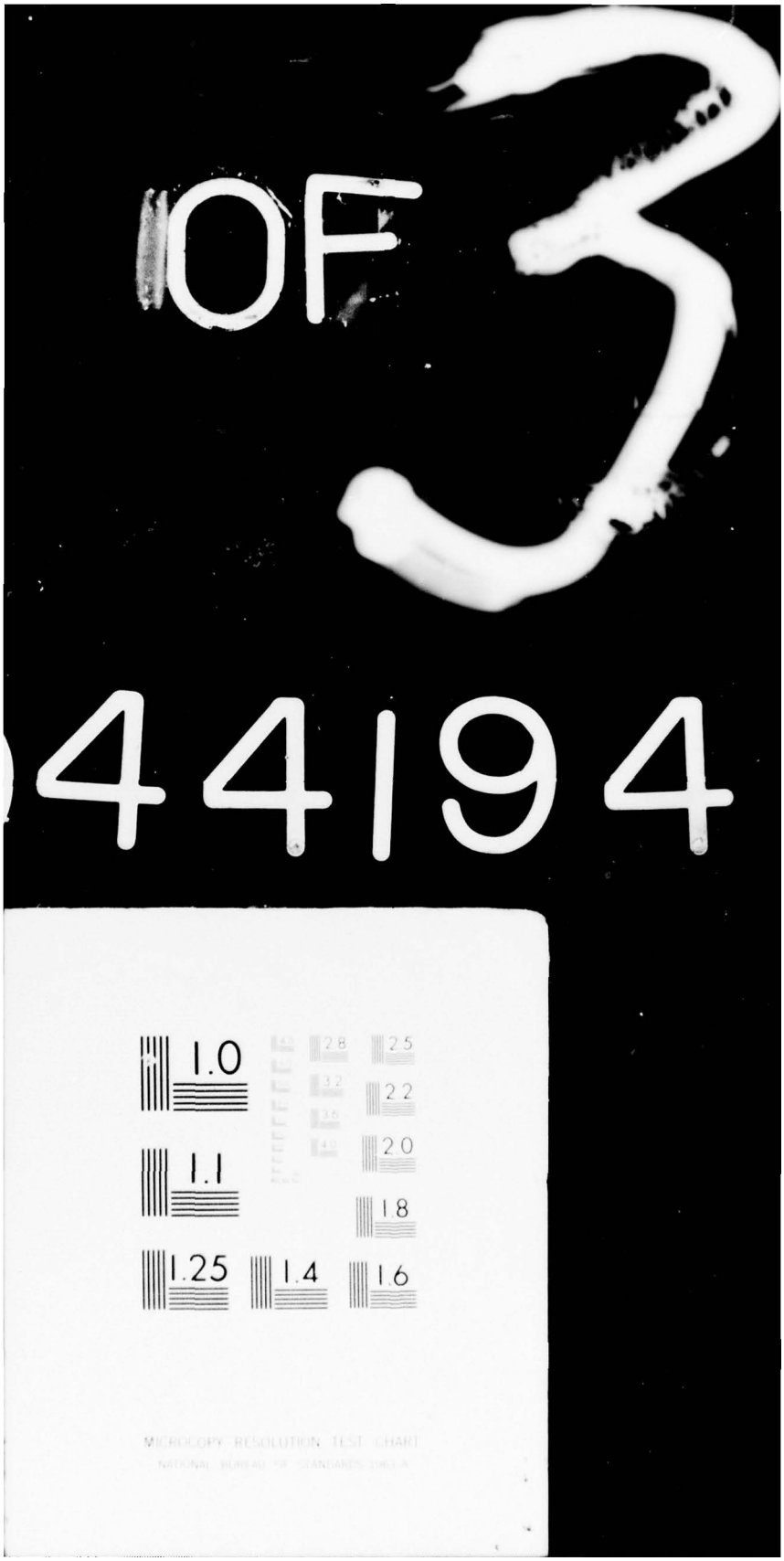
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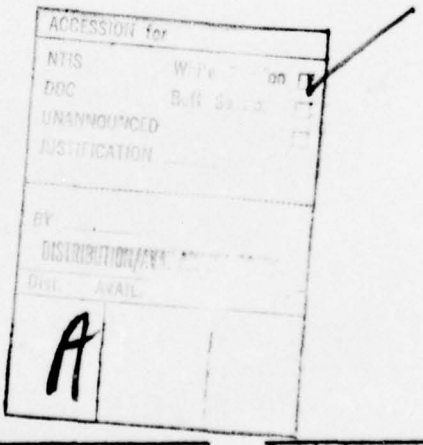

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Cost estimation of USAF major weapon system package sales should be as accurate as possible to assure relationships with foreign customers are not strained. This thesis examines the cost estimation procedure of the F/RF-4 Systems Program Office, Financial Directorate, used to prepare a price and availability (P&A) estimate for Foreign Military Sales (FMS) requests. The study provides an analysis of the coordination process involved in an F/RF-4 P&A request, beginning with the foreign country and concluding with the Aeronautical System Division of the Air Force Systems Command. A detailed analysis of the data base for the computer algorithm used by the Financial Directorate is provided. The algorithm assures that real-time component costs are included in the P&A estimate. Conclusions from this research indicate that the data base allows continuous updating of cost components. It also enables instant modification of cost estimates in response to country inquiries arising from changes which occur during formal price negotiations.

19. CONT'D.

F/RF-4 Cost Components

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FOREIGN MILITARY SALES WEAPON SYSTEM COST ESTIMATION PROCEDURE: A CASE STUDY OF THE F-4 FIGHTER/ATTACK AIRCRAFT

A *Thesis*

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Logistics Management

By

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This thesis, written by

Captain Charles Flowers

and

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has been accepted by the undersigned on behalf of the faculty of the School of Systems and Logistics in partial fulfillment of the requirements for the degree of

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Chapter 1

INTRODUCTION

Changes in the estimated cost of expensive and sophisticated American aircraft sold through the Foreign Military Sales Program can become a source of embarrassment to the United States government and to the purchasing foreign nation. This embarrassment would stem from additional charges or cost variations caused by inaccurate cost estimates developed during the Price and Availability Study[1]. A cost estimate that is too low on a major weapon system may involve a cost variation of several million dollars between the estimate and the actual price. The embarrassment would occur when the U. S. government attempts to recover these additional funds from a less affluent foreign government (20:7). These cost variations are

> . . . experienced with relative frequency by all buyers, and that these occurrences are not confined to a single U.S. service, indicates an apparent weakness in the FMS [Foreign Military Sales] program [10:99].

The Foreign Military Sales Act of 1968 (as amended) specified that the United States government will incur no monetary loss coincident to an FMS transaction (33:219).

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[1]A Glossary of Terms and their definitions is provided in Appendix A.

Therefore, the country is billed at the actual cost regardless of the estimated cost provided on the U. S. Department of Defense Letter of Offer and Acceptance (LOA)[2] (35:1-3). If the pricing of major weapon systems sold through the Foreign Military Sales Program is to be accurate, cost estimation techniques must be improved. Furthermore, the long production leadtime between the initial cost estimate and the actual delivery of the weapon system necessitates consideration of changing economic and production factors by the cost estimators.

Background

After World War II the United States was forced to assume a dominant role of leadership in the free world because of the decline of Britain and France as world powers. As a consequence of emerging as a major power, the United States entered into a number of military treaties and formed military organizations such as the North Atlantic Treaty Organization (NATO); South East Asia Treaty Organization (SEATO); Australia, New Zealand, and the United States (ANZUS); the Rio PACT; and the bilaterals (23:665). Involvement in these numerous organizations led to sponsorship of military and economic assistance programs in an effort to create a condition of stability in friendly foreign governments (7:3-4).

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[2]A Glossary of Acronyms is provided in Appendix B.

Military assistance grant aid program. In the early phases of the U. S. foreign military and economic assistance program, the predominant form used was grant aid (39:3). Grant aid provided military assets to friendly foreign governments without charge to strengthen their defense capabilities while their economies recovered from the war. The National Security Act of 1947 (Truman Doctrine) provided aid to Greece and Turkey; in 1948 the military and economic recovery of Western Europe was accelerated by the Marshall Plan. The Mutual Defense Assistance Act of 1949 provided the grant aid program for rearming NATO (23:667). The Mutual Security Acts of 1951, 1953, and 1954, as well as the Foreign Assistance Act of 1961, subordinated sales to grant aid. During the 1950's, grant aid appropriations averaged $2.4 billion annually reaching a peak of $5.74 billion in 1952 (39:3). There was little need for specific cost estimation techniques with grant aid since the U. S. was transferring the military equipment without expectation of reimbursement (32:42).

Foreign sales programs. Sales programs achieved prominence over grant aid as foreign nations recovered economically from the effects of World War II (7:3-6). By 1961 foreign sales of military equipment was recognized as a means of balancing U. S. occupation costs (47:45). The original authority for conducting international military sales was established in 1940 (11:607). This authority was brought up

to date in the Foreign Assistance Act of 1961 (as amended) (32:48) and the Foreign Military Sales Act of 1968 (as amended) (33:219). That the Foreign Assistance Act (FAA) of 1961 placed some consideration on the cost estimation is inferred by the following:

> No agreement or grant which constitutes an obligation of the United States Government in excess of $100,000 . . . shall be made . . . until engineering, financial, and other plans necessary to carry out such assistance, and a reasonably firm estimate of the cost to the United States Government of providing such assistance, have been completed . . . [32:57-58].

The Foreign Military Sales Act (FMSA) of 1968 went a little further than the FAA's use of the terms "reasonably firm cost estimate" by stating:

> The President may sell defense articles from the stocks of the Department of Defense . . . to any friendly country . . . if such country . . . agrees to pay not less than the value thereof in United States dollars [33:219].

Foreign Military Sales exceeded Grant Aid Appropriations for the first time in 1963 (44:Table 750; 39; 3). In 1967 the Congress passed the smallest foreign military assistance bill in the twenty-year history of the program and attached provisions destined to all but terminate grant aid (39:3). Consequently, this reevaluation of the sales program was instrumental to the passage of the FMSA of 1968 (29:39). It is important to note that in passing the FMSA the Congress affirmed the increasing cost and complexity of defense equipment (35:1-1). It also set the stage for increased attention to detail in cost estimation of foreign

sales as witnessed from the following excerpt from AFM 400-3, Foreign Military Sales:

> . . . prices fixed under such sales agreement [with foreign countries] shall be sufficient to reimburse the United States for the cost of the defense articles or defense services ordered. The President shall submit to the Congress promptly a detailed report concerning any fixed-price sales agreement under which the aggregate cost to the United States exceeds the aggregate amount required to be paid by the purchasing country or international organization [35:2-1].

Foreign military sales orders have risen from $1.5 billion in fiscal year 1969 to $10.8 billion in fiscal year 1974 (39:14). These increased sale orders and newer sophisticated weapon systems explain the desire of Congress for more accurate cost estimation procedures.

F-4 cost estimation experience. The sale of a major weapon system, e.g., the F-4, is one of the most complex FMS transactions. According to Mr. Roger Will (48), Financial Management Specialist in the Fighter/Attack Weapon System Program Office, the F-4 is one of the most successful FMS weapon systems that has ever been manufactured in America. Its success is a direct result of its versatility as a multi-mission fighter aircraft (18:4). McDonnell Douglas has, to date, received orders to build over 5,000 of these aircraft for the United States Armed Services and the FMS program. It is the largest quantity of any advanced fighter aircraft ever to be built for the United States and its allies (3; 26; 48). The F-4 was first built in 1965 and through 1976 the Department of Defense (DOD) has purchased

3,976 at a program cost of $10.491 billion. Additionally, foreign buyers have purchased 998 aircraft at a total cost of $5.066 billion (18:4). To exemplify continued interest, Turkey and Greece have both indicated a desire in 1977 to purchase the F-4[3]. The earlier time period of the DOD purchases accounts for the more favorable unit costs of the F-4 indicated above (13). These sales have included the weapon system itself, aerospace ground equipment (AGE), spare parts, technical assistance, maintenance, and other special services such as training or ferry charges (35:3-1).

Responsibility for FMS cost estimation for the F-4 aircraft was transferred to the USAF in 1972 (13). In 1973 the F-4 financial management team under the direction of Mr. George C. Kuntz, Director, Financial Management, Fighter/Attack Weapon System Program Office (F-4), developed a sophisticated cost estimation technique utilizing a computer algorithm (48). Coincident with the development of the computer algorithm, a training program to upgrade the cost estimation experience of the F-4 financial team was initiated.

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[3]"Turkey has been eager to continue ordering F4s as an improvement of its air force with the plane, . . . still one of the best fighter-bombers in common use around the world [2:1]." ". . . Mr. Carter has asked Congress . . . to enable Turkey to proceed with a cash purchase of 40 F-4 fighter-bombers, in which it has already invested $134 million [8:7]." Additionally, "the Defense Department notified Congress that it plans to sell 18 McDonnell Douglas Corp. F4E fighter planes to Greece for an estimated $161 million [45:1]."

The training program was started to eliminate a deficiency which grew out of the partial failure of the recruiting process in filling financial management positions. These positions were frequently filled by nonprofessional personnel assigned through excess or overstrength personnel actions (12:3). In addition, Mr. Kuntz states in his training guide that the financial management function had expanded and now incorporated the

> . . . planning, organizing, pricing, controlling, and coordinating [of] the financial aspects of systems acquisition in which cost, schedule, and technical performance were an essential and integral part of the management effort, which had to be assessed periodically throughout the life cycle of the system for the lowest possible cost [12:3].

The emphasis in the F-4 office was changed from a control function to an analysis and evaluation function providing financial assessment, analysis, evaluation, and trend prediction to the System Program Director (12:4). This background of experience and the training of the team are the prime motivators for the successful use of the computer algorithm (13).

With their estimating experience forming a base and by using the algorithm as a tool, the financial team has been able to estimate the cost of the F-4 within 5 to 8 percent of the final contract price (13). Major Stiles of the General Purpose Aircraft Division, Air Force Systems Command, indicated that the computer program was a major factor in the accuracy achieved by the F-4's financial

management team (26). In October, 1976, the accuracy of this cost estimation method was further substantiated. The negotiation team from McDonnell Douglas used the cost estimate developed by the F-4 financial team as their own commercial price during negotiations with a foreign nation (48).

AFM 400-3 Foreign Military Sales. This manual prescribes the USAF policies and procedures for the conduct of FMS to foreign governments and international organizations. The instructions deal with the government-to-government sales program, and provides the authority, restrictions, and guidance to customers (35:i). Detailed guidance to purchasing countries, their designated representatives and to U. S. representatives in MAAGs is presented in a step-by-step format which includes: documentation (military forms with examples and directions for completing them), types of cases (what can be purchased and which countries are eligible to make purchases), processing of a country's request (includes the responsible U. S. government agency and actions that must be taken within specified time frames), implementing and negotiating the FMS program, pricing policies and specific percentage guidelines by type of FMS case, and requirements and guidelines for submitting and handling complaints and liabilities. Appendix D contains an extraction of the FMS flyaway cost statement and identifies the flyaway cost components (35:1-1--9-5). The instructions for

completing this flyaway cost statement are the same as those extracted from AFM 177-112 which are presented in Appendix E.

AFM 177-112 International Accounting Transactions. This manual provides detailed financial procedures and accounting requirements for conducting FMS transactions with foreign governments and international organizations (36:i). The ultimate goal of insuring prompt and complete service to the customer at no cost to the U. S. Government can only be accomplished by providing financial management of FMS programs. This is accomplished through the specified guidance and procedures for pricing, case administration, and reporting (36:A5-1). The components for the flyaway cost statement listed in this manual are presented in Appendix C. The instructions for preparing flyaway cost statements can be found in Appendix E.

Research Justification

The Price and Availability (P&A) request provides the basis for a cost estimate to be initiated. Any errors made during the P&A study, e.g., incorrect assumptions, inaccurate quotations, incorrect forecasts, will be compounded as the FMS case moves through the system (48). For example, packing, handling, and crating costs are calculated at 3 1/2 percent of the Government Furnished Equipment Costs and the latest loose equipment cost data recorded on the Aircraft

Inventory Record (DD Form 780) (35:8-8). Additionally, Snow[4] and others found that administrative and computation errors, e.g., failure to include all FMS costs in the estimate, was the single largest cause of inaccurate initial cost estimates (24:43). Major variations between estimated and actual prices can cause economic hardship and embarrassment to those nations which are economically strong; for the less affluent countries they can become critical (10:100). Therefore, greater precision in the original cost estimates furnished by the U. S. military services in Letters of Offer and Acceptance may eliminate or reduce criticism of the cost estimates provided to the foreign country (10:71-72).

The purchasing country's main complaint of the FMS program is that, in too many instances, prices charged substantially exceeded the estimated cost which they had used for fiscal budget preparation (10:27). In 1969 Kaine and Wilhite identified this situation during interviews with foreign buyer representatives. In their study, "The Buyer's View of the Management of the United States Foreign Military Sales Program," they reported that most country representatives stressed their limited defense budgets and the careful programming of these budgeted funds. Any major variation between estimated and actual costs may cause economic hard-

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[4]Major E. F. Snow performed this study in 1975 in his capacity as Logistics Officer, Logistics Study Office, U. S. Army Logistics Management Center, Fort Lee, Virginia.

ship regardless of the size or economic strength of the nation involved (10:100-101).

That this situation still exists was evidenced by a 1975 U. S. Army study initiated to develop more realistic cost estimates for FMS material. The investigation revealed that

> . . . the disparity between the quoted and the billed price has resulted in embarrassment to the USG [U. S. Government] in attempting to collect the additional costs from the foreign customer [24:7].

When a foreign government has budgeted a purchase based on an estimated cost and the final price substantially exceeds the original estimate, securing these additional funds entails more time and causes embarrassment in obtaining approval for payment (10:71). To alleviate this situation a review of current management practices in FMS cost estimation procedures is required (10:100-101). This situation becomes more critical as the dollar volume of weapon system sales orders increases.

For example, Iran and Saudi Arabia, two members of the OPEC group, have ordered $3.94 billion of FMS materiel in fiscal year 1975 (39:14-15). These two countries are experiencing a balance-of-payments problem because of decreased demand for their oil exports and inflationary prices on their imports (28:26). The significance of this fact is that these two and other OPEC nations will undertake more budgetary planning in the future and may be more sensitive to large dollar increases in FMS purchases (24:12).

Research Objectives

The primary objective if this study was to analyze the F-4 cost estimation methods and procedures and to identify their strengths and weaknesses. In support of this objective, an analysis of the general components with the computer algorithm was accomplished. The analysis was aimed at determining those cost components which have increased or decreased at a higher rate, therefore having an increasing or decreasing impact on the final cost estimate. A secondary objective was to determine the accuracy of the F-4 FMS cost estimates in relation to the final price paid by the foreign government.

Research Questions

The analysis of the F-4 cost estimation procedures addresses the following research questions:

1. Are the components and instructions used in the F-4 cost estimation algorithm consistent with the components and instructions listed in AFM 177-112 and AFM 400-3?

2. What are the strengths and weaknesses of the cost estimation algorithm that determine the final F-4 cost estimate developed during the Price and Availability study?

3. How accurate are the F-4 cost estimates derived during the Price and Availability study in comparison to the final price paid by the foreign government?

RESEARCH APPROACH

The primary data sources for this thesis effort were the personnel from the Fighter/Attack Weapon Systems Program Office (F-4) who develop cost estimates for the F-4 aircraft and those documents which specify the cost components included in the final estimate. Secondary sources of data used throughout this study are selected research reports, government reports, DOD manuals and guidelines which provide insight into the environment of the FMS cost estimation program. A capsuled list of the primary data sources is included in the next section.

Personal and telephone interviews were unstructured and were conducted without a specific list of questions. The unstructured format promoted a more candid answer to the questions asked. This method was preferred in this research as it allowed for instant feedback, continuous questioning, better rapport, and a maximum flow of information. The main advantage in using the interview technique was that the information collected included supplementary data which provided the key to understanding why the F-4 cost estimation program was so effective. Besides the capability for return visits, immediate clarification of any ambiguities was sought and amplification was requested for critical item responses. The majority of the interviews were tape recorded to insure that an accurate record of the discussion was obtained.

Sources and Nature of Data

The following list comprises those primary data sources which have been critical to an understanding of the F-4 cost estimation procedures:

1. Interviews (both personal and telephone). These individuals were the most knowledgeable on the subject matter and were the closest to the problem. Interviews were conducted with personnel assigned to or associated with the following activities:

a. Financial Management Branch (F-4, Fighter/Attack Weapon Systems Program Office, Wright-Patterson AFB, OH). Areas discussed included general cost estimation techniques, the F-4 cost estimation methodology, and Air Force instructions for cost estimate development.

b. General Purpose Aircraft Division, Air Force Systems Command, Andrews AFB, MD. Areas discussed included cost estimation problems, the F-4 method, other aircraft cost estimation methods, and the accuracy of the F-4 estimates from FY 1972 through FY 1976.

c. Directorate of Acquisition and Engineering, Foreign Military Sales Division, Air Force Systems Command, Andrews AFB, MD. Areas discussed included cost estimation problems, the F-4 method, other aircraft cost estimation methods, and the accuracy of the F-4 estimates from FY 1972 through FY 1976.

d. Foreign Military Sales Division, Air Force

Logistics Command, Wright-Patterson AFB, OH. General problem areas in major weapon system sales were discussed. This provided background information pertinent to the entire FMS cycle.

e. Aeronautical Systems Division, Air Force Systems Command, Wright-Patterson AFB, OH. Areas discussed with F/RF-4 Systems Directorate (SD 27) personnel included individual division actions and interactions involved during a price and availability study.

2. All closed F-4 FMS cases (unclassified) since FY 1975. A closed F-4 FMS case is one whereby all deliveries and financial transactions have been completed (35: A1-2). These cases provided a detailed breakout of the cost estimate given to the foreign country. They also included the final price paid and all cost modifications to the original estimate necessitated by U. S. State Department and foreign buyer revisions.

3. Pertinent government directives related to cost estimation and price and availability requests. The primary directives used were the following:

a. AFM 400-3, Foreign Military Sales, which stated the authority for Air Force FMS, listed eligible countries and their respective codes, indicated the Air Force major commands responsible for FMS components, and provided detailed instructions required for weapon systems cost estimation development.

b. AFM 177-112, International Accounting Transactions, which discussed financial data preparation and detailed preparation instructions for the FMS Case Cost Statement which indicates the final price the foreign government is charged.

c. DOD 5105.38-M, Military Assistance and Sales Manual, which discussed the United States Government and Military Departments' responsibilities in approving and preparing price and availability cost estimates as well as detailed instructions concerning the type of Security Assistance for which specific countries are eligible.

Scope

This research effort only considers those F-4 cases developed during the period of 1972 to the present. This time frame was chosen because cost estimation responsibility for the F-4 FMS transactions was transferred to the U. S. Air Force from the U. S. Navy in 1972. This time frame represents a period of rapidly increasing prices due to economic factors and production factors (48). For example, in 1972 the flyaway cost of one F-4 was $3.311 million while in 1976 an estimate of the flyaway cost for a comparable F-4 model was $6.236 million (48). These figures are based on FMS cases already closed and a 1976 FMS case being prepared for presentation to a foreign country.

Limitations

The primary limitation affecting this research was the realization that each sale of the F-4 weapon system is unique. The purchasing country has specific requirements for aircraft configuration that may substantially change the estimated cost. These unique configurations limit the usefulness of statistical techniques only because of the lack of common factors for analysis. Only general relationships among major components of the price and availability cost estimate can be compared.

Assumptions

The complexity of the F-4 cost estimate development required the application of several major assumptions in this research.

1. Any political decisions that may influence the final cost estimate have already been stated and considered by the U. S. Government. This assumption is to avoid an obvious discrepancy between the estimated cost and the final price paid by the foreign country.

2. The value of an F-4 FMS transaction exceeds 25 million dollars. This assumption introduces the influence of Congress in the FMS case approval/disapproval cycle as required for FMS cases in excess of 25 million dollars by section 36 of the amended Foreign Military Sales Act (43: C-11). It is also consistent with the International Security Assistance Arms Export Control Act of 1976 (34:15).

The case value includes the cost of the aircraft and all components that make up the F/RF-4 weapon system package.

3. U. S. Government offices and agencies external to the Fighter/Attack SPO/F-4 have no effect on the cost estimation procedures used by the financial team. For example, the procedures used by the Aeronautical Systems Division in developing escalation factors are not relevant to this research effort -- only its application during the estimation process is relevant.

Chapter 2

F/RF-4 P&A COORDINATION PROCESS

The purpose of this chapter is to give the reader an understanding of the coordination processes involved in a request for P&A and the preparation of an LOA. Specifically, the focus will be on the procedures involved when a foreign government offers to buy and the United States Government consents to sell a stated number of F/RF-4 aircraft. The reason for doing this is to give the reader a complete picture of how the whole process of foreign military sales evolves. The process begins with the foreign country and ends with the Aeronautical Systems Division where the cost estimate is developed. Chapter three is a continuation of the processes -- actually where all P&A and LOA data are compiled and brought together -- giving substance and meaning to all the processes described in chapter two.

This chapter is presented in three parts. Each part consists of an organizational chart representative of the flow of the FMS request and provides a short explanation of the major functions of each department portrayed on the chart.

This chapter has been prepared with the objective of indicating the actions and interactions necessitated by a normal F/RF-4 FMS request. Inclusion of every office in-

volved in or all possible exceptions to an FMS case is beyond the scope and intent of this chapter and, therefore, has not been attempted. The authors do feel, however, that the chapter provides a basic overview of the normal F/RF-4 FMS request cycle and, as such, provides the reader with some insight into the organizational complexities involved in the preparation of a cost estimate conformable to a country's FMS request.

PART ONE

Part one illustrates the origination of a request by a foreign country. It also indicates the interaction necessitated among the upper echelons of the executive branch of the United States Government.

Executive Office of the President

This office determines the eligibility of prospective purchasers on the basis that sales will strengthen U. S. security and promote world peace (43:Part III, B-3). Foreign countries approved to date can be found in the Military Assistance and Sales Manual, Part III, Table A-2. Additionally, the Executive Office of the President prescribes procedures to assure coordination among the representatives of the U. S. Country Team. The President in his notification to Congress for sales over $25 million may certify that an emergency situation exists which requires a

specific sale in the interest of U. S. national security and thus negate possible Congressional objections to the proposed sale (34:15).

Foreign Country

Category A countries' cash sales requests for the F/RF-4 (see Figure 2-1) are submitted, at their discretion, either through their representatives in the U. S. or through the U. S. Country Team[5] located in the foreign country. The country's representatives in the U. S. can be the Purchasing Missions, Embassies, or Military Attaches in Washington. The U. S. Country Team can be the U. S. Embassy, the Military Mission or the U. S. Defense Attache's Office (DAO). These cash sales requests are submitted directly to the Department of the Air Force. Information copies of FMS requests are provided to the State Department by all African and Inter-American nations where regional ceilings are imposed by statute (43:Part III, C-3).

Category B countries' cash sales requests for the F/RF-4 (see Figure 2-1) are submitted, at their discretion, through their representatives in the U. S. or through the

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[5]The U. S. Country Team, as described in DOD Manual 5105.38, The Mutual Assistance and Sales Manual, is incomplete in that it does not include all agencies formally considered as members of the U. S. Country Team. According to FM 38-8, International Logistics Management, the U. S. Country Team consists of the Ambassador, MAAG, the Agency for International Development, Embassy staff, the U. S. Information Service, and other agencies such as agriculture attaches, and so on (37:FIG 6-2).

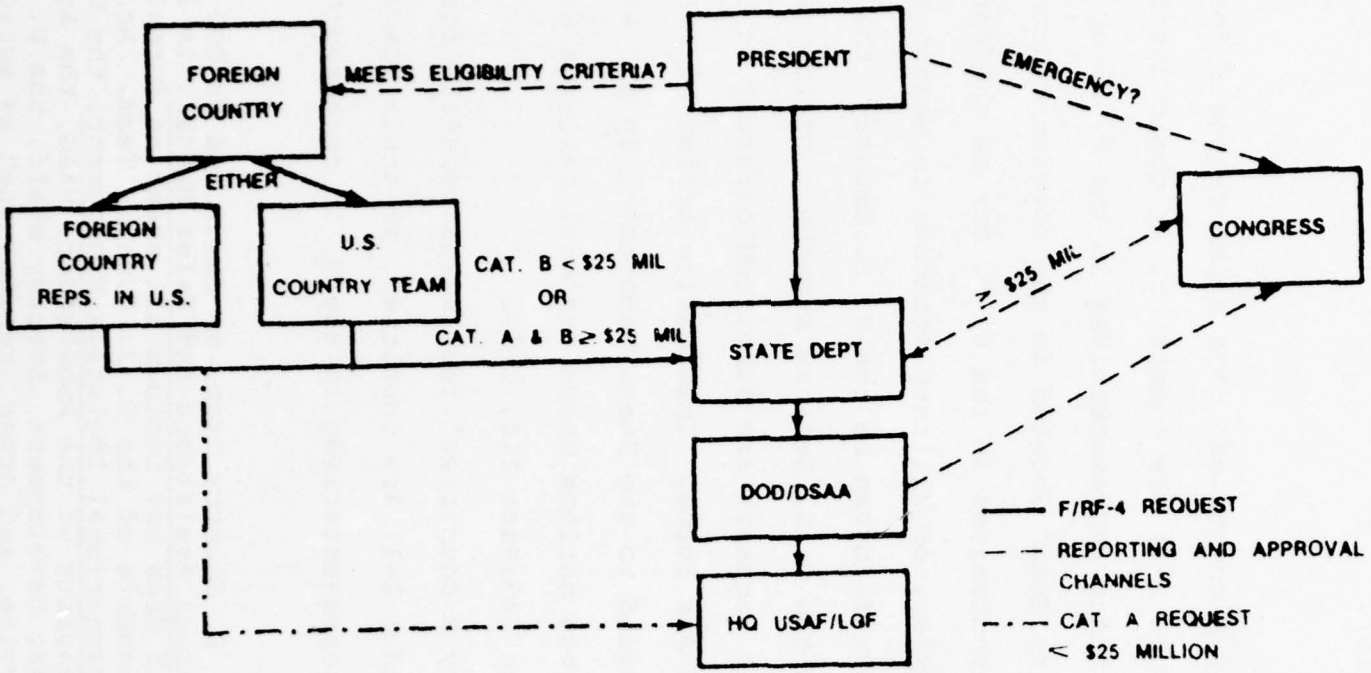

Figure 2-1

Cash Sales Coordination Process

U. S. Country Team. Such requests are forwarded directly to the State Department. Information copies are forwarded to the Defense Security Assistance Agency (DSAA), Directorate of Sales Negotiations, as well as to the MAAG/Mission or DAO (43:Part III, C-4).

State Department

The Secretary of State has been directed by the President to determine whether there will be a sale to a foreign country and, if so, the amount of the sale (43:Part I, B-1). Requests for purchase of F/RF-4 are forwarded through diplomatic channels to the Secretary of State for approval and, if approved, forwarded as appropriate to DOD for implementation (43:Part III, A-1). The State Department will coordinate all credit sales with the Treasury Department for credit program approvals prior to forwarding Letters of Offer and Acceptance (LOAs) to the Defense Department (43:Part III, C-3--C-4). State has authorized Defense to approve sales of F/RF-4 to Category A countries; however, coordination with State's Office of Legal Advisor is required for statutory interpretations (42:Section I, 6).

Department of Defense
(DOD)

The Defense Department takes an average of sixty to ninety days to accumulate data, prepare the LOA, effect coordination with the Congress and State Department, and present the LOA to the prospective purchaser (42: Section I,

6). The Secretary of Defense has delegated primary responsibility for supervising, administering, and implementing the above to DSAA (43:Part III, B-1).

DSAA coordinates F/RF-4 FMS requests with the State Department and Headquarters, United States Air Force (HQ USAF) and is responsible for preparing and submitting reports concerning the impact of the sale and reimbursement procedures to Congress. DSAA administers annual FMS credit appropriations and defends these appropriations before Congress. All credit negotiations with foreign countries are also accomplished by DSAA (43:Part III, C-3--G-3). Upon coordination and approval of an F/RF-4 request, DSAA forwards the request to HQ USAF for preparation of a P&A study and LOA (43:Part III, B-4). Of primary importance, is that DSAA thoroughly checks the purchaser's request to assure that it is all inclusive and contains definitive identification of configuration and support requirements.

United States
Country Team

This team may consist of all or one of the following: 1) U. S. Embassy, 2) Military Assistance Advisory Group (MAAG), 3) U. S. Military Mission, or 4) U. S. Defense Attache's Office (DAO), dependent upon the foreign country requesting the purchase of U. S. defense items (43:Part III, C-3). Chiefs of MAAGs are representatives of the Secretary of Defense on Security Assistance matters.

MAAGs are actually under the military command of the Commanders of Unified Commands who supervise Security Assistance matters in their areas of responsibility and coordinate plans and programs directly with the Secretary of Defense. MAAGs are also under the general supervision of the ambassador who is responsible for the U. S. governmental objectives in the country (43:Part I, B-2).

The MAAGs assist foreign countries in developing and executing Security Assistance programs and plans. This is accomplished in a number of ways. First, the MAAG is authorized direct contact with HQ USAF to request information for the host country, such as technical advice, data on item configuration and availability, cost factors, and supply data for the F/RF-4 (43:Part III, C-3). Second, the MAAG may be chosen by the host country as the channel through which requests for LOAs may be forwarded. In this event the Chief of MAAG must coordinate with the Chief U. S. Diplomatic mission and submit such request to the Unified Command. The normal channel of communication in most instances is between the Unified Commands and the DSAA with coordination of the Joint Chiefs of Staff (JCS) (43:Part I, B-2).

The JCS is responsible for correlating security assistance planning with military force planning objectives (43:Part I, B-2). Therefore, it can be inferred that communications concerning F/RF-4 sales will normally have mili-

tary operational or policy implications and thus require JCS coordination.

PART TWO

Part two indicates the actions required of the Department of the Air Force once the Price and Availability Study is approved at the top echelon. These actions involve the coordination between HQ USAF and its major commands as well as the interaction and coordination among the major commands involved (see Figure 2-2).

Headquarters USAF

Upon the State Department's approval, the Department of Defense, Defense Security Assistance Agency, develops the actual P&A and the LOA (DD Form 1513). The Chief of Staff, USAF (CSAF) is responsible for the development, implementation, and management of sales for the F/RF-4 as delegated to him by DOD. These responsibilities have been further delegated to the Directorate of Military Assistance and Sales, DCS/S&L. In this Directorate, the Director of Military Assistance and Sales (LGF) assists the Office of Secretary of Defense in government-to-government negotiations, provides information on cost and funding requirements, and directs delivery of the aircraft in accordance with the terms and conditions of the sales agreements (35:4-1).

The Secretary of Defense has specified that without exception the maximum time for furnishing an offer to a

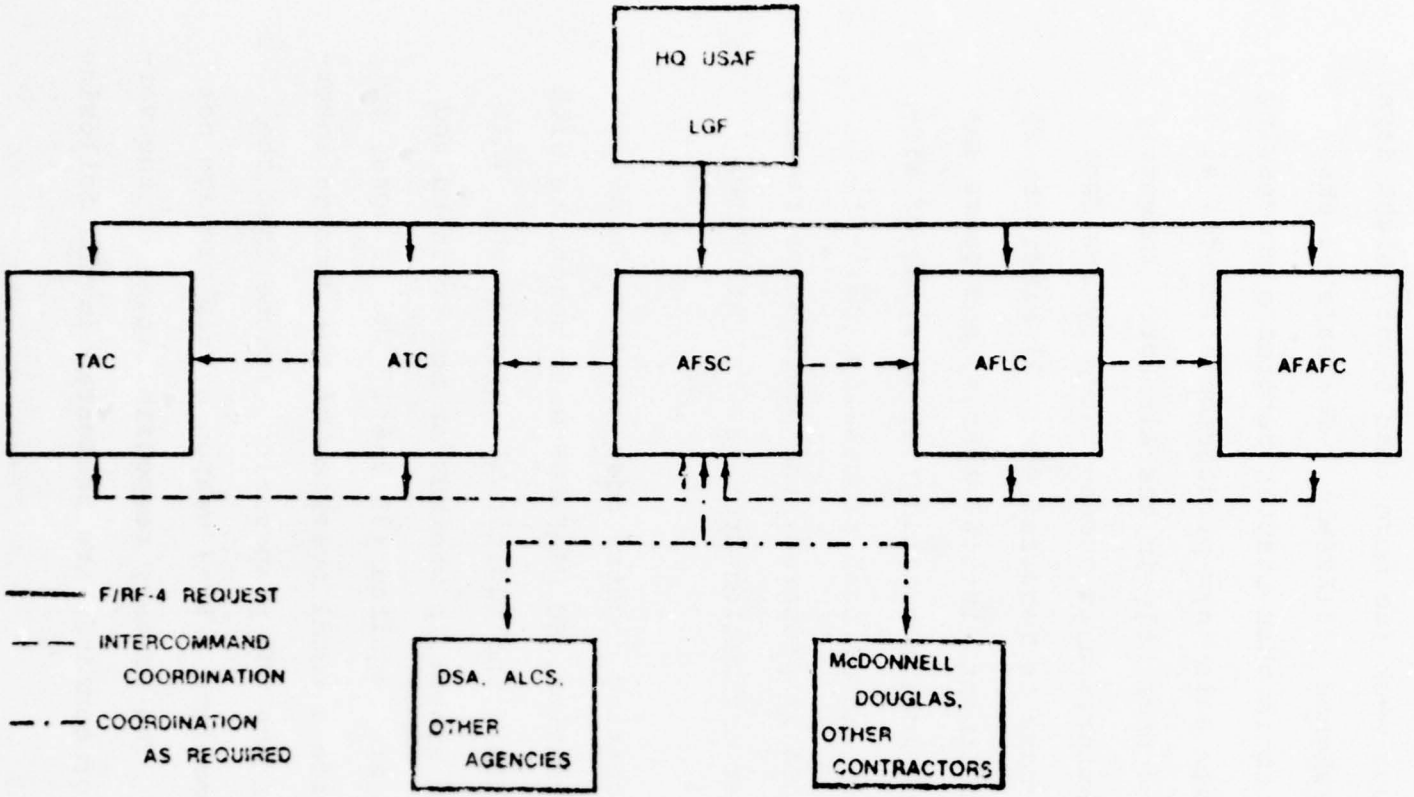

Figure 2-2

HQ USAF and Major Commands Coordination

foreign country is six weeks from the date of the original request (35:5-2). When the CSAF directs a command to provide P&A data, a four-week (no more than twenty eight days) suspense date is assigned (35:A25-1). The sale of the F/RF-4 as referred to in this chapter denotes a processing weapon system package sale (new production aircraft) as opposed to an F/RF-4 presently in the Air Force inventory (35:5-8). This distinction is necessitated by the fact that an individual case is required for: 1) aircraft; 2) peculiar support equipment, initial spares, and spare engines; 3) formal and mobile training; 4) ferrying of aircraft; and 5) credit and/or cash processing (35:5-9). Although only one LOA is prepared, the preparation requires interaction and cost estimation from several Air Force major commands.

If the purchasing country does not provide all of the necessary information, HQ USAF/LGF will negotiate with the purchaser to obtain the additional information. This procedure will also ascertain whether or not training and other support data are required (35:5-8). The authors, in an attempt to provide a total overview of the command interactions involved in the LOA preparation, assume that the request is for a complete F/RF-4 weapon system package not just the aircraft. The primary responsibilities of the various Air Force major commands are presented in the following paragraphs.

The Air Force Systems Command (AFSC) is of primary importance in the preparation of the P&A study for an F/RF-4 LOA. AFSC is assigned responsibility for determining estimates for complete aircraft, peculiar support equipment, mobile training sets, training devices, special data requirements and special research, development, and testing services required (35:5-9). If it is determined, after examining the foreign country's request for a P&A that additional information is required to properly complete the P&A, then AFSC will notify HQ USAF/LGF for approval to establish a team. Upon approval from HQ USAF/LGF, a team made up of major command and activities such as Air Training Command, MAAG, and the system contractor (McDonnell Douglas) will be established.

AFSC will further provide data required to prepare a schedule of fund requirements to meet deliveries or payments to McDonnell Douglas (35:5-8). The Air Force Logistics Command (AFLC) will provide P&A data for: 1) initial spares based on the purchaser's desired flying hour program; 2) spare engines (usually accomplished by HQ AFLC); 3) standard support equipment; 4) technical assistance teams; 5) applicable modification (if any); 6) contract technical services and/or personnel, e.g., weapon system logistics officers; and 7) publications. The Air Training Command (ATC) has primary responsibility for providing P&A estimates for formal flight training and mobile training assistance as

requested by the purchasing country. The Tactical Air Command (TAC) provides P&A data for ferrying of the aircraft to the foreign country if this means is requested. These data will include the cost estimates for fuel and personnel (35: 5-8--5-9).

Coordination may be required with Air Force Air Logistics Centers (ALCs), the Defense Supply Agency (DSA), and the Air Force Accounting and Finance Center (AFAFC), as well as contractors who provide equipment and supplies. If information is required from private contractors, they must be informed that items for which P&A data are requested are for sale to a foreign government (38:6-705). These commands, agencies, and contractors are shown in Figure 2-2.

All P&A data prepared by the major commands are forwarded to HQ USAF/LGF where the data are compiled and the LOA prepared. The LOA is then forwarded to the purchasing country through the channels covered in part one.

PART THREE

Parts one and two have traced the request for a price and availability study for the F/RF-4 from the foreign country through the diplomatic channels to the upper echelon departments of the United States Government. Because the F/RF-4 is a USAF FMS responsibility, the request is forwarded to HQ USAF/LGF. Part two presented the interaction between HQ USAF, its major commands, and other governmental

agencies which are involved in the P&A study.

Part three explores the actions of AFSC's Fighter/ Attack Systems Program Office, Aeronautical Systems Division (ASD) for the F/RF-4 (SD 27) in preparing its phase of the weapon system package P&A study (see Figure 2-3). It should be stated that it is the authors' intention to present a general approach to the subject without detailed analysis of all the minute tasks involved.

Air Force Systems Command (AFSC)

AFSC, upon receipt of instructions and specifications of the P&A request from HQ USAF/LGF, notifies the F/RF-4 Systems Program Office (SPO) by message. The message contains general instructions for preparing the P&A. The instructions specify the F/RF-4 configuration and delivery schedule requested (13).

F/RF-4 Aeronautical Systems Division (ASD/SD27)

The F/RF-4 Systems Division Director forwards the request and instructions to the Program Office (SD27M). The program manager thus becomes the single point of contact (27). There are three program managers within ASD/SD27. Each is responsible for managing requests for specific foreign countries. In the words of Major Stuart[6]

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[6]Major Warren C. Stuart is an F-4 Program Manager

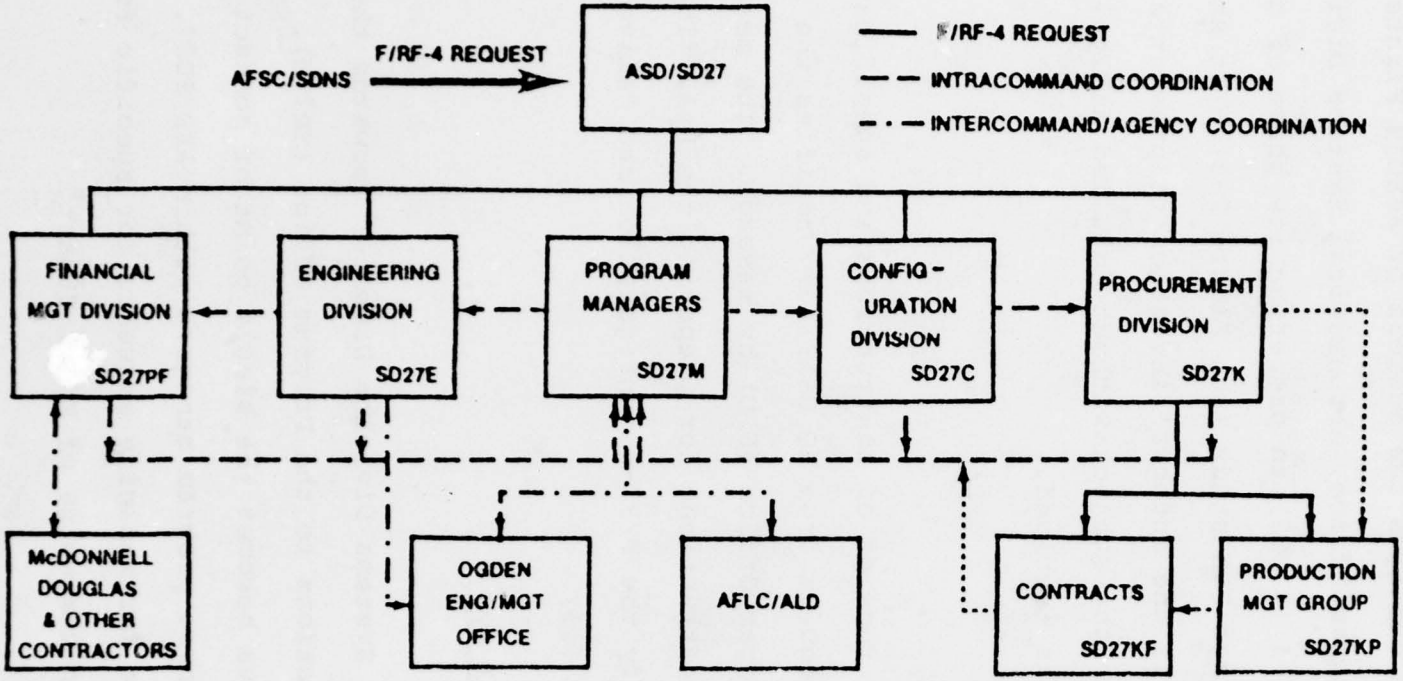

Figure 2-3

AFSC and ASD Coordination Process

> Our job is to make sure the price and availability study is a coordinated effort . . . to assure the scope of the program encompasses what everyone is doing and that problems don't crop up at the last minute [27].

Upon receipt of the message from the Director, a coordination meeting is set up consisting of all ASD offices involved in the P&A preparation. Actions are discussed and known problem areas are brought up that require clarifying action. For instance, the country may request an equipment item which the contract personnel may already know is no longer being manufactured by the contractor. Thus, determining a suitable substitute becomes necessary (27). The divisions consist of Engineering (SD27E), Configuration (SD27C), Production/Manufacturing Group (SD27KP) and Contracts (SD27KF) both from the Procurement Division (SD27K), and Finance (SD27PF). After this coordination meeting, each of the divisions performs its respective responsibilities (27).

The Engineering Department is not directly involved in a P&A study unless it is in an advisory capacity and requested by the Engineering and Management Office at Ogden ALC, Utah. The engineering responsibility was transferred to the Ogden office in October, 1975. The responsibilities associated with the engineering department include, but are not limited to, coordination on potential problem areas which may be encountered if a country requests an item which

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with ASD/SD27, Wright-Patterson AFB, OH.

has never before been used in an F/RF-4. This requirement entails environmental and/or flight modification testing by the engineering department. An example of such a request was a foreign country request for an F-4E to be configured with an LW-33B inertial navigation system. This system had been used successfully in the F-5 but had never been installed in an F-4E. Thus, flight safety had to be incorporated through qualification and flight testing. McDonnell Douglas was able to quote price data to the financial management cost estimation personnel before flight testing was begun. A statement is made in the P&A message to the effect that configuration is in accordance with McDonnell Douglas F-4E specification for the country (if a previous specification exists for this country) with the exceptions as identified in the formalized P&A study (9).

The Configurations Management Division reviews the instructions and prepares a list of government furnished equipment and technical publications requirements (46). At the same time, the Procurement Division, Production Management Group, establishes a production schedule and determines government furnished equipment supportability (1). This study is provided to the Program Manager within two weeks (27). During this two-week period, the Procurement Division, Contracts Section, reviews the lead time for the contracts between the Air Force and manufacturers as required by the production schedule and determines if the lead times

can be realistically met (14). The Financial Management Branch uses the computer algorithm explained in chapter three to prepare a financial analysis and cost estimate for the P&A request. This branch also requests written confirmation of agent fees from McDonnell Douglas, General Electric, and other contractors. Additionally, they prepare a weapon system budget estimate (P&B) (DD Form 1537) to obtain reimbursement of funds from AFAFC. The completed P&A estimate is then forwarded to the Program Manager (13).

The Program Manager assimilates the inputs from the various sources into an LOA format. He also informs the Air Force Logistics Command, Acquisition Logistics Division (AFLC/ALD) of the production delivery schedule, any configuration peculiarities, and all non-standard support equipment requirements. Also included are any qualifications and options requested by the country. A typical finalized P&A will include (27):

1. The expiration date of the P&A [a fixed date normally ninety days from the preparation date (35:5-3)].
2. The applicability of agent's fees.
3. The production delivery schedule.
4. The prices arranged into FMS cases.
5. The limitation of USAF involvement in relation to the scope of the problem if test and development is required.
6. The coordination with ASD/PP (Procurement)/ACBM

(Comptroller).

7. The financial analysis in five copies. The Program Manager, having completed the above, briefs the system Director (SD) and obtains his signature (27). The completed P&A is then forwarded through channels to HQ USAF/LGF where the LOA is prepared in final format for approval by DSAA before being provided to the designated foreign country representative (35:5-38).

Chapter 3

THE F-4 COST ESTIMATION PROCEDURE

The coordinative process required by U. S. Government offices and agencies in the preparation of the Letter of Offer and Acceptance was discussed in chapter 2. Chapter 3 will look specifically at the Finance Division and its role in developing the cost estimate that is the primary input to the Price and Availability Study. The discussion in this chapter begins at the Program Manager's coordination meeting after receipt of the P&A directive.

The purpose of the coordination meeting as seen by the financial team is to insure that all aspects of the FMS transaction are investigated to provide accurate development of the cost estimate (48:29 Apr 77)[7]. The main questions that must be answered at this and subsequent meetings are:

1. What is the production schedule?
2. What is the configuration?
3. What Government Furnished Aeronautical Equipment (GFAE) is required?

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[7]The primary source of material discussed in this chapter was interviews with Mr. Roger Will, Financial Specialist at the Fighter/Attack SPO/F-4, and leader of the cost estimation team. He is directly responsible for the development of the cost estimate and for insuring that the necessary cost data are collected and updated by the financial team.

4. What nonrecurring items must be included in the cost estimate?

Each of the represented divisions at the coordination meeting has a responsible input. The Procurement Division must determine when the aircraft are scheduled for delivery to the purchasing country. The delivery schedule of the aircraft is a prime determinant of the final price. Procurement must also determine whether the GFAE, as described in the configuration, can support or meet the production schedule. This action is necessary to prevent a break in the production schedule and the addition of nonrecurring costs.

The Configuration Division must determine if the aircraft's specifications are up to date and that all other divisions are aware of the requested aircraft's configuration. The specifications list all the equipment included on the aircraft. The specifications must be up to date to identify what equipment requires an estimate.

The Engineering Division must determine if the systems requested by the country are compatible with the configuration they have specified. It is possible for the country to request two different systems for their aircraft that are either not compatible together or that must be tested for compatibility. If the requested systems are not compatible, the country must be informed. When testing for compatibility is required, additional charges are involved.

In addition, if the purchasing country specifies that a new system be installed on its aircraft that is currently not in the USAF inventory, then nonrecurring integration costs are included. For example, an inertial navigation system sold only on request by the contractor, must be integrated into the USAF inventory and must be made a functional part of the aircraft. Once all the above information is determined, the Finance Division is ready to begin development of its cost estimate.

The financial team divides its cost estimation procedures into five phases: preparation and notification, airframe cost development, GFAE cost development, other cost development, and supplemental cost development (see Figure 3-1). Each of these phases is discussed below[8].

PHASE 1 -- PREPARATION AND NOTIFICATION

The beginning phase starts with the request for an up-to-date listing of the computer data base. The listing is used as a work sheet throughout the estimation process. Phase 1 is a preliminary step leading to the actual estimation procedures. During this phase, direct contact is made with major GFAE buyers, the prime contractor, the AGE Manager, and the Trainer Manager. Total time required to com-

[8]Although these phases are discussed as separate and distinct, they each overlap to some degree. In actuality, Phases 2, 3, 4, and 5 occur almost simultaneously.

Phase 1 -- Preparation and Notification

- Fighter/Attack SPO/F-4 Divisions
- Propulsion SPO
- Major GFAE buyers
- Prime Contractor
- AGE Manager
- Trainer Manager

Phase 2 -- Airframe Cost Development

- Raw Materials
- Contractor Furnished Equipment
- Subcontractor Equipment
- Inter-Company Work Orders
- Direct Labor
- Factory Overhead
- General, Administrative, and Other
- Earnings
- Nonrecurring Charges

Phase 3 -- GFAE Cost Development

- Engines
- Other GFAE

Phase 4 -- Other Cost Development

- Engineering Change Orders
- Repair of Reparables
- Pro Rata Research and Development
- Accessorial Charges
- Asset Use Charges
- Production Shutdown Delta

Phase 5 -- Supplemental Cost Development

- Technical Publications
- Peculiar AGE
- Trainers
- Ferry
- Travel

Figure 3-1

F-4 Cost Estimation Phases

plete this first step varies with each F-4 FMS transaction; however, it typically takes between two and three days.

From the data base listing all major GFAE items are identified including the type of engines requested by the purchasing country. Major GFAE, as identified by the financial team, are those items with a unit cost greater than $5,000. First, the engine costs are determined. The Propulsion SPO is contacted by the financial team and notified of the production schedule. This office then determines whether the schedule can be supported with on-time deliveries and what the engines will cost. After notifying the Propulsion SPO, all other major GFAE buyers are contacted. These buyers include the Air Logistics Centers (ALC), the Aviation Supply Office (ASO), and the Aeronautical Systems Division (ASD). The buyers are each notified of the production schedule and the quantity of GFAE required. GFAE items include the auto pilot, the target identification system, and the weapons release computer.

The GFAE buyers must be able to meet the production schedule or "dock time" of when the equipment is needed. If the buyers cannot meet the dock time, then alternative arrangements must be made by the financial team for McDonnell Douglas to supply the item. The various buyers respond to the notification with real-time quotes on the future cost of their equipment as determined by the production schedule. Their response time is not immediate; instead, it requires

several days to insure a fair degree of accuracy (48:29 Apr 77).

With the notification to all major GFAE buyers completed, the prime contractor -- McDonnell Douglas -- is then notified of the potential sale. McDonnell Douglas is asked to contact their major CFE suppliers and subassembly contractors for real-time price quotes. Major CFE and subassembly items must also meet the $5,000 criteria specified by the financial team. Major CFE items include the refrigeration unit, the central air data computer, the forward looking radar, and the ejection seats (see Figure 3-2). Major subassemblies are items such as the aft fuselage, the landing gear, the canopies, and the outer wing[9]. At this same time, McDonnell Douglas is also contacted on the technical publications requested by the country. They are asked to provide the cost of the technical publications required to support the aircraft configuration.

The above notification process is all external to the Fighter/Attack SPO/F-4. The remaining contacts under Phase 1 are with offices located adjacent to the Financial Division and internal to the Fighter/Attack SPO/F-4. The financial team contacts the AGE Manager in the Procurement Division to determine what AGE equipment requested by the

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[9]The difference between a major CFE item and a subassembly is that the CFE item is similar to a purchased part off the shelf where the subassembly may be a distinct section of the aircraft.

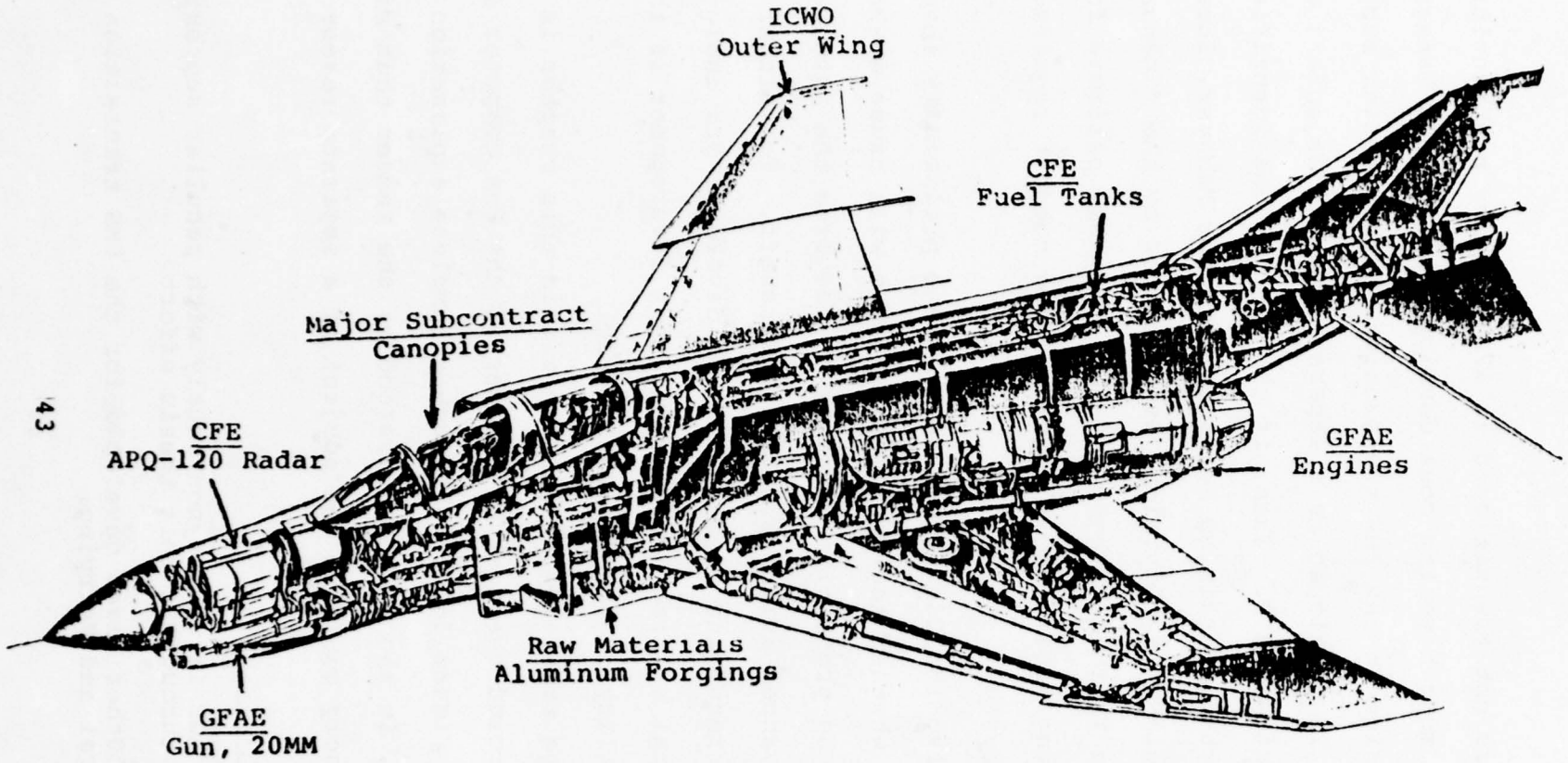

Figure 3-2

F-4 Cutaway

country has not transitioned to AFLC[10]. Any nontransitioned equipment must have its cost developed by the AGE Manager for inclusion in the FMS transaction. The peculiar support equipment is developed as a separate case, independent of the aircraft case[11]. Then, if the country has identified a requirement for training sets, the Trainer Manager, located in the Engineering Division, is contacted by the financial team. The Trainer Manager develops the cost estimate for the training sets based on the training support required by the country.

Also included in Phase 1 is the preliminary investigation of whether the proposed FMS sale will cause either a break in the production schedule or requires the integration of any advanced avionics into the aircraft. For either reason, a nonrecurring expense must be developed and included in the total airframe cost. This cost development is the responsibility of the financial team.

The remaining discussion within this chapter is organized around the cost categories of the F-4 computer data base (see Figure 3-1). Although a complete explanation is attempted, it should be understood by the reader that each cost category could be the subject of a separate research

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[10]AGE is used synonymously with peculiar support equipment throughout this thesis effort.

[11]Other cases developed for the FMS transaction include Travel and Ferrying.

effort. As such, sufficient detail is presented to permit a more complete understanding of the complexity involved in the cost estimation process.

The discussion of each cost component includes: an explanation of what the component is or involves; how the cost data is calculated, estimated, or derived; and finally, how the computer data base is updated to reflect the new estimated price of each component. Numerous examples are provided to better explain this complex series of events. The reader is encouraged to review and periodically refer to Figure 3-1 during the following discussion. In addition, Appendix H is a discussion on the data base itself, its format, and how it is updated for each component.

PHASE 2 -- AIRFRAME COSTS

The first major cost category that is developed by the financial team is the cost of the basic airframe. The airframe is separated into both recurring and nonrecurring cost components. These cost components are shown in Figure 3-3. Each of these components is discussed below.

Raw Materials

The first recurring cost component is raw materials. This category accounts for over 6,000 items procured for installation on the F-4. It is the highest volume for any single cost component in the data base. Raw materials include common items such as pan stock and small purchased

Recurring Cost Components:

- Raw Materials
- Contractor Furnished Equipment (CFE)
- Subcontracts
- Inter-Company Work Orders
- Direct Labor
  - Design Engineering
  - Product Support
  - Tooling
  - Production
  - Quality Assurance
  - Overtime
- Factory Overhead
- General and Administrative Expense
- Earnings

Nonrecurring Cost Component:

- Nonrecurring Expenses

Figure 3-3

Phase 2 -- Airframe Cost Components

parts[12]. It also includes items that are in a highly volatile cost area such as: aluminum and steel bars, tubes, copper wire, aluminum and titanium castings, and forgings.

The initial data for the computer data base was obtained from a McDonnell Douglas bill of materials. The bill of materials included all the individual items and their quantities used on the aircraft. It also provided summary pages where the items had been placed into major commodity groups. These commodity groups are a range of items that possess similar characteristics or have similar applications (43:Part I, 3). They became the original data source for raw materials in the computer's data base and are represented by over 150 line entries.

To update the raw materials commodity groups the team must first determine the type of cost escalation index to apply. For example, aluminum, copper, and titanium items are in a highly volatile cost area requiring monthly updated economic escalation indices. The financial team had found that the Bureau of Labor Statistics index, Metal and Metal Products, was more accurate in estimating rising costs during the energy crisis than the ASD 110-C index. As such, the ASD 110-C index was not used on FMS cases developed during the energy crisis. The ASD indices were simply not keeping pace with inflation (48:29 Apr 77). Figure 3-4 dis-

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[12]Pan stock items are nuts, bolts, washers, screws, grommets, etc.

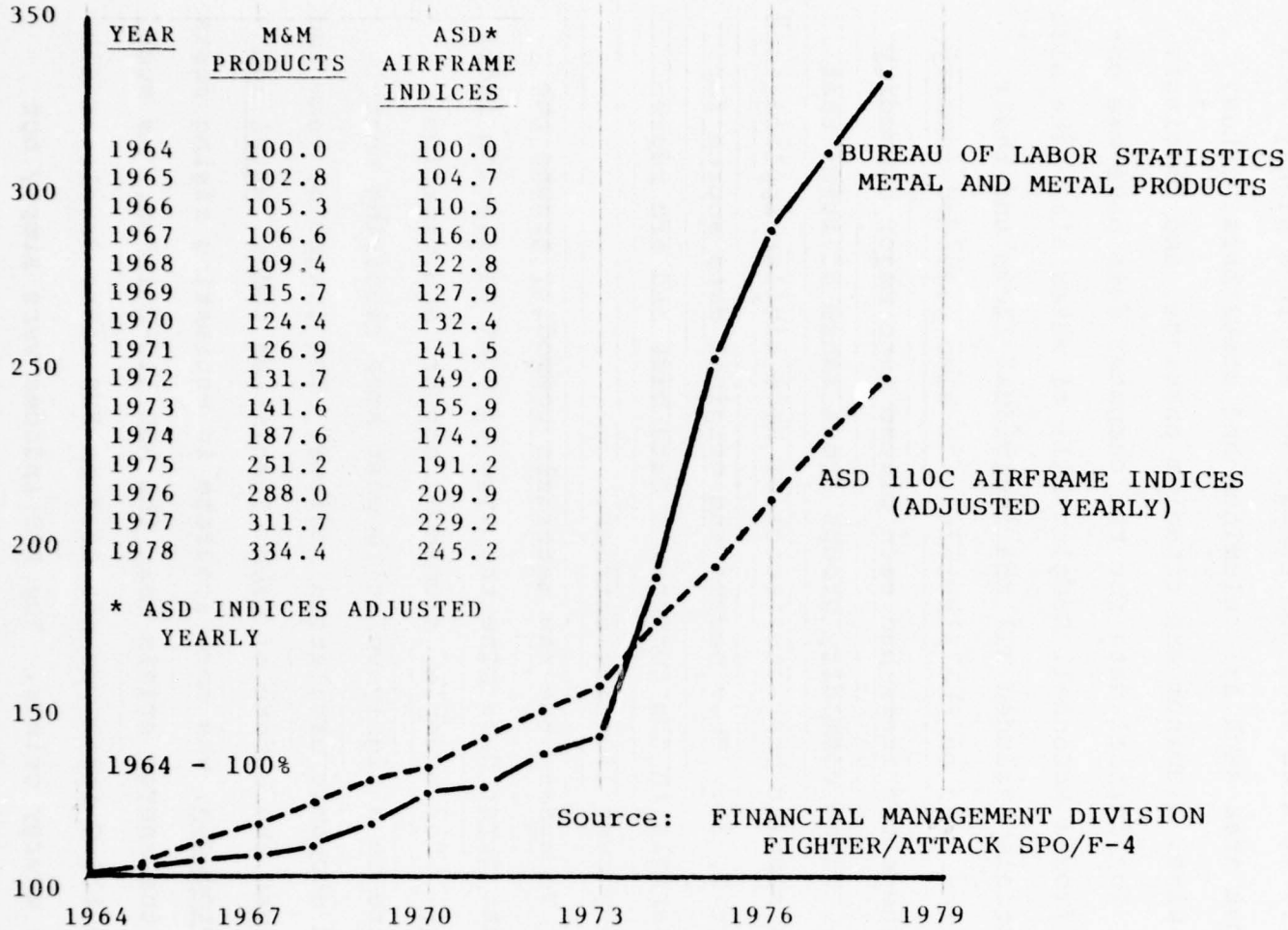

FIGURE 3-4

INDICES FOR ALUMINUM & TITANIUM SHEETS, FORGINGS, & CASTINGS

plays the inflationary trend of raw materials prices and visually depicts why accurate estimation for this cost component is necessary. For the more common items, such as pan stock, the financial team always uses the ASD 110-C index (48:29 Apr 77).

The indices are applied to the commodity groups based on the midpoint of the raw materials delivery schedule. For example, if production was to take three years, the indices would be applied to escalate the costs to the approximate midpoint range, i.e., 17-19 months into production. The midpoint is used because the raw materials arrive at various time periods throughout the production schedule. The midpoint serves as an average figure for estimation. It is also consistent with similar methods used by McDonnell Douglas (48:29 Apr 77).

To update the cost data in the data base, each of the commodity groups has its listed value multiplied by the appropriate escalation index. The new value is then entered into the computer. If a quick update was required because of time constraints, the total cost of the raw materials is multiplied by the escalation index. However, each item is eventually updated to insure accurate estimation on future FMS cases.

Contractor Furnished Equipment

The second recurring cost component is contractor

furnished equipment (CFE). These items carry a McDonnell Douglas part number for identification. They are standard items of hardware, electrical equipment, etc. that are furnished as part of a larger assembly (35:A1-1). McDonnell Douglas is responsible for the procurement of these items from its suppliers. CFE items include: the forward looking radar, the central air data computer, the ejection seats, the digital scan convertor, plus 722 other CFE items[13]. Also included in this area are subassemblies that are contracted out by McDonnell Douglas to other manufacturers. As these subcontracted assemblies are identified separately within the data base, they are discussed separately in this chapter.

Each year, the financial team is provided a copy of the CFE listing by McDonnell Douglas. The data base is cross-checked to insure that all items on the list are in the data base. In addition, if there are any items in the data base but not on the list, they are removed. This yearly update insures that the data base contains the correct components at their current prices. The financial team believes this procedure is necessary because the contractor can change vendors or the equipment may be modified during the year. Either action will cause the price to fluctuate.

With each FMS case, the financial team contacts

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[13]This is the quantity listed in the data base for an RF-4. The F-4 model requires less CFE items.

McDonnell Douglas for a real-time quote on their major CFE items[14]. These quotes are based on the delivery schedule of the item into the production line. As the quotes are called into the financial team, the work sheet is annotated for each major CFE item. Each corresponding line entry in the data base is then updated to reflect the latest estimated cost. In addition, a major CFE assembly, consisting of many low value CFE items, has the unit price updated for the assembly. Each of the individual CFE components within the assembly has no value listed.

The remaining CFE items have a listed value of less than $5,000 and are considered minor items. An escalation factor using the ASD 110-C index is applied to these items and any major CFE item where a real-time quote was not received. Each of these items is then updated in the data base to reflect its estimated cost as calculated by the financial team members.

Subcontracts

Subcontractors provide McDonnell Douglas with subassemblies of the F/RF-4. The major subassemblies are identifiable sections of the airframe. They include: the aft

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[14]The reader should be aware that any item in the data base with a unit cost over $5,000 is considered by the financial team to be a "major" item and that a real-time quote (based on the future cost of the equipment) is always requested. A major item may also be an assembly of smaller CFE items whose individual values do not exceed $5,000 but their combined value is over $5,000.

fuselage, engine doors, and the spoilers; also, the landing gears, armament pylons, and the slotted leading edge (see Figure 3-2). In addition, the subcontractors also provide six minor subassemblies.

For the major items, McDonnell Douglas is contacted to provide a real-time quote. The updating process for the data base is the same as for the CFE items above. The minor items have the ASD 110-C escalation factor applied and each cost element in the data base is updated. The original source of the minor subassembly cost data was obtained from negotiated contracts. These original costs have been updated accordingly, based on the delivery schedule of the item into the production line.

The above discussion on subcontracted items looked only at the cost of the subassemblies furnished to McDonnell Douglas. When these subassemblies arrive, there is additional work that must be performed on the item. This work is to prepare the item for inventory and eventual installation on the aircraft and includes tooling and production labor hours.

The financial team uses the Pricing Memorandum from the latest negotiated contract between the USAF and McDonnell Douglas to determine the amount of hours required for this additional work. The labor rates that are applied to these labor hours are obtained from the Overhead Bid

Plan[15]. The calculation is to multiply the tooling labor hours by the tooling labor rate and then multiply the production labor hours by its labor rate. Each of these estimated values are then placed in the computer data base as separate line entries in the subcontract area.

Inter-Company Work Orders[16]

The fourth recurring cost component is inter-company work orders. They are major subassemblies produced at a McDonnell Douglas corporate division. For example, Douglas Aircraft in Long Beach, California, manufactures the outer wing. Other subassemblies in this category include the nose wheel steering, gun control unit, and the light control (see Figure 3-2). ICWO is a relatively small area and accounts for only ten of the total components on the F/RF-4. These items are updated through real-time quotes obtained from McDonnell Douglas. The updating process is the same as that used for CFE and subcontracted items.

The above four recurring cost components -- raw materials, contractor furnished equipment, subcontracts, and inter-company work orders -- when added together, provide the financial team with the cost of the materials used in

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[15]The method of determining the tooling labor rate and the Overhead Bid Plan are discussed in more detail under "Direct Labor".

[16]The correct terminology is "Intra-Company Work Orders" as these items are produced by McDonnell Douglas divisions.

the production of the F/RF-4.

Direct Labor

This cost component consists of the following elements used in the manufacture of the aircraft: design engineering, product support, tooling, production, quality assurance, and overtime. Each of these elements is discussed below.

Design engineering. This is the labor effort by the Design Engineering Department at McDonnell Douglas to update all the drawings, blueprints, illustrated parts breakdown, and the specifications to support the purchasing country. In general, it is the labor cost for them to manage the engineering effort required in the production of the aircraft.

The charges for design engineering all stem from an engineering pool of labor hours. The pool has a fixed amount of engineering hours that must be absorbed into each aircraft. For example, if design engineering was estimated to be 25,000 hours over the total production cycle of the aircraft, then the labor cost for these hours must be absorbed, whether one aircraft or five aircraft are produced. Extending this example further, if there are three F-4s for Iran and two F-4s for Greece under production, then each aircraft would absorb 5,000 design engineering hours.

The required engineering labor hours are obtained by

the financial team from the MCAIR Report 7290, "F-4 Cost Data" (17:9-13). The data in this report is from McDonnell Douglas historical information. The labor hours used by the financial team are based on the midpoint or average production schedule that occurs between the signing of the Letter of Offer and delivery of the first aircraft. The midpoint is used because McDonnell Douglas is spreading their engineering efforts between other aircraft. It is also where the maximum engineering effort takes place (48:5 May 77).

In addition to the fixed pool of labor hours, design engineering also includes a standard rate for variable engineering hours. The variable hours are based on McDonnell Douglas historical information and are currently set at 1,000 hours per aircraft. Therefore, using the above example again, total design engineering is 6,000 hours (5,000 + 1,000) per aircraft.

To develop the cost of total design engineering hours, the 6,000 hours must be multiplied by the appropriate labor rate for engineering. These rates are provided in the McDonnell Douglas Overhead Bid Plan. This plan is a five year forecast prepared for projecting contract funding requirements and for pricing contract proposals (16:1).

The labor rates shown in the Overhead Bid Plan are negotiated between McDonnell Douglas and the labor union. The Plan is given to the Air Force Plant Representative Office (AFPRO) located at the contractor's plant. They, in

turn, forward a copy to the financial team. The appropriate labor rate is then applied throughout the aircraft's production. If an FMS transaction extends beyond the negotiated contract, the contractor will forecast these labor rates which are reviewed and approved by the AFPRO and finally sent to the financial team.

There is also the possibility that an FMS case will overlap two calendar years with different labor rates for each year. When this event occurs, a composite rate is established by the financial team. For example, if Iran had three aircraft being produced this year and two scheduled for next year, then a composite rate is established as follows:

$$\text{Composite Rate} = \frac{(3 \times \text{current year labor rate}) + (2 \times \text{next year's labor rate})}{5}$$

The composite rate is then applied to the total design engineering hours to arrive at total cost of design engineering. This value would then be entered on the line number to update the computer data base.

Product support. This cost element of direct labor is applied as a percentage of the total design engineering man hours discussed above. It is the charge for the typist and others who are categorized as indirect labor. They support the design engineers and are part of the design engineering effort. This rate is provided in the MCAIR Report 7290 and is currently set at 10 percent. Therefore, if 6,000 design

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engineering hours were estimated in the example above, then 600 hours (10% x 6,000) would be estimated for product support. To these labor hours, the appropriate labor rate from the Overhead Bid Plan is applied to arrive at the cost of product support. The final estimated cost is placed into the data base as a separate line item entry.

Tooling. Tooling is basically the operation of a machine shop. It includes boring machines, dies, cut-off machines, drill presses, stamping, and forming machines. Tooling is an auxiliary operation to the main production process and does not include the tooling performed on the subassemblies as discussed under "Subcontracts". Tooling, as discussed here, is primarily completed on raw materials used by the contractor in the manufacture of the aircraft.

For cost estimating purposes, the financial team expresses tooling labor costs as a direct relationship between the tooling hours and the total manufacturing hours. This percentage is calculated once each year by the financial team. It is applied against the estimated manufacturing hours for each FMS case developed in the following year. This is a quick way to estimate the tooling hours instead of extracting all the data from the MCAIR Report 7290. These hours are fairly consistent from one year to the next and are only a minor input when compared to production and engineering labor (48:5 May 77).

The estimated tooling labor hours are multiplied by the labor rates as provided in the Overhead Bid Plan to arrive at the estimated cost of tooling. This cost figure is placed into the data base as a single line entry in the "Direct Labor" area.

Production. The fourth cost element included under "Direct Labor" is production. It is the actual manufacturing of the aircraft. The production line is composed of the major assembly, fabrication, final assembly, and flight checkout areas. As the aircraft's major components move through these areas, they accumulate production time. For example, within the major assembly area there is work being performed on the inner wing, the forward fuselage, the center fuselage, the hydraulics, etc.

The manufacture of an F/RF-4 is broken down into production "blocks". Within a block are a varying amount of aircraft where similar work is performed. Each block has a logical starting and stopping point which is based upon timing and the aircraft's configuration. These blocks are established by McDonnell Douglas. Within a specific block may be a number of aircraft from different FMS cases. The blocks vary in length of duration with some lasting as long as six months. For an FMS case, fifteen blocks are required for complete assembly (48:5 May 77).

The financial team considers production labor hours as the key element when estimating the total direct labor

costs. To estimate the amount of production labor required, the financial team first determines the setup and run times for the aircraft. The setup time is the time required to make the production line functional. It involves calibrating the equipment, setting up jigs and fixtures, placement of equipment in their proper sequence, etc. In other words, doing everything necessary in preparation for a block of aircraft.

To establish the setup time, the financial team uses the MCAIR Report 7290. Within the report they attempt to identify previous production aircraft with similar configurations. The labor hours in the report indicate how much time is required to set the line up for the production block. If a similar aircraft configuration is not identified, McDonnell Douglas is asked to estimate the number of hours required for the setup. The financial team uses this input with their other data to estimate total setup time required for the FMS case.

After the setup time has been estimated, the "run time" must be estimated. Run time is the length of time it takes to process, assemble, attach, etc., the aircraft through the production block. For example, if the outer wing was to be attached in a specific block, the run time would be the total time required by all departments to complete their work in attaching the wing. This data is obtained from the MCAIR Report 7290 for similarly configured

aircraft.

Next, the financial team must determine the learning curve adjustment that is needed. The learning curve provides an analytical framework for quantifying the commonly recognized principle that a worker becomes more proficient in his job with experience (4:587). The financial team makes this adjustment based on the quantity of aircraft, any unusual configuration, or an established break between time periods when a particular model was manufactured. For example, if only F-4s had been made for two years and the next sale was for the RF-4, the learning curve would adjust the amount of production hours for the RF-4s upward. This accounts for any loss in efficiency from prior production.

Early in the discussion on production, it was mentioned that the four major areas involved with production are major assembly, fabrication, final assembly, and flight checkout. Each of these production areas require a separate estimate for the setup, run time, and learning curve adjustment. The labor rates are the same for each, but the labor hours all vary with production. Of the four areas, the financial team spends a greater amount of effort in developing an estimate for fabrication than on the other areas. Fabrication is the actual production line and it consumes the most hours. Therefore, an error in adjusting the learning curve can have serious consequences on the total labor esti-

mate (48:5 May 77).

The final addition to production labor hours is production control. According to the financial team, production control is an indirect labor expense to cover the cost of expeditors at the plant. It is based on historical data and is included as a percentage of production hours. The current rate is 6 percent (48:5 May 77). For example, if the production hours were estimated at 60,000, production control hours would be calculated as 3,600 hours (60,000 x 6%). Therefore, the total production estimate would be 63,600 hours.

To develop the cost estimate for production labor, the financial team combines the setup, run time, learning curve adjustment, and production control hours and multiplies the sum by the production labor rate found in the Overhead Bid Plan. If the production extends over two separate labor rate periods, a composite cost is developed as discussed earlier in engineering labor. To update the data base for the estimated production labor, the line number is located within the data base and the cost is entered. In addition, the total hours and labor rate used in the calculation are entered into the "description" field of the line number (see Appendix H).

Quality assurance. The next cost element included under Direct Labor is quality assurance. It represents the cost associated with McDonnell Douglas inspecting the tooling,

product, and related production processes. The labor hours required for quality assurance are based upon a yearly ratio or percentage developed by the financial team from the MCAIR Report 7290.

From the previous year the number of tooling inspection hours are divided by the total tooling labor hours. This percentage is then used throughout the current year to estimate the tooling quality assurance hours. The number of tooling inspection hours for a new FMS case are found by multiplying the developed percentage figure by the estimated tooling hours. This same procedure applies to develop a production quality assurance percentage. The production inspection hours are divided by total production hours and the resulting percentage is then multiplied by the estimated production hours for the new FMS case.

When both the tooling and the production quality assurance hours have been calculated, they are added together and the sum is multiplied by the appropriate labor rate from the Overhead Bid Plan. The updating process is the same as production. A single entry is made at the appropriate line number for the cost data while the number of hours and rate are placed in the "description" field.

Overtime. The final cost element included under Direct Labor is the overtime incurred in the production process. The financial team evaluates the latest contract proposal negotiated with McDonnell Douglas to determine what this

rate has been in the past. Separate ratios are developed from this contract for both engineering overtime and manufacturing overtime. The hours are found by dividing the engineering overtime by total engineering hours and then multiplying this percentage by the estimated engineering hours for the new FMS case. In the same manner, the manufacturing overtime is calculated (where manufacturing hours are the sum of engineering, production, and quality assurance hours). These overtime hours are then multiplied by their respective labor rates from the Overhead Bid Plan.

Each of the overtime figures is placed into the data base on separate line numbers in the Direct Labor area. In addition, the ratios used in the calculations are placed in their respective "description" fields. With the addition of overtime to the data base, the total estimate for direct labor is available. The financial team merely adds the summary totals for design engineering, product support, tooling, production, quality assurance, and overtime. The discussion now turns to the next recurring cost component included in the cost of the airframe -- factory overhead.

Factory Overhead

This cost component includes the costs associated indirectly with the production of the aircraft. Major cost elements as listed in the Overhead Bid Plan include: indirect labor, fringe benefits, and payroll taxes. Also included are depreciation, insurance, utilities, etc. (16:

14-19). These associated costs are consolidated as engineering and manufacturing overhead pools by McDonnell Douglas. The overhead costs from these pools are then separated by major weapon systems -- each taking a proportionate share based upon yearly production. For example, from a total pool for manufacturing overhead of $200.0 million and an engineering pool of $100.0 million, the F-4 will absorb a certain amount based on its sales forecast. Also, the F-15, F-18, the AV-8A, and others, all absorb a pro rata share of the manufacturing and engineering overhead costs.

It is for that very reason -- the pro rata sharing of the overhead pools -- that the financial team considers overhead as critical in the preparation of a P&A (48:5 May 77). They feel obligated to know what is happening with the other weapon systems being built by McDonnell Douglas. If something impacts on the F-15 production, it directly affects the F/RF-4 program. For example, assume that twelve F-15s were being assembled at the same time that ten F-4s were being built. Then, a DOD decision is made that reduces the F-15 program to only seven aircraft. The overhead dollars that are no longer absorbed by the deleted five F-15s are placed back into the overhead pools and pro rated to the other systems under construction. The cost for the F-4s in production has just increased!

Therefore, in normal daily communication with the

contractor, the financial team tries to determine if the present sales projection for the other weapon systems are still valid. These projections are listed as "Major Assumptions" by McDonnell Douglas in their Overhead Bid Plan (16:1). If the projections are not valid, the financial team makes adjustments to the overhead pools to determine the impact on the F/RF-4 program.

McDonnell Douglas notes the importance of governmental legislation and directives in their Overhead Bid Plan where it is stated that overhead costs have increased faster than direct labor costs (16:6). Other influences on the overhead pools are legislation concerned with F.I.C.A. taxes, unemployment taxes, national health insurance, workmen's compensation, energy, state and local taxes, environmental and safety, government fiscal and monetary policies, and the impact of the judicial process on pension costs and products liability insurance costs (16:6).

The calculation of overhead for the P&A study is considered by the financial team as the most important cost component in the estimation process (48:5 May 77). For the Iranian "Peace Roll V"[17] P&A, total overhead contributed

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[17]This FMS case was still under negotiation when these figures were calculated in May, 1977:

Factory Overhead	= $1.7 million
General and Administrative Overhead	= .6 million
Total Overhead	= $2.3 million
Total Airframe Cost	= $ 7.4 million
Total Flyaway Cost	= $10.6 million

more than 30 percent to the total airframe cost and more than 20 percent to the total aircraft or flyaway cost.

After the adjustments are made to the overhead pools the pro rata share for the F/RF-4 program is estimated by the financial team. The data base is then changed to show the new overhead allotments. In addition, the application rates are placed in the "description" fields.

General and Administrative Expense

The next cost component included in the airframe cost is the charge for the general and administrative expenses incurred from operating the business. This cost component includes charges for general and administrative overhead, computer services, rental, DD780 equipment, and ground and flight insurance.

The general and administrative overhead is a consolidated pool of dollars that is pro rated to the weapon systems as before. The same conditions and influencing factors discussed under "Factory Overhead" apply to this cost element. However, general and administrative overhead is calculated as a percentage of direct labor and factory overhead. The rate used on the latest P&A (Iran "Peace Roll V") had the rate set at 23.6 percent. Therefore, an error in calculating direct labor and factory overhead is compounded into general and administrative overhead.

The overhead pools may also need adjustment from

factors other than production. The financial team believes this is where it is important to have a good relationship with the overhead specialist at the AFPRO (48:5 May 77). Actual estimation of overhead has become a very thorough process for the financial team. For example, McDonnell Douglas is in the Berkley School District in St. Louis, and pays a certain amount of taxes on their facilities. Assume that a court decision is made to provide equal education and opportunity between school districts. To do so, the school districts adjacent to Berkley are combined under one equalization rate so that all districts now pay the same taxes. The industrial school district (Berkley) had originally paid a lower rate but are now required to pay a higher rate. The tax burden on McDonnell Douglas from the court decision in the above example could be as much as $1.0 - 1.5 million. The overhead pool must be adjusted upward and the additional amount pro rated to the F-4 and the other weapon systems.

The remaining cost elements are a miscellaneous collection of general and administrative items. The charges for these items are taken from the Overhead Bid Plan. Each cost is entered into the data base as a single line entry. The application rate for general and administrative overhead is also placed in the "description" field.

Earnings

The final recurring cost component included in the total airframe cost are the earnings that McDonnell Douglas

receives for producing the F/RF-4. The rate used to calculate earnings is negotiated between the Procurement Division and the contractor. This rate is established at 16 percent of all recurring costs included in the airframe. To this base earnings rate, McDonnell Douglas charges an FMS incremental profit addition which varies between 1 and 4 percent. The additional charge was to pay for the added risk of an FMS transaction (48:5 May 77). After calculation, the amount of earnings is entered into the data base.

Nonrecurring Expenses

It was stated in the beginning of the discussion on the airframe costs that it was divided into recurring and nonrecurring expenses. Everything discussed to this point has concerned recurring charges -- occurring with every transaction. The remaining cost component in the computation of the airframe cost are the charges for nonrecurring expenses. It represents a one-time charge because of an unusual system, configuration, etc.

Nonrecurring expenses are separated into minor and major categories. Minor charges are for block differences that result in design engineering requirements. As the aircraft move from one block of production to another, all engineering change orders (ECOs) must be incorporated into the production block based on the latest changes required to support the purchasing country's configuration and specifications. All aircraft within the block share in the cost of

the ECOs. The financial team develops the cost by examining the unincorporated engineering change proposals and they estimate what charge is necessary to cover that block of aircraft. This estimate is then entered into the data base.

Major charges for nonrecurring expenses occur when the purchasing country requests a peculiar non-standard requirement that causes aircraft modification. This could be a system that has not yet been qualified and placed into the USAF inventory. It could also be a major subsystem from another weapon system that has never been installed on the F-RF-4. For example, Iran is purchasing RF/4Es that include the F-15's inertial navigation system with digital computer and interface. They also want the new AAD-5, Infrared Mapper, installed. This requirement cost Iran $22.0 million for nonrecurring charges.

The financial team cannot estimate major nonrecurring charges so they rely on the contractor for a cost quote. To this calculation, the financial team adds an additional 10 percent to protect the U. S. Government, the purchasing country, and themselves from the embarrassment of a low estimate (48:5 May 77). This additional charge is added to the contractor's quote and the sum is entered into the data base. The total airframe cost has now been developed.

The financial team justifies their use of the additional charge on contractor reliability. If the supplier or

contractor has continuously provided bad or low quotations on its new systems, the price may be increased as high as 20 or 30 percent. For one supplier, the price is increased by 50 percent because the financial team has absolutely no faith in his quoted price (48:5 May 77). If the contractor or supplier objects to this arbitrary increase to the quote, the financial team offers them a chance to correct it. They simply ask the contractor to provide a formal "not to exceed price" on the quote signed by a corporate officer. If the supplier does this, the financial team accepts the quoted price. The "not to exceed price" is not legally binding in this case, but it does make the contractor morally obligated (48:5 May 77).

Summary and Conclusions

This section has examined those cost components that are included in the development of the total airframe cost. Those components included charges for raw materials, contractor furnished equipment, subcontracts, and inter-company work orders whose total value are the materials put on the airframe. In addition, direct labor added the labor component to the airframe. Factory overhead and a major portion of the general and administrative expense added the overhead to the total. Then McDonnell Douglas' earnings were added followed by any nonrecurring charges for new systems or unusual configurations.

Most of these components, like contractor furnished

equipment, subcontracts, and earnings, involve the use of a quoted price or applying a predetermined rate to a base price to update the data base. However, the raw materials area, direct labor, and overhead areas must be developed by the financial team from furnished data. Awareness of economic conditions, government legislation, and court rulings all impact on the cost of the F/RF-4 program. The amount of influence they have must be determined by the financial team if an accurate estimate is to be developed. Finally, the financial team's questioning of a contractor's quoted price is based on the historical accuracy of the contractor. Challenging the cost quote provides a reappraisal of the original estimate. Discussion now turns to phase three of the F-4 estimation procedure -- development of the government furnished aeronautical equipment.

PHASE 3 -- GFAE COSTS

The second major cost category that is included in the P&A cost estimate is the cost of the Government Furnished Aeronautical Equipment (GFAE) that is installed on the aircraft during production. The GFAE cost category is composed of only two general component categories -- Engines and Other GFAE. Each of these components are discussed below including how the cost is developed and how the computer's cost data base is updated.

Engines

The purchasing country has the option of buying either the smokeless/low smoke engine or the lower priced non-smokeless engine. In either case, the Propulsion SPO is responsible for negotiating the cost of the engines with the contractor -- the General Electric Corporation. The costs of the engines are negotiated in increments of fifty units. For example, separate costs will be developed for the first fifty engines, then the second set of fifty engines, and so on until the end of the calendar year.

A lower cost is applied if more engines are purchased, i.e., the purchase of 200 engines throughout the year results in a lower per unit cost than if only 100 engines were purchased. This lower cost is equally applied to all FMS cases during the calendar year that contributed to the total number of engines purchased. For example, if Germany purchased forty-six engines in January at the higher price and a sale to Iran of ten engines caused the total engines purchased during the calendar year to extend into the next increment, i.e., 51-100, then Germany and Iran would equally benefit and share in the lower price range (48:22 Apr 77).

When the P&A study is requested, the Propulsion SPO is also notified. They are responsible for tracking the total number of engines produced for the calendar year and for obtaining the latest quoted price for the P&A study. At

the same time, the financial team established the cost per engine based on the negotiated prices and the total quantity produced for the year. The Propulsion SPO is then asked to verify the prices used by the financial team. In addition, they are asked whether or not the production schedule can be supported, i.e., to have the required quantity of engines in place and on time for installation.

Under certain circumstances, the financial team may disagree with the negotiated price given by the Propulsion SPO. Prevailing economic conditions or additional sales during the year may cause the final price to fluctuate either up or down. When the financial team makes the decision to change the price, they also accept full responsibility for their decision. This increase or decrease is not based on any index factors; it is an arbitrarily assigned value. For example, if the negotiated cost was given at $525,000 per engine, but there was an energy crisis or other unusual economic conditions, then the cost may be increased by $50,000 or whatever they believe to be a more realistic figure. The only danger with this procedure is that one must be correct (48:22 Apr 77). If the negotiated price turns out to be correct and the financial team had previously adjusted their estimate, then they either underpriced the engines or needlessly tied up the purchasing country's funds.

When the cost has finally been agreed upon or ac-

cepted, the computer data base is updated. The line number for the engines is located and the cost of one engine is entered. During the printout of the data base, the computer multiplies this cost by two for the cost per plane.

Other GFAE

The remaining cost component listed under GFAE costs is Other GFAE. This area includes all government furnished equipment (except engines) used on the F/RF-4. The financial team separates the GFAE items into two general classifications for cost estimation purposes -- major GFAE and minor GFAE. Using the team's classification, major GFAE are those items, with the exception of the engines, that have a unit cost greater than or equal to $5,000. This group represents approximately 20 percent of the total GFAE items but 70 percent of the total GFAE value. Minor GFAE are those items that have a value less than $5,000. They represent 80 percent of the total GFAE items but only 30 percent of the total GFAE value (48:22 Apr 77). Major GFAE includes items such as the AAD-5 Infrared Mapper, Inertial Navigation System, Starter Cartridge, and Radar Homing and Warning. Minor GFAE includes items such as the ladder assembly, tires, wheels, brakes, and wing tip lights, among many others.

The receipt of the P&A directive from Air Staff includes the configuration the purchasing country has requested. If the financial team has any questions regarding the GFAE items, then Air Staff is immediately contacted for

confirmation and/or clarification by the MAAG. Once these questions are answered, any optional GFAE item that is not to be supplied has its quantity immediately zeroed out in the computer data base. This action is to prevent the accidental inclusion of cost data not directly related to this specific FMS transaction (48:22 Apr 77).

For major GFAE items, the financial team establishes direct contact with the component's buyer. The buyer may be at ASD, any of the ALCs, or even the Navy Aviation Supply Office in Philadelphia. When contacted, they are asked to provide a price quote based on the production schedule of the aircraft and the quantity being purchased. The buyers are, in effect, forecasting the cost of their GFAE component for the financial team (22:5 May 77). The cost estimate received from the buyer is called a "real-time" quote and is based on the future cost of the equipment. When these quotes are received, they are screened and entered directly into the computer data base. No escalation factors are applied to the quotes as they already represent a forecasted price (48:22 Apr 77).

Making direct contact with the buyers for minor GFAE items would be a time consuming process and a needless exercise considering the low value for most of these items. Instead, the financial team uses the latest negotiated price and applies an escalation factor to these items based on the production schedule. Each line number in the data base is

located and the latest cost is entered. As there are GFAE items common to both the F-4 and the RF-4, duplicated line items are updated for both aircraft.

The latest negotiated cost information for these minor items had previously been obtained from the Government Furnished Aerospace Equipment Book. This report was discontinued as of 31 July 1976. Therefore, an internally developed Cost Tracking Program has become the primary source of minor GFAE cost data. This program also serves as an additional source for major GFAE cost data. The Cost Tracking Program was put into operation in September, 1976 (13:26 Apr 77). It is designed to track funding and obligations for each FMS case for the Program Manager.

The Cost Tracking Report identifies the estimated price, the negotiated price, the item description, etc. The information to update the minor GFAE cost data is periodically extracted and the computer data base is updated. This is a continuous process that occurs throughout the year. It is designed so that, as a minimum, the data base is updated twice each year.

Summary and Conclusions

This section has looked at the development of the cost data for all the government furnished equipment installed on the F/RF-4. Discussion first focused on the prime GFAE item -- the engine -- and how the engines were priced according to production blocks of fifty each. The

experience factor of the financial team is beneficial for both the U. S. Government and the purchasing country. Their assessment of prevailing economic and other conditions may result in the rejection of the negotiated engine price for the P&A study. This new adjusted price is then used and the financial team accepts the responsibility for its accuracy.

The second GFAE cost component discussed was Other GFAE. It was classified into two separate categories, major and minor, based on the dollar value of the item. Each area had its own method of cost development. For the major GFAE, the buyer or the contractor forecasted the future cost of these items. The minor items had a cost escalation factor applied by the financial team.

Of importance here is the use of the Cost Tracking Program in a dual role. It is a management aid to the Program Manager and a cost updating device for the P&A study. The program is designed for use by any SPO within ASD, but, to date, has only been adopted by the F-5 and EF-111 SPOs. The final cost category included in the aircraft case is Other Costs. It is discussed next in phase 4.

PHASE 4 -- OTHER COSTS

The third major cost category incorporated into an FMS transaction is Other Costs. This category represents a miscellaneous collection of cost components that directly affect the aircraft's production cycle (see Figure 3-5).

Each of these components is discussed below to include a discussion of the component, how the cost data is derived, and how the computer cost data base is updated.

Engineering Change Orders
Repair of Reparables
Pro Rata Research and Development
Accessorial Charges
Asset Use Charges
Production Shutdown Delta

Figure 3-5

Phase 4 -- Other Cost Components

Engineering Change Orders

The first component to be discussed is the Engineering Change Order (ECO). An ECO represents a change in the aircraft configuration. These changes take place after the signing of the Letter of Offer and before aircraft delivery. In other words, ECOs occur during the production phase of the transaction. The ECOs may be standard engineering changes that the USAF has made and the country adopts or it could be a peculiar change that the purchasing country has decided to incorporate. For example, the country may decide it prefers a new stainless steel landing strut, a new weapons release computer system, or simply a change in the wiring.

Historically, the F-4 has always had a certain amount of ECOs made after the signing of the Letter of Offer. The charge for ECOs represents an allowance that is included in the P&A to cover any of these unincorporated

changes. The inclusion of the allowance permits the financial team to make any requested change without being required to submit a new P&A and a new Letter of Offer. It provides the flexibility that is needed for better program management (48:14 Apr 77).

The ECO allowance has an established range from a maximum of 4 percent to a minimum of 1 percent of the total airframe cost. This range covers the majority of ECOs that have occurred on previous FMS transactions. The 4 percent allowance is applied to each FMS case unless the purchasing country requests a smaller allowance. The country representatives may feel that the 4 percent charge is too high. Some of the reasons for requesting a smaller allowance include: only minor changes are anticipated, the case has a short production run, or the purchasing country's financial resources are limited.

However, even when the purchasing country requests a smaller allowance, the financial team will not develop the P&A unless the allowance is at least the 1 percent minimum. This guideline applies even when a country has previously purchased a large quantity of F-4s and are now purchasing more of the identical configuration.

An amendment to the case is made when the purchasing country's ECOs have exceeded the established allowance. This typically occurs when the country directs that a major change be performed which exhausts all of the funds allotted

for ECOs. The amendment is used to replace those funds required for the major change.

Naturally, when the aircraft are paid for and the FMS case is closed, any unexpended funds remaining in the ECO allowance are returned to the purchasing country. But a refund may also occur while the case is still active. For example, this happens when there is a substantial reduction in the negotiated airframe cost because of a change in configuration. As these allowance dollars are excess to the case, the financial team prefers not to hold them idle. Instead, they prefer to reduce the billing charges, make the adjustment, and refund the money (48:14 Apr 77). An alternative is to notify both Air Staff and the country that these funds are excess to the case and may be applied elsewhere at their discretion. The purchasing country must then decide whether to accept reduced billing or apply the funds to another project.

The computer data base is updated to reflect the percentage figure agreed upon by the financial team and the purchasing country. During the printout of the data base, the computer multiplies this percentage figure by the total airframe cost. The calculated ECO allowance is then printed out on the summary page of the report.

Repair of Reparables

The second component as listed under Other Costs is Repair of Reparables. It represents the provision in the

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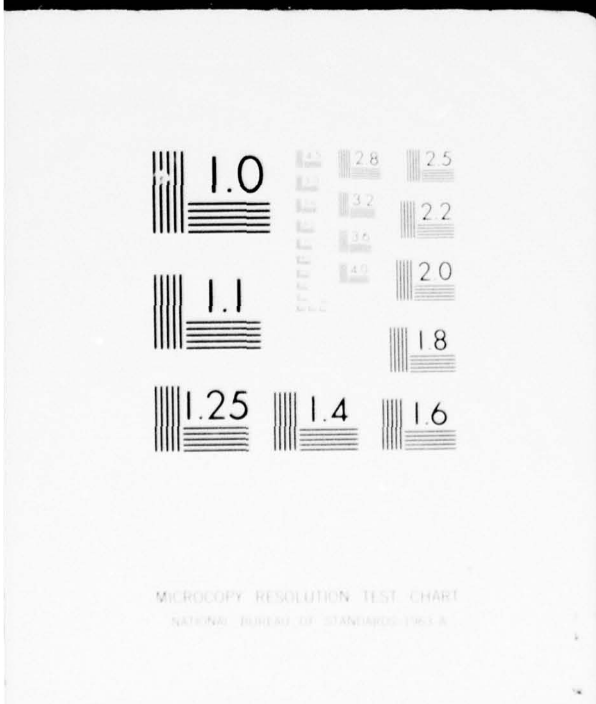
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contract to repair government furnished aeronautical equipment (GFAE) at the McDonnell Douglas assembly plant. The repair work is performed at the contractor's plant to save time, to save money, and to keep the production line on schedule. There simply is not enough time to send the asset back to the manufacturer or the Ogden Air Logistics Center (OOALC) and keep the production line on schedule (48:14 Apr 77). Instead, a repair is made so that the asset can be installed on the aircraft. These repairs range from fixing a loose wire to repairing an item damaged in shipment. In other words, the repairs are made to make the system operational and to pass quality assurance.

An asset that is furnished as GFAE may be supplied from government inventories at any ALC. Therefore, these GFAE items are not necessarily new and unused. For example, the USAF may have used the asset for three years on its own aircraft. Now OOALC is supplying the asset for an FMS transaction and the purchasing country is being charged the current cost of a new and unused asset (48:14 Apr 77).

The charge for the repair of reparables is calculated at 1 percent of the airframe cost. Of course, the country may insist on only new and unused GFAE which avoids most of the repair expense, but the 1 percent charge is still applied. Even new items can malfunction during inspection and this allowance provides management flexibility and protects the country. It is interesting to note that,

to date, only Germany has asked for new and unused GFAE. Any unexpended funds are handled in the same manner as the ECO allowance.

The computer data base automatically charges the 1 percent allowance for the repairs. The total airframe cost is then printed on the summary page of the FMS case report.

Pro Rata Research and Development

The third component is the pro rata assessment of research and development (R&D) costs. DOD Directive 2140.2 requires the inclusion of any DOD nonrecurring costs that are associated with the research, the development, and the production of a major weapon system or defense equipment offered for sale to a foreign country or organization (41: Section IV). These development costs are spread over the potential aircraft sales base on a pro rated basis. The potential sales base represents the combined USAF and FMS anticipated purchases (48:14 Apr 77).

However, specific cost criteria must be met before recoupment of R&D costs are necessary. Specifically, recoupment is required when R&D nonrecurring development costs of major weapon systems exceed $50.0 million, nonrecurring production costs of major weapon systems exceed $200.0 million, or if major subsystem development costs exceed $5.0 million (41:Section I).

The F-4 financial team developed the amount of R&D

recoupment for the F-4 airframe. They also develop the pro rata charges for each new system or support equipment meeting the above criteria. But these pro rata costs are only a recommendation. They are forwarded through HQ USAF, with all data used in calculating the charges, to the Defense Security Assistance Agency (DSAA). The DSAA has final approval authority over these recommendations (35:6-5a) and can approve, disapprove, modify, or waive these charges for the purchasing country. Because the design of the FMS program is not to make a profit, the calculation of the pro rata charges and the estimate of total production aircraft is extremely critical (48:14 Apr 77).

When the financial team receives the directive to develop a P&A, they are also instructed on what amount is to be charged for pro rata R&D. The team then verifies that recovery of all R&D charges have been included by cross-checking the requested configuration with the directive. If a charge has been omitted from the directive, a recommendation to include these omitted charges is forwarded to HQ USAF. This management action prevents the inadvertent omission of recoverable charges (48:14 Apr 77).

The amount of R&D recoupment varies by each case, depending upon the configuration of the aircraft and any political decisions made by the State Department. For the proposed sale of five RF-4Es to Iran under "Peace Roll V," the total R&D nonrecurring charges totaled $86,000 per air-

craft (see Appendix H). These charges were broken down as follows: $46,000 for the airframe; $25,000 for leading edge slats -- a modified configuration; and $15,000 for the AAD-5, Infrared Mapper -- a new system development (48:14 Apr 77).

When all recoupment costs are verified and approved, the data base is updated to reflect the total charge. Any future charge to the requested airframe configuration or the addition/deletion of new major subsystems requires revision of the cost data.

Accessorial Charges

The fourth component included under Other Costs is Accessorial charges. It is a yearly calculation made by the financial team for government quality assurance inspections on the weapon system; first and second destination transportation charges; and packing, handling, and crating (PH&C) (19:21 Apr 77). The costs associated with the quality assurance inspections are for the use of U. S. Government inspectors assigned to the AFPRO. These inspections are primarily on GFAE items shipped to McDonnell Douglas from the ALCs and government contractors (48:14 Apr 77).

At the end of each calendar year, the financial team analyzes the number of inspection hours required on aircraft delivered during the year. These figures are extracted from AFSC Form 72, "Statement of Cost and Certificate of Inspection." The total inspection hours are then multiplied by

the hourly wage rate as established by Air Staff for the government inspectors. To this calculated cost of inspection are added the transportation and PH&C charges (48:14 Apr 77).

The sale of the five RF-4Es to Iran has accessorial charges of $40,000 (see Appendix H). This cost is composed of the following: quality assurance inspections, $24,500; first destination transportation, $12,300; second destination transportation, $1,500; and PH&C, $1,700 (19:21 Apr 77).[18] The computer data base is updated by locating the accessorial charge line number and updating the cost data.

Asset Use Charges

The fifth component discussed under the major category of Other Costs is Asset Use Charges. It is a recent addition to the financial team's estimating procedure, being added within the past year (48:14 Apr 77). DOD/DSAA directs that sales of defense articles that involve the use of government-owned facilities in their production, manufacture, or assembly will include a 4 percent charge for the use of these facilities (40:Section X). In addition, the sale of any defense article which uses government-owned tooling is to be priced to include a rental charge for the

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[18]PH&C charges were calculated at 3 1/2 percent of the latest available GFAE cost data shipped from the ALCs, cost data from GFAE stock shipments from DSA/Army/Navy/other sources, and the latest loose equipment cost data shipped from the ALCs.

use of the tooling and equipment (38:13-404; 25).

The financial team found no government-owned facilities in the production of the F/RF-4. However, government-owned tooling and equipment was used and a fair rental charge had to be developed for approval by DSAA. The financial team's methodology was to contact the AFPRO at the prime contractor's plant, the AFPRO at the engine manufacturer's plant, and each of the suppliers of major GFAE components to obtain the current value of the government-owned tooling and equipment. From previous studies, the financial team knew that the major GFAE component suppliers were responsible for approximately 70 percent of the total GFAE costs. They then assumed that the percentage of government-owned tooling would also be the same. Using the extracted value of the tooling used by the major suppliers to represent 70 percent of the total GFAE tooling, they then added an additional 30 percent for the tooling used by the minor GFAE suppliers (48:14 Apr 77).

The total government-owned tooling and equipment used by the prime contractor, the engine manufacturer, and GFAE suppliers was then divided by the total production base of 5,050 aircraft. The end result was an asset use charge of $43,000 per aircraft to be applied to all future cases (48:14 Apr 77).

Production Shutdown
Delta

Like the Asset Use Charge, the Production Shutdown Delta has recently been added to the F-4 cost estimation procedure. McDonnell Aircraft Company was formally requested by ASD (SD4K) message 301750Z Jul 75 to provide a budgetary estimate of the cost associated with closing down all McDonnell Douglas activities for the F-4 program.[19] However, before final action was taken, a South Korean request for an FMS purchase arrived at the Financial Division. The South Korean FMS aircraft extended the shutdown date to January, 1978. Because of this extension, the financial team recomputed the closedown costs and recommended to Air Staff that any additional FMS purchases include an incremental charge for the further extension of the closedown date (13:19 May 77). Additional F/RF-4 FMS transactions are still occurring and actual shutdown will not occur until some time in the future.[20] The extension of the shutdown date by these additional transactions increases the total cost of shutdown because of normal inflationary growth (48: 14 Apr 77).

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[19]The contractor complied with this request on 12 September 1975 with a contract proposal, "Estimated Cost for F-4 Program Closedown Requirements."

[20]At the time of this writing, Iran has requested a P&A study on five RF-4Es; Turkey has indicated its need for 32 F-4s and 8 RF-4s; and Greece is considering buying 18 F-4s and 8 RF-4s (48:12 May 77).

The estimation procedure that is followed by the financial team is better understood by looking at a hypothetical example. For this example, it will be assumed that the established cost of shutdown is $10.0 million and Iran has signed a Letter of Offer for five RF-4Es. This production is to extend the shutdown date from January, 1978 to July, 1978. During this six month extension, the inflationary growth rate is estimated to be 3 percent.[21] The financial team would calculate the incremental charge to Iran as $300,000. The cost per aircraft is then calculated by dividng the incremental cost by the number of aircraft being purchased. This final figure is then written onto the summary page of the data base printout which is given to the Program Manager. The volume of future FMS orders will determine if this cost component is to be made an actual part of the computer data base with the other cost components.

In the above example, the purchasing country was not paying for the eventual closedown of the line, they were only paying for the inflationary costs of keeping the line open. This incremental cost factor is redeveloped with each new FMS case based on its production schedule. If two or more countries were purchasing F-4s concurrently, they would share the cost of keeping the line open in those months where they had common production.

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[21]The actual inflationary growth rate would be extracted from the ASD Cost Escalation Report 110-C.

Summary and Conclusions

Within this section, discussion has centered on the six cost components that are grouped under Other Costs. These components are basically an attempt by the U. S. Government to collect the miscellaneous charges that occur because of or during the production of the aircraft. Engineering change orders and repair of reparables were estimated based upon an applied percentage of the airframe cost. They provide management flexibility for the program manager and prevent delays during the production schedule. The next three components -- pro rata R&D, accessorial charges, and asset use charges -- are applied at a fixed value under DSAA direction. The Production Shutdown Delta is calculated to charge the FMS customer with the incremental cost of keeping the production line open beyond its scheduled shutdown date. With phase 4 completed, the total flyaway cost of the aircraft has been estimated. In phase 5 -- Supplemental Costs -- the final costs are added to the P&A study to complete the case value.

PHASE 5 -- SUPPLEMENTAL COSTS

The final major cost category for an FMS transaction is Supplemental Costs (see Figure 3-6). Each of these components is discussed below to include what it encompasses, how the cost data are gathered, and how the cost data are updated in the computer.

Technical Publications
Peculiar AGE
Trainers
Ferry
Travel and Mission Support

Figure 3-6

Phase 5 -- Supplemental Cost Components

Technical Publications

This component includes those items found in the Air Force Acquisition Document (AFAD 71-531[1]), "Technical Order Data Requirements for Aircraft." A few examples of items included in this component are: aircraft manuals, maintenance manuals, and the Illustrated Parts Breakdown. These publications are supplied to the foreign country by either the U. S. Government through AFLC or the prime contractor, McDonnell Douglas. They are published in the English language and are then translated by the purchasing country into their own native language.

The purchasing country has three primary methods available to acquire the technical publications needed to support the F-4 weapon system. There is also a fourth method used by Germany which is discussed as it may apply to any country having its own logistics support system.

The first method involves supplying free copies of U. S. technical publications to the purchasing country. The U. S. Government is responsible for supplying a purchasing country with all technical publications required to maintain and support a weapon system sold through the FMS program.

This support period does not expire until 180 days after delivery of the final aircraft (5:15 Apr 77). After this time period, the country must negotiate with McDonnell Douglas for future updates and supplements.

Unfortunately, the use of free U. S. technical publications may prove more of a hindrance and a burden to the purchasing country. The U. S. publications are formatted to support aircraft configurations used by the United States. Only if the purchasing country's request is for an almost identically configured aircraft will they be able to use the free U. S. publications. With the large variety of optional equipment available, their configurations are normally different in several areas than U. S. configurations. What this means to the purchasing country is that, although the U. S. publications are free, they will not be compatible with or have all of the systems data required to support their country's own F-4 configuration. Without these publications, the optional systems cannot be supported or maintained.

The second method that can be used by the country to acquire their technical publications is to purchase technical "difference data." These data represent differences between the United States and the purchasing country's aircraft configuration. Through this option the country would receive free U. S. publications as previously discussed. In addition, they would have to purchase from McDonnell Douglas

the technical publications required to make the free publications compatible with their aircraft configuration. This method is similar to changing any standard manual with supplemental data. It is a low-cost means of acquiring the required technical information (5:15 Apr 77).

Although this option has been offered to several countries, it has never been accepted (48:7 Apr 77). It would appear that the purchasing country is missing an opportunity to save approximately $2.5 million in publications cost. However, the purchasing countries have recognized the primary problem with not having their own unique publications. The problem is one of updating -- keeping those publications current with the recent system modifications. A technical publication program runs into problems when it must be updated after the initial lay-in of publications. By having their own unique set of technical publications, specifically designed for their aircraft tail numbers and configuration, the problem of updating is minimized (48:7 Apr 77).

A third method of acquiring technical data is to purchase an entire set of McDonnell Technical Orders (MTO) specifically designed for the country's aircraft configuration. This method is the most expensive way of acquiring technical data. It is also the most preferred way because the problem of updating is minimized as the configuration may be unique to that country (48:7 Apr 77). The expense of

the MTO method may be shared when there are two or more countries purchasing an identically configured F-4 at the same time. This method involves the joint procurement of technical publications at a substantial savings to the countries. Some minor differences may exist between the aircraft without having an impact on the required technical publications. Even if a major subsystem is involved, e.g., the inertial navigation system, the countries may still be able to share the publications cost by purchasing difference data in addition to the basic publications (5:15 Apr 77).

The participating countries would simply share the cost of the publications data that is common to all of them. In addition, each country would purchase from McDonnell Douglas, the difference data for their particular aircraft configuration. Unlike the previous example of a single country purchasing difference data, it is based on differences from the standard configuration of the consortium. It is not based upon the standard U. S. configuration (5:15 Apr 77).

As mentioned previously, a fourth method of acquiring technical data exists. To date, it has only been used in Germany but it could be established in any country having their own logistics support system. This method involves the purchase of a complete initial set of publications from McDonnell Douglas and the periodic updating of these publications by the country itself -- totally independent of any

system changes made by AFLC or the contractor. The "Data Carrier Program" used by Germany provides maintenance data that primarily affects the Illustrated Parts Breakdown. Their logistics support system provides a breakdown of assemblies to the point where they cannot be disassembled further, i.e., nuts, bolts, and washers (48:7 Apr 77).

The charges for technical data and publications only occur when the purchasing country procures all or part of their required publications from McDonnell Douglas. The quoted cost is based on the publication package requested by the country, the aircraft configuration, and the updates that are required by the aircraft delivery period. The quoted price is normally accepted by the financial team unless it appears excessive. From previous FMS transactions, the financial team has developed what they consider to be an acceptable range for different configurations where the cost, as quoted from the contractor, will not normally be challenged. For example, the normal cost for a complete set of technical publications is approximately $3.0 million. If the contractor's cost exceeds 150 percent of this figure, or $4.5 million, the cost will probably be challenged by the financial team. There is some judgment involved for prices that fall within the acceptable range. This is primarily because different aircraft configurations require different publication sets (48:7 Apr 77).

When the contractor's cost is challenged by the fi-

nancial team for being excessive, contact is made with the Air Force Plant Representative Office (AFPRO) located at the McDonnell Douglas plant. The AFPRO has a specialist assigned to technical publications that will perform a cost analysis upon request. This analysis has been completed on several previous FMS transactions that successfully lowered the quoted price to a more realistic figure (48:7 Apr 77).

Once the cost of the technical publications has been agreed upon by the F-4 financial team and McDonnell Douglas, the computer data base is keyed to a specific sequence number for technical publications and the total cost is updated. This figure is based upon the cost of the entire FMS transaction, not on the cost per aircraft. If the purchasing country had accepted the free U. S. Government publications or had previously purchased F-4 technical data and had kept it updated, this field would be left blank within the data base.

Peculiar AGE

There are basically two different classifications of support equipment,[22] transitioned and non-transitioned to the depot. Over 95 percent of the F-4's support equipment has been transitioned from AFSC to AFLC because the F-4 is a well-established weapon system (48:7 Apr 77). These transi-

[22]Peculiar Support Equipment is used interchangeably with Peculiar AGE (Aerospace Ground Equipment).

tioned items are also known as common AGE. The remaining 5 percent of the items characterize the non-transitioned or peculiar equipment that are developed because of modifications or improvements in the F-4's subsystems. These items are still under the control of AFSC. As such, AFSC is responsible for the procurement and cost estimate development when the purchasing country requests these newer subsystems and/or test equipment (15:15 Apr 77).

Therefore, peculiar support equipment includes any of the new maintenance test sets or maintenance test benches/equipment required to provide the proper ground support and equipment testing capabilities for the aircraft configuration requested by the purchasing country. This equipment is similar in nature to the testing equipment, e.g., the navigation system, that is found at USAF Organizational Maintenance Shops except that the purchasing country has requested newer equipment. Examples include the avionics test bench and new systems like the AAD-5 Infrared Mapper, where the AGE has not transitioned to AFLC. Because these items are so new, AFSC still is responsible for the procurement and the cost estimation. Eventually, the item and the responsibility will transfer to AFLC.

Naturally, there are some equipment items in the transition process when the directive to develop a P&A arrives. In these cases, the financial team makes direct contact with the item manager to coordinate who will develop

the cost estimate for the item. This direct contact avoids any confusion over responsibility and avoids the possibility of not charging the country for the R&D recoupment (48:7 Apr 77).

The cost development for peculiar support equipment centers around the number of operational locations that this equipment must support. If two air bases are to have operational F-4s, then two sets of support equipment are required -- one for each base. For each set of peculiar support equipment that is required, the AGE Manager, located within the Fighter/Attack SPO, establishes a base price which is the latest purchase cost of the equipment. The financial team then applies the avionics ground support index to these figures to escalate the cost for future delivery prices. If a current price is not available for the support equipment because it is a brand new item, then the contractor or the buyer is contacted either by the financial team or through the AGE Manager. The contractor's price then has the escalation factor applied as before (48:7 Apr 77).

If the test equipment had a development cost of $5.0 million or more, then an R&D recoupment cost must be developed for both the system itself and the peculiar support equipment. For example, the Infrared Mapper used to support the RF-4 has a forecasted procurement cost of $600,000 and a pro rata R&D cost of

$160,000.[23] Therefore, the actual cost of the Infrared Mapper is calculated at $760,000 each.

The computer data base is updated in a manner similar to the technical publications costs. The delivery price is obtained or the escalated price is calculated by the team. This figure is then entered into the appropriate sequence number. If no peculiar support equipment was required, this entry would be left blank.

Trainers

The trainer cost component is available under two general classes of equipment: flight simulators which are used for aircrew training and maintenance trainers which are used for the training of maintenance technicians responsible for the operational aircraft.[24] The F-4 flight simulator combines the flight qualities of the aircraft with a tactical fighter mission environment. The flight simulator is called a Weapon System Training Set (WSTS). The maintenance trainers are selected according to the major subsystems on the aircraft. These trainers are called Mobile Trainer

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[23]The pro rata charge for the Infrared Mapper was developed by the financial team based on total R&D expenditures and total aircraft sales ($800.0 million ÷ 5,000 aircraft). The recoupment charge was then forwarded to and approved by DSAA.

[24]The information presented in the discussion on Trainers was obtained primarily from a personal interview with Mr. Paul Hefner, Chief Functional Engineer, Fighter/Attack SPO/F-4.

Sets (MTS). Figure 3-7 shows an artist's conception of the WSTS while Figure 3-8 shows one panel of the electrical system MTS.

The purchasing country may also request an equipment update. The update is developed when an existing WSTS or MTS program requires a new system to update its training capabilities for new aircraft configurations. For example, if the F-4s flown by a friendly nation had a newer, more advanced navigation system installed, the MTS and WSTS would have to be updated to provide training in this new system.

The procurement of a WSTS or a MTS is normally a one-time purchase unless additional trainers are required by the country at a later time. The equipment updates are used to keep the trainer current with the latest system modifications that occur on the purchasing country's aircraft. Rarely is a complete new trainer purchased to replace an existing operational set (6:21 Apr 77). On the initial aircraft buy, one MTS is normally purchased along with one WSTS for each operational wing. With subsequent purchases additional WSTSs may be required for new operational locations and the MTS is updated for any changes in aircraft configuration (48:8 Apr 77).

The cost estimate for these trainers is developed by the Trainer Manager as a separate case for the P&A study. The cost estimate is based on the delivery schedule of the equipment to the purchasing country (48:8 Apr 77). Because

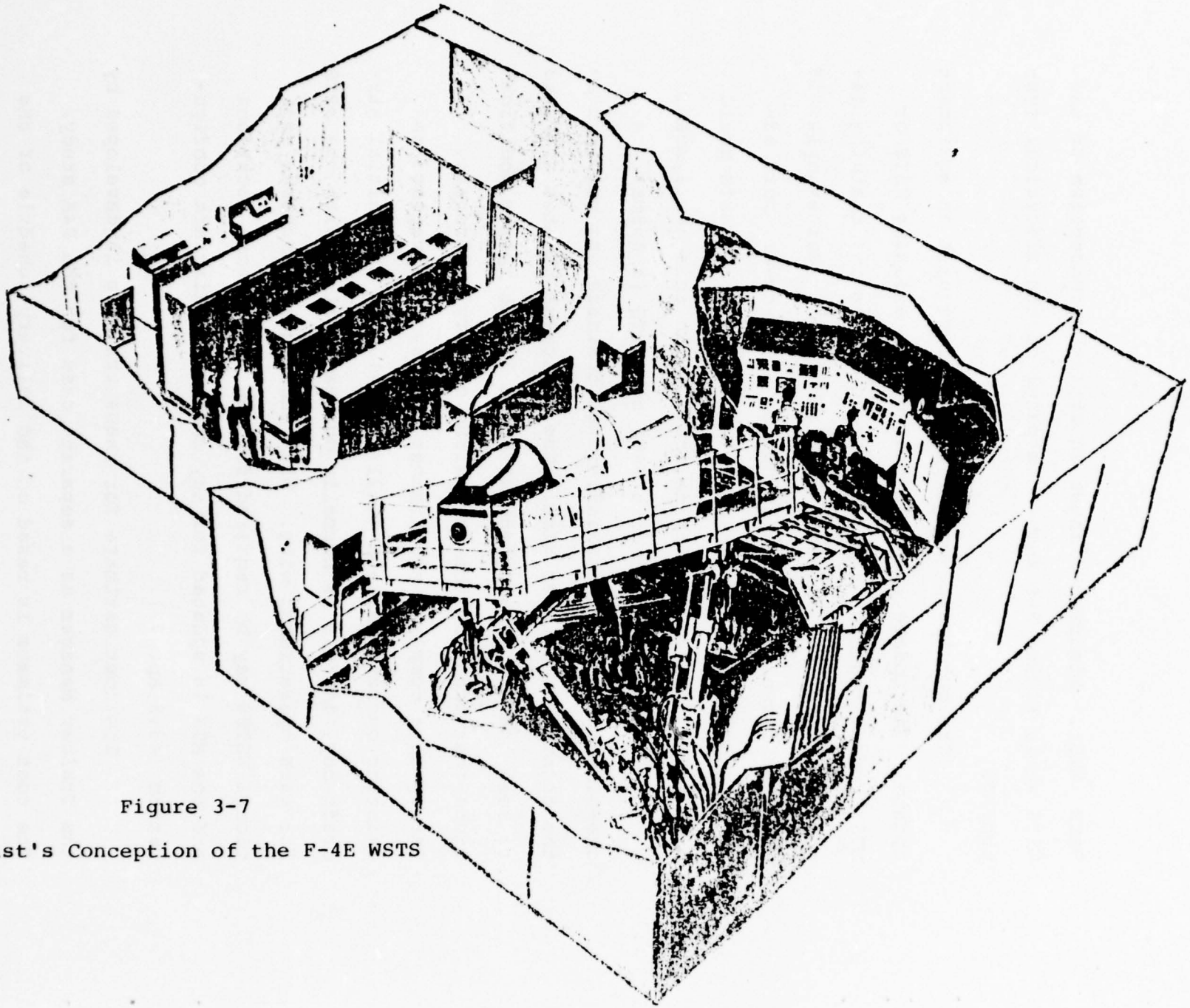

Figure 3-7

Artist's Conception of the F-4E WSTS

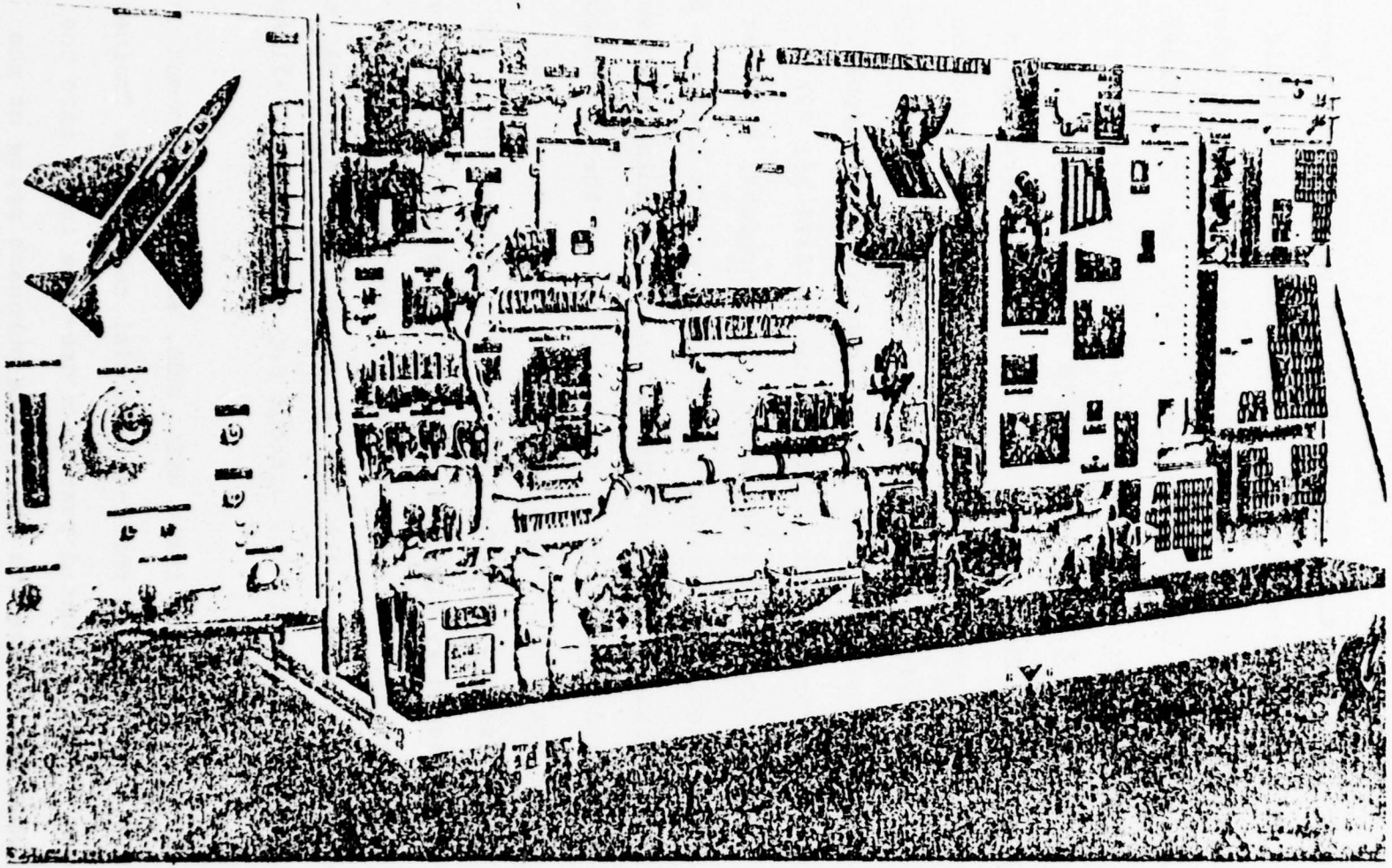

Figure 3-8

F-4E Electrical System MTS

of production lead time, the trainer delivery cycle is normally longer than the 27 month aircraft delivery schedule. Ideally, the trainers should be in place three months prior to the arrival of the first aircraft (6:21 Apr 77). Under a total cost concept, the cost for one WSTS and one MTS is approximately $7.0 million and $12.0 million respectively. These costs include: manufacture, delivery, installation, configuration update to the end of the aircraft production schedule, operations and maintenance technical orders, supporting test equipment, one year of repair parts support, and manpower for one year of maintenance (6:21 Apr 77).

According to Mr. Hefner, Chief Functional Engineer in the Engineering Division, air shipment of the trainers is required because of the separate delivery schedule, shipment integrity, and protection of fragile state-of-the-art components. If the country does not have aircraft capable of providing airlift, then Military Airlift Command (MAC) aircraft are tasked by CSAF and funding is provided during the FMS negotiations. Airlift charges are not included in the P&A study as the funds are held at Air Staff to allow MAC to handle the billing direct, without SPO involvement (6:21 Apr 77).

The cost data for a WSTS, MTS, and any equipment updates are provided to the F-4 financial team by the Trainer Manager. This estimated cost is a one-time input into the data base and represents the future purchase price of the

trainers. No escalation factor is required. The data base is updated as before -- locate the correct sequence number for "Trainers" and update the price (48:8 Apr 77).

Ferry

This component includes the actual delivery of the aircraft to the purchasing country. It also includes the maintenance support required during delivery and the support cost incurred by landing and refueling while in transit. Under different circumstances, an FMS aircraft can be flown to the purchasing country by a USAF Air Delivery Group, by McDonnell Douglas pilots, or by a private aircraft ferrying corporation. Each of these methods involves a different procedure for cost development in the P&A study.

The first method involves the use of the USAF pilots to ferry the aircraft. Under the normal delivery pattern and under normal circumstances, a USAF Air Delivery Group, e.g., the 2nd Air Delivery Group at Langley AFB, Virginia, is tasked by Air Staff to deliver the aircraft. This tasking requires the development of a separate P&A by the Air Delivery Group. Because a separate P&A is involved, no pricing or cost data is given to the financial team and the computer data base is left blank for ferrying charges.

The second method of ferrying involves the use of McDonnell Douglas civilian pilots to deliver the aircraft. This situation typically occurs when it is in the U. S. Government's political interest not to have a USAF pilot at

the controls (48:8 Apr 77). For this type of delivery, the costs are separated into USAF and contractor charges. For example, the cost of the pilots are estimated by McDonnell Douglas. In addition, the cost of McDonnell Douglas ground maintenance support crews located at intermediate stopping points are also estimated by McDonnell Douglas. Typically, the cost for pilots and maintenance crews average $50,000 per aircraft. However, the support costs, e.g., landing and refueling charges, are priced out by the USAF and billing is handled separately from the financial team's P&A. Therefore, only the charges developed by McDonnell Douglas are used to update the computer's data base. These cost estimates are input as a straight quotation from McDonnell Douglas (48:8 Apr 77).

The third way to have an aircraft delivered is for the purchasing country to contract the delivery flight to a private corporation. These organizations are independent ferrying groups of civilian pilots. A representative of the organization contacts the country's representative about the use of the corporation's ferrying services. Normally, these organization's can underprice the contractor or the U. S. Government (48:8 Apr 77). If the purchasing country agrees to this delivery method, then the contract price is obtained from the organization and entered into the computer data base. The development of the landing and refueling charges is handled by the USAF and billing is handled separately by

the designated command. These support costs are not included in the P&A study and do not enter the computer data base.

Travel and Mission Support

This component is comprised of two major elements: travel and mission support. Travel is the temporary duty travel by U. S. civilians and military personnel in support of the FMS transaction. Any travel involved in the sale, e.g., delivery schedules, negotiations, and contract settlements, are included in the estimate. This element also includes any travel required for the airframe, the peculiar support equipment, and the trainer cases. It does not include any travel costs incurred by McDonnell Douglas as the prime contractor.

The travel cost estimate is developed by the Program Manager who forecasts the amount of travel required throughout the life of the FMS case. The lifespan of a travel case may be a few months or a few years. For example, a recently closed Federal Republic of Germany case spanned five years. The travel requirements for this case had to be estimated for this entire time period (48:8 Apr 77).

The cost estimate for travel is a function of the amount of Administrative Charges imposed on the purchasing country by Air Staff. These administrative charges are priced at 2 percent of the Flyaway, and Technical Publica-

tions costs but are not included in the financial team's P&A.[25] If the purchasing country pays the full 2 percent administrative charge, the travel case is established to handle only international (overseas) travel. Any travel within the U. S. is absorbed in the 2 percent figure. Typical charges for international travel range between $100,000 to $150,000 while U. S. travel averages $100,000. For various reasons (mostly political) the normal 2 percent charge may not be fully applied to the FMS transaction (48: 8 Apr 77). The purchasing country may, for example, only be required to pay 1 or 1 1/2 percent administrative charges. When this occurs, the travel case includes both international and CONUS travel in support of the FMS transaction. As stated before, this cost development is the Program Manager's estimate of the amount of travel expenses required throughout the life of the FMS case. This figure is used by the financial team to update the computer data base.

The second major element of this component is mission support. It is a new program and has only recently become a part of FMS (48:8 Apr 77). Mission support costs occur when a country has decided it would like to have its own peculiar subsystem or program. An example is the modi-

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[25]There are many modifications to the 2 percent administrative charge but these are not relevant to this research effort. The only feature necessary for cost estimation by the financial team is what percentage figure was applied by Air Staff.

fication of the weapons release computer system in the APQ-120 radar. The U. S. has an air-to-air computer for missile combat but perhaps an air-to-ground capability is requested by the purchasing country.

At the country's request, the U. S. Government devotes manpower, computer time, services, etc., to manage the program for the country. Included in the estimate are charges for development of the system, engineering, the software requirements, prototype development, feasibility demonstrations, pre-production flight testing, and a cost tracking monitor system. It also includes any computer simulation, report binding, or telephone service, e.g., WATS and autovon lines (48:8 Apr 77). This cost estimate is added to the estimate for travel and computer's data base is updated to reflect the total cost of both elements.

Summary and Conclusions

In this section, the discussion has focused on the cost components that make up the area of Supplemental Costs in the computer data base. These components include technical publications, peculiar support equipment, trainers, ferry, and travel and mission support. Specifically, what these items are, how the cost estimate was developed or established, and how the data base was updated were all discussed for each component.

The one item that continuously appeared in the interviews for this area was that the financial team questions

any estimate that appears excessive. When they challenge an estimate, a cost analysis is performed or a new source of supply is found. These challenges not only include the large dollar items like technical publications, but also the small dollar items like report bindings for mission support. In a recent mission support case, the financial team found a local source to do the report binding at a $9,000 savings for the country. The attitude of the team is that it's worth the trouble to fight the red tape if it benefits the purchasing country.

Chapter 4

RESEARCH QUESTION SUMMARY

Initial research focused on the FMS case environment of the Price and Availability Study, that is, those sequential steps which precede and authorize the study and those steps which follow once it is completed. The P&A coordination process is discussed in chapter two. The components of the P&A study were then investigated. The primary data sources, listed in chapter one, provided the cost components and the P&A coordination process which yield the minimum basis for an F/RF-4 weapon system cost estimate. The F-4 cost estimation methodology was then analyzed. The step-by-step procedure for developing the estimate, the reasons why certain details are included, and what internal actions are taken to insure an accurate cost estimate are all recorded (see Chapter Three).

The first research question concerns whether or not the cost estimation components and instructions used in the F-4 cost estimation algorithm are consistent with the components and instructions listed in AFM 177-112 and AFM 400-3. The purpose of this question was to determine if the F-4 estimation methodology incorporated any additional cost components in their estimate that are not specified in the manuals. These additional cost components narrow the gap

between the estimate and the final price thereby reducing the estimation error and increasing the accuracy.

To answer the first question a critical review of the F-4 computer algorithm procedures (see Chapter 3) was conducted to determine if all cost components are included as specified in AFM 177-112 (see Appendix C) and AFM 400-3 (see Appendix D). Additionally, the basis for deriving the F-4 component cost estimate (see Chapter 3) was compared against the instructions provided in AFM 177-112 and AFM 400-3 (see Appendix E). This comparison was accomplished to determine if any differences existed between what was required to be charged and what actually was charged for each cost component. The addition of any extra costs to the total cost reduces the amount of any error and decreases the possibility of their estimate understating the actual cost.

The authors found that all cost components listed in the AFM 400-3 and AFM 177-112 are included in the F-4 computer algorithm. In addition, the basis for deriving the component cost estimate coincided with the instructions provided by both manuals. However, it was found that the financial team does incorporate additional charges into various cost components.

These additional charges are added to the cost components original estimated value because of economic conditions, missing information, knowledge of supplier estimates,

etc. For example, the estimate for raw materials included under airframe costs is supposed to be developed using the indices provided by ASD 110-C. Since these indices did not keep pace with the inflationary trends during the energy crisis, the financial team used what it considered to be a more accurate index -- the Bureau of Labor Statistics Metal and Metal Products. If they had used the required indices the estimates would have been lower and the cost of raw materials understated.

Other adjustments to estimates occurred in Inter-Company Work Orders (ICWOs). When a real-time quote on a major piece of contractor furnished equipment or subassembly was missing the escalation indices were used. If the team was not satisfied with these calculated prices an additional amount was included as a separate line entry in the data base. For the Iranian case "Peace Roll V," the addition to the estimate was $28,000. In addition, the overhead pools used in the calculation of factory and general and administrative overheads were adjusted based on other weapon system programs at McDonnell Douglas or various legislative action impacting on the contractor. As all of the above components (raw materials, ICWOs, and overhead) are included in the recurring airframe costs, any additional charges are also incorporated into the earnings of the contractor. Earnings are calculated based on a negotiated percentage of all recurring airframe cost components. As such, additional

costs are included in earnings.

Additional charges are also included under Nonrecurring Expenses when the financial team is not satisfied with the estimate provided by the supplier or subcontractor. Other additional charges are incorporated in the estimate because of the team's lack of faith in the historical accuracy of the contractor or the team's own assessment of the system's cost. Further, the additional costs included in the development of total airframe costs are also included in any other calculation or estimate which is determined as a percentage of the total airframe costs. For example, engineering change orders are estimated as 1 to 4 percent of the airframe costs and repair of reparable items are estimated as 1 percent of total airframe costs. Also, extra charges may be included in the negotiated cost of the engines provided to the financial team. This amount is based on the financial team's knowledge of pending P&A studies and evaluation of economic conditions.

By including these additional charges in the P&A cost development, the financial team has basically assured itself that it will not understate the value of the case. The team has not included any additional components, only additional charges. These charges are over and above the estimated value of specific components.

The second research question addresses the strengths and weaknesses of the cost estimate developed during the

price and availability study. The FY 1977 figures (see Appendix G) provided insight into the present level of importance of each cost component when compared against all others included in total Flyaway Costs. For example, if a component's contribution to the final cost estimate had increased over time, then it should be receiving proportionately more attention now than before to insure higher estimation accuracy. If the component's cost was now contributing to 20 percent of the final cost estimate, the authors believed a similar or proportional amount of time should be applied to the estimation of the component's value by the F-4 team. In other words, the more it contributes, the more attention it should receive to insure higher estimation accuracy. The authors also believed a weakness in the estimation methodology would exist when a component contributed, for example, 20 percent to the total estimate but only 5 percent of the total time was used to develop its cost.

Appendix G provides the Flyaway cost components as a percent of the total Flyaway costs for all cases prepared using the computer algorithm. The FY 1977 cases presented in this appendix are still undergoing negotiation with the purchasing country. The time taken by the financial team to develop the estimate for each cost component could not be determined for various reasons.

First, phases 2, 3, 4, and 5 are occurring simultaneously during the estimation process. Therefore, while the

airframe cost components are being estimated, cost data for GFAE and Other Cost components were being received and fed into the data base. Second, the updating of GFAE and CFE minor components is a continuous process throughout the year even if a P&A study is not being accomplished. Third, the financial team is not directly involved with the estimation of several large contributors to total flyaway costs. For example, contractor furnished equipment estimates are provided by McDonnell Douglas, the engine costs are provided by the Propulsion SPO, and GFAE costs are provided by government buyers. Fourth, several cost components are calculated as percentages of other components. For example, McDonnell Douglas earnings are a percentage of total recurring airframe costs and charges for ECOs and repair of reparables are calculated as percentages of total airframe costs. These components are large contributors to total flyaway costs as shown in Appendix G but the estimation time is based on the speed of the calculator once the phase 2 components are completed.

In addition, total cost development time required by the F-4 financial team was compared against the 28 day maximum time criteria (35:A25-1) to identify any time difference which occurred using the F-4 computer algorithm. According to Mr. Kuntz,

> Prior to implementing the computer algorithm, it required two personnel, 28 days to assimilate the information and compute a cost estimate for an FMS case. With the computer algorithm, these same two

individuals only required ten days [13].

There are several reasons why the authors could not verify the absolute accuracy of this statement. First, there are a number of influences on the time required to complete the P&A study once it arrives at the ASD level in the coordination process. One such influence is a configuration change requiring flight and qualification testing by the engineering and management group at Ogden, Utah (see Chapter 2, Part Three). Second, there were no cases established during the research time frame which the authors could review in order to specify the total number of days required to prepare the P&A estimate. Although Appendix G indicates two FY 1977 cases, these could not be considered valid examples. The estimates for these cases were originally prepared on 30 July 1976. The 14 December 1976 P&A estimates, in effect, are only an update of the 1976 estimates and do not truly reflect the actual time involved in preparing a P&A estimate. This update was caused by negotiation difficulties. These difficulties occurred because of continued configuration changes requested by the purchasing country. Whenever these changes cause negotiations to exceed the 90 day time limitation, from the date of final P&A preparation, a new, updated P&A estimate must be prepared.

The above information formed a base for the determination of the strengths or weaknesses in the F-4 cost

estimation methodology. Throughout the course of this research, the interviews with the financial team and members of the Fighter/Attack SPO/F-4, highlighted what the authors believe to be the strengths of the F-4 estimation process. These strengths are discussed below.

First, the experience and professionalism displayed by the team was immediately noticeable to the authors. All financial team members contribute to the development of segments of the final P&A estimate. Each cost component is evaluated and then reevaluated to insure that all costs are covered and all influencing factors are considered. This experience can be attributed not only to the length of time it has been accomplishing P&A studies but also to the internally developed training program. Under the training program, each team member becomes knowledgeable in the estimation procedures of the other members.

The second strength of the estimation process is the use of the computer data base. The data base allows instant modification and continuous updating of cost components. It further allows quick response to country inquiries caused by any changes occurring during negotiations. This is because all the cost information is compiled into a 26 page computer report.

Third, the financial team does not accept estimates from contractors or even negotiated contracts, if in their opinion, economic conditions or the reliability of the con-

tractor is in doubt. The team challenges any cost quote that appears unreasonable and asks for a "not to exceed price" when the contractor objects.

Finally, the team's evaluation of the overhead pools at McDonnell Douglas insures that all influencing factors on the distribution of overhead costs are considered. In addition, the assumptions upon which the overhead pools are based are also investigated.

The only identifiable weakness of the estimation process is not a weakness of the financial team's methodology, but in the opinion of the authors, is a weakness of the entire FMS system. The directives of AFM 400-3 and AFM 177-112 stipulate that the latest costs be used to estimate the component values. To insure an accurate estimate is made, the financial team adjusts the latest available costs as given by the contractors, suppliers, the Propulsion SPO, etc., based on prevailing eonomic conditions and previous experience. The purpose of this adjustment is to insure that every conceivable cost is included in the final estimate. In doing so, the financial team provides an estimate that allows the USAF negotiating officer to begin immediate discussion with the prime contractor. It also insures that the case has not been understated which may cause embarrassment to both the U. S. Government in asking for additional money, and the purchasing country in paying the additional money.

The third and final research question addressed the accuracy of the F-4 cost estimate developed during the Price and Availability Study in comparison with the final price paid. All F-4 FMS cases developed using the computer algorithm were reviewed to determine the final cost estimate of each individual case. This same data source also provided the estimated final price to be paid by the foreign government on a case by case basis.

A comparative analysis of the accuracy of the cost estimate with the estimated final price to be paid was accomplished. The difference between the original P&A and the estimated final price was used to determine the percentage accuracy of the F-4 estimation methodology (see Appendix I). This percentage accuracy was then compared to the standard specified in AFM 400-3. AFM 400-3 specifies that a cost estimate must be within 10 percent of the final price paid (35:5-37). The researchers used these F-4 percentages to determine if the standard was met or exceeded.

The final price for the cases presented in Appendix I cannot be determined because none of the cases, prepared using the computer algorithm, are closed to date. However, a comparison of the original P&A estimate to the 9 May 1977 revised estimated price to be paid by the foreign country was accomplished. The authors believe this comparison does provide some measure of accuracy, although, the estimated final price may be revised again before the cases are

closed.

The accuracy and error percentages are provided in Appendix I. It should be noted that to date these percentages meet the 10 percent standard required by AFM 400-3. This does not imply, however, that accuracy percentages will meet the set standard when the cases are eventually closed.

CONCLUDING OBSERVATIONS

The financial team's method of cost estimation is a "building block" procedure.[26] They start at the very foundation of the aircraft -- the configuration requested and the specification list to derive a complete bill of materials. Next, the labor requirements for each operation are determined and the appropriate labor rates are applied based on the future production schedule. The overhead pools are then analyzed to insure completeness and accuracy. In addition, the logic and assumptions that are the basis for the pools are studied. For the financial team that estimates the cost of the F/RF-4, this procedure is the only way to insure accuracy. They have little use for algorithms or fancy mathematical models; they use statistics as little as possible; and, they challenge the assumptions, quoted prices, and estimates when they appear out of line with their own calculations.

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[26]This technique closely approximates the "grass-roots" approach to cost estimation.

It can be categorized as experience. Not only the procedural expertise that is required to estimate a weapon system, but the knowledge of the aircraft itself, the contractor, the purchasing country, the prevailing and anticipated economic conditions, etc. In estimating the cost of raw materials, the very first airframe component in the estimation process, the financial team had to be aware of the economic conditions and the effect of the energy crisis on raw material costs. In doing so, they rejected their basic escalation indices because they had not kept pace with inflation. Instead of lagging behind the price increases, the financial team remained abreast of them and prevented the possibility of underestimating the FMS cases. It was noted early in the discussion in chapter one, that underestimating is worse than overestimating because the purchasing country must pay these additional charges and it may not have the funds readily available.

The estimation of the airframe's direct labor charges represent a series of calculations that are based upon previous FMS cases with similar configurations. The financial team relies on the historical data from the MCAIR Report 7290 and the labor rates published in the Overhead Bid Plan for the majority of the labor data. However, the learning curve adjustment requires the experience of the financial team to estimate the additional labor hours that are required.

The calculation of the overhead that is included in the airframe cost is perhaps the most nebulous of all estimates. The financial team questions everything about the overhead charges. They investigate what is incorporated into the overhead pools; the concurrent production base for the other McDonnell Douglas weapon systems; the assumptions used by the contractor to establish the overhead pool values; and any local, state, and federal legislation that impacts on the overhead base. This type of analysis is necessary because the last recurring expense item in the airframe cost is the contractor's earnings. These earnings are calculated at a negotiated percentage of all the recurring airframe costs. Therefore, an underestimate in direct labor or factory overhead also underestimates general and administrative overhead, earnings, and the entire FMS case value. Likewise, an overestimate of either direct labor or factory overhead compounds the error into general and administrative overhead, earnings, and the total case value, needlessly tying up the purchasing country's funds.

The estimation of the nonrecurring expenses from a configuration change is also subject to the discretion and experience of the financial team. The Engineering Division is consulted on whether the estimate from the contractor is realistic in price and if the contractor is capable of meeting the production schedule. If the price is unrealistic or a break in the production schedule is anticipated, the esti-

mate is adjusted accordingly. In addition, adjustments are made based on the previous history of the contractor or supplier in meeting his original estimate. A supplier that is historically 20 percent low will have his estimate adjusted upward.

In establishing a future cost for government furnished and contractor furnished equipment, the financial team relies on the experience of the government buyers and the prime contractor. To minimize the use of the escalation indices for these items, the financial team obtains an estimate for all equipment valued at more than $5,000. This price classification insures that 70 percent of the aircraft's total equipment dollar value is established. The remaining 30 percent are updated with escalation indices. In their use of these escalation factors, the financial team relies on their data base file, its accuracy, and its updating process.

In addition, they make every attempt to supply maximum government furnished equipment to meet the configuration requested by the purchasing country. Their reasoning is that for each piece of equipment provided by the contractor, an appropriate charge is made to cover the handling, ordering, etc. Therefore, by insuring that maximum government furnished equipment is provided, the purchasing country's costs are minimized. Even the engine prices, supplied under government contract, are questioned. At this

point the financial team is taking upon itself, the full responsibility in disagreeing with a previously negotiated contract price. They may change the price up or down depending upon economic conditions or knowledge of other F/RF-4 FMS cases being developed.

The charges for technical publications are also examined by the financial team. From past experience and various aircraft configurations, they have established an acceptable range for a publications cost estimate. A price that appears excessive is challenged and the AFPRO is asked to perform a cost analysis to verify or refute the contractor's estimate. Also, small mission support items are questioned just as much as the high valued items. If it appears unreasonable or does not conform to previous cases, the estimate is challenged and a new source of supply is found.

In addition to these managerial practices, the financial team also adds additional funds to the inter-company work order area of the data base. This action occurs when there are major contractor furnished equipment quotes missing and the team is not satisfied with the estimate provided by the escalation factor. The estimate is not considered to be real-time and occurs at a time when there is a decrease in F-4 production. This is not a substantial amount. For example, the Iran "Peace Roll V" FMS case of five RF-4Es had $28,000 added to cover possible errors on major subcontracted assemblies where a real-time quote was

missing. It is a judgment decision based upon the experience of the team.

As explained in one of the many interviews, the purpose of all the additional evaluations, the challenges of cost estimates, the adjustments, etc., is to provide flexibility. When all the above adjustments and corrections are coupled with the 4 percent allotment for engineering change orders, the financial team believes they have developed a negotiable case. As stated by Mr. Will, the leader of the team,

> Remember, a good P&A is plus 5 percent. That's how you define a good P&A. It means that you've got enough money to manage the case. If it's right on the button, you've had to get more money to handle your budget proposal before negotiation. So you're temporarily overrun on that case. . . . It's better to put enough money in to manage the case without going back at anytime for more money. So the best P&A is a plus 5 percent [48:10 May 77].

RECOMMENDED FUTURE STUDIES

During the interviews with the personnel from the Fighter/Attack SPO/F-4, many subjects for future study were mentioned and discussed. These areas are listed below:

1. Each of the major cost categories -- Airframe Costs, GFAE Costs, Other Costs, and Supplemental Costs -- should be investigated in more depth. Many influencing factors can and do occur that affect each of these areas. A few of these influencing factors were discussed under each category in chapter three.

2. The construction of the overhead estimates should be a separate area for future study. Overhead is undoubtedly a pure subjective evaluation by the cost estimators. The Overhead Bid Plan used by the financial team was only a starting point. This single component contributes approximately 30 percent of the F-4's flyaway cost and that fact alone warrants the additional study.

3. Further study is also recommended on the recently implemented Cost Tracking Program for GFAE items. The usefulness of this report to provide up-to-date cost data for incorporation into P&A studies should be determined.

4. The development of the Mission Support estimate under Supplemental Costs should be investigated to identify potential problem areas in the recovery of all costs. With the nations of the world desiring a more active part in the development of their weapon systems, this area will see increased usage.

5. Additional studies should be made into the cost estimation procedures used on other weapon systems. This study focused only on the F-4 aircraft and the strengths and weaknesses within its procedures. When the best points from a variety of estimation procedures are consolidated, a more viable and realistic approach may be possible for all weapon systems.

6. Finally, a research effort should be structured around the feasibility of a centralized Price and Availabil-

ity Directorate within the Aeronautical Systems Division. The experience of the personnel involved in cost estimation is fragmented among the existing weapon systems. A consolidated effort would develop a team expertise in the areas of raw materials, overhead application, and production costs, among others. There are simply too many factors that influence the accuracy of a cost estimate for one man or a small group to master.

APPENDIXES

APPENDIX A

GLOSSARY OF TERMS

Aerospace Ground Equipment (AGE): All equipment required on the ground to make a weapon system, command and control system, support system, advanced objective, subsystem, or end item of equipment operational in its intended environment. This includes all equipment required to install, launch, arrest, guide, control, direct, inspect, test, adjust, calibrate, appraise, gauge, measure, assemble, disassemble, handle, transport, safeguard, store, actuate, service, repair, overhaul, maintain, or operate the system, subsystem, end item, or component. This definition applies regardless of the method of development, funding, or procurement. AGE is functionally sub-classified only as operating ground equipment (OGE) and maintenance ground equipment (MGE). AGE is that AGE which is a functional part of a system and which operates with the aerospace vehicle or end item as an essential operating element thereof. MGE is that AGE required to restore a system or end item to operating condition.

Commodity Group: A grouping or range of items which possess similar characteristics, have similar applications, or are susceptible to similar supply management methods.

Contractor Furnished Equipment: Standard items of hardware, electrical equipment, and other standard production or commercial items furnished by a prime contractor as part of a larger assembly.

Country Representatives: A person or persons duly authorized by a foreign government to act on behalf of that government, to negotiate, commit, sign contractual agreements, and accept delivery of materiel.

Foreign Military Sales: The selling of US-produced military equipment and services to friendly foreign governments and international organizations under the authority of the Foreign Military Sales Act of 1968.

Government-Furnished Aeronautical Equipment (GFAE): Those equipments which have been selected and are to be furnished by the US Government to a contractor or a US Government activity for installation in, or use with, or in support of the aeronautical system during production, conversion or modification.

Price and Availability Study: An action normally involving end items of equipment, selected spares, and services for which estimated price and availability data are re-

quired for the preparation of a letter of offer by the USAF to be tendered to the customer country.

Production Lead Time: The time interval between the placement of a contract and receipt into the supply system of material purchased. Two entries are provided: a. initial--the time interval if the item is not under production as of the date of contract placement. b. reorder --the time interval if the item is under production as of the date of contract placement.

US DOD Offer and Acceptance (DD Form 1513): A contractual instrument specifying the defense article or services being sold, the estimated price and delivery, and giving the conditions of sale for an FMS case which the foreign government accepts before action is taken by the Air Force to provide requested materiel or services. Additional Terms and Conditions are incorporated by attachment when appropriate.

Weapon System: A weapon and those components required for its operation. It is a composite of equipments, skills and techniques that form an instrument of combat which, usually, but not necessarily, has an aerospace vehicle as its major operational element. The complete weapon system includes all related facilities, equipment, materiel, services, and personnel required solely for the operation of the aerospace vehicle, or other major elements of the system, so that the instrument of combat becomes a self-sufficient unit of striking power in its intended operational environment.

APPENDIX B

ACRONYMS

ACF - Accounting and Finance Division

AERNO - Aerospace Equipment Reference Number

AFAD - Air Force Acquisition Document

AFAFC - Air Force Accounting and Finance Center

AFLC - Air Force Logistics Command

AFPRO - Air Force Plant Representative Office

AFSC - Air Force Systems Command

AGE - Aerospace Ground Equipment

ALC - Air Logistics Center

ALD - Acquisition Logistics Division

ANZUS - Australia, New Zealand, and the United States

ASD - Aeronautical Systems Division

ASO - Navy Aviation Supply Office

ASW - Deputy for Subsystem and Equipment Management

ATC - Air Training Command

AUTOVON - Auto Voice Network

BUYAC - Buying Activity

CFE - Contractor Furnished Equipment

CONUS - Continental United States

CSAF - Chief of Staff Air Force

DAO - Defense Attache's Office

DCASO - Defense Contract Administration Services Office

DCS/S&L - Directorate of Military Assistance and Sales

DOD - Department of Defense

DSA - Defense Supply Agency

DSAA - Defense Security Assistance Agency

ECO - Engineering Change Orders

FAA - Foreign Assistance Act

FDT - Factored First Destination Transportation

FMS - Foreign Military Sales

FMSA - Foreign Military Sales Act

GFAE - Government Furnished Aeronautical Equipment

GFEL - Government Furnished Equipment List

GFM - Government Furnished Materiel

GFP - Latest Loose Equipment

HQ USAF - Headquarters United States Air Force

ICWO - Inter-Company Work Order

JCS - Joint Chiefs of Staff

LGF - Director of Military Assistance and Sales

LOA - Letter of Offer and Acceptance

LT - Lead Time

MAAG - Military Assistance Advisory Group

MAC - Military Airlift Command

MFG - Manufacturer

MPC - Material Program Code

MTO - McDonnell Technical Order

MTS - Mobile Trainer Set

NATO - North Atlantic Treaty Organization

NSN - National Stock Numbers

OCALC - Oklahoma City Air Logistics Center

OOALC - Ogden Air Logistics Center

OPEC - Organization of Petroleum Exporting Countries

P&A - Price and Availability

P&B - Price and Budget Estimate

PH&C - Packaging, Handling, and Crating

POL - Petroleum, Oil, Lubricant

R&D - Research and Development

RDT&E - Research, Development, Training, and Engineering

SAALC - San Antonio Air Logistics Center

SD - Systems Directorate

SEATO - South East Asia Treaty Organization

SLAR - Side Looking Airborne Radar

SPO - Systems Program Office

TAC - Tactical Air Command

UPP - Units Per Plane

USG - United States Government

WATS - Wide Area Telecommunications

WSTS - Weapon System Trainer Set

APPENDIX C

FMS FLYAWAY COST STATEMENT EXTRACTED FROM AFM 177-112

The flyaway cost statement shown below is prepared by the Systems Program Office (SPO) at the Aeronautical Systems Division (ASD) for accounting and reporting for FMS flyaway production aircraft. The total price of the first aircraft for each case is the basis for completing this flyaway cost statement. If price adjustments are required, a revised report must be accomplished by the SPO. This cost statement is used for billing foreign customers (36:8-1--8-30).

I. Flyaway Production Aircraft Case No.: _____

A. Flyaway Costs. Acft Serial No.: _____:
1. Latest available airframe and Contractor-Furnished Equipment (CFE) cost data (include engineering change orders and technical data).
2. Latest available Government-Furnished Aeronautical Equipment (GFAE) cost data (contractor-shipped).
3. Latest available GFAE cost data shipped from Air Materiel Areas (now Air Logistic Centers).
4. Factored First Destination Transportation (FDT) cost (based upon value of line item A2 plus B1a "and A6").
5. Three percent factored second destination transportation cost of value of line items A3, A6, and B1b.
6. Costs for government furnished items procured from Defense Supply Agency (DSA/Army/Navy/other sources). (Furnished directly to the airframe contractor for inclusion in aircraft).
   a. Contractor Shipments
   b. Stock Shipments

B. Other Costs (To Be Added to Flyaway Package):
1. Latest loose equipment cost data.
   a. Contractor-shipped.
   b. Shipped from Air Materiel Area.
2. Petroleum, oil, lubricant (POL) cost (flight testing and, if applicable, training).

a. POL
b. 3 percent or 3 1/2 percent accessorial charge

3. Packaging, handling and crating (PH&C) costs (3 1/2 percent) of value of lines A3, A6, and B1b.
4. Quality control and inspection costs (AFSC Form 72) if applicable.
5. Ground and flight risk insurance, if applicable.
6. Miscellaneous

Total Costs

APPENDIX D

FMS FLYAWAY COST STATEMENT
EXTRACTED FROM AFM 400-3

The flyaway cost statement shown below is prepared by the Systems Program Office (SPO) at the Aeronautical Systems Division (ASD) for accounting and reporting for FMS flyaway production aircraft. This statement is then forwarded to the Air Force Accounting and Finance Center (AFAFC) to reflect the total price of the first aircraft for the FMS case involved. If price adjustments are required, a revised report must be accomplished by the SPO and forwarded to AFAFC. This revised cost statement will then be used for billing foreign customers (36:8-1--8-12).

I. Flyaway Costs:

- A. Latest airframe and contractor-furnished equipment (CFE) cost data (including engineering change orders and technical data).
- B. Latest government-furnished aeronautical equipment (GFAE) cost data (contractor shipped).
- C. Latest GFAE cost data (shipped from Air Materiel Areas) (now Air Logistic Centers).
- D. Factored first destination transportation (FDT) cost based on line item B above.
- E. Factored second destination (3 percent transportation cost of value of line item C above).
- F. Pro rata share of nonrecurring research and development (R&D) cost, where appropriate.

II. Other costs (to be added to flyaway cost):

- A. Latest loose equipment cost data (DD Form 780, Aircraft Inventory Record).
- B. Factored petroleum, oil, lubricants (POL) cost (per flight and flyaway).
- C. POL accessorial charges -- 3 1/2 percent.
- D. Packaging, handling, and crating (PH&C) cost -- 3 1/2 percent of IC and IIA above, shipped from Air Materiel Areas.

APPENDIX E

AFM 177-112 INSTRUCTIONS FOR PREPARING FLYAWAY COST STATEMENTS

This instruction sheet is to be used as a guide by the Systems Program Office (SPO) in developing cost data for the "Cost Statement." Subsequent paragraphs are keyed to the "Cost Statement."

I. FLYAWAY PRODUCTION AIRCRAFT CASES:

A. Flyaway Costs:

1. Latest available airframe and contractor-furnished equipment (CFE) (include engineering change orders (ECOs) and technical data). The SPO will use of [sic] the latest available contractual information to develop cost data for the airframe and related CFE. The ECO and technical data costs will also be included on this line.

2. Latest available Government-furnished aeronautical equipment (GFAE) cost data (contractor-shipped). The Deputy for Subsystem and Equipment Management (ASW) will use the DD Form 610, "DOD Government Furnished Aircraft Equipment Requirement Schedule," and contractual sources to develop the latest GFAE cost data for contractor-shipped items. (Government-furnished Materiel (GFM) items procured from DSA/Army/Navy, etc., and furnished to the contractor for inclusion in GFAE will also be included.)

3. Latest available GFAE cost data (for GFAE materiel shipped from Air Materiel Areas). The Deputy for Subsystem and Equipment Management (ASW) will employ the DD

Form 610, and contractual sources/supply catalogs to develop latest GFAE cost data for materiel shipped from AFLC Air Materiel Areas. (See AFM 400-3, para 5-19, for further information on pricing materiel issued from stock.) AFLC participation in pricing inventory-shipped items should be solicited.

4. Factored first destination transportation (FDT) cost (based upon value of line item A2 plus B1a). The SPO will compute the FDT cost by using the predetermined factor currently in effect.

5. Three percent factored second destination transportation cost of value of line item A3, A6, and B1b.

6. Costs for GFM/GFAE items procured from DSA/Army/Navy/other sources. (Furnished directly to the airframe contractor for inclusion in aircraft.) The Accounting and Finance Division (ACF) will furnish these costs to the SPO. For factoring purposes assume all items shipped as second destination transportation. NOTE: Caution must be exercised in developing cost data for this line item, which is for GFM furnished directly to the airframe manufacturer, as opposed to the line item "2" which includes GFM furnished to a GFAE manufacturer.

B. Other Costs (To Be Added to Flyaway Package):

1. Latest loose equipment (GFP) cost data. The SPO will use the DD Form 780, "Aircraft Inventory Record," to identify the loose equipment included in the flyaway pack-

age. Loose equipment normally includes items that are identified as procurement category "4" (AFR 70-9/AFSC Sup 1, System Procurement). GFAE included in "flyaway costs" line items A1/A3, or as CFE, will not be repeated as a cost element on this line.

2. Petroleum, oil, lubricants (POL) costs, (flight testing, flyaway, and if applicable, training). Statement of POL costs incurred for flight testing, flyaway, and, if applicable, training, will be prepared by the Air Force property administrator at the AFPRO/DCASO (see AFM 67-1 volume I, part three, chapter I, section A, para 6f). POL consumed during training period will be accrued to each aircraft by the manufacturer and included in above statement, unless the agreement between the US Air Force and/or contractor, and foreign country provides that refuels to these aircraft will be handled on a transit basis, or as private transactions between the contractor and the foreign country. For those cases where aircraft are handled on a transitory basis, reimbursement to POL stock fund will be effected by San Antonio Air Logistics Center (SAALC). After delivery of the last aircraft for a particular FMS case, a POL cost statement for all POL delivered, for all aircraft on the case, will be prepared by the property administrator. This statement will also include a pro rata of operational losses, for example, evaporation and spillage. The final cost statement prepared by the SPO will take into consider-

ation, and include, the adjusted net POL figure. For example: $2,000 is charged for POL issues against each of four aircraft for a total of $8,000. The POL cost statement for all POL delivered against the FMS case reflects a total of $11,000. The final cost statement will show the $3,000 difference. The accessorial charge of 3% for Canada, or 3 1/2% for all other countries, will be computed by the SPO.

3. Packing, handling, and crating (PH&C) costs (3 1/2% of value of line A3, A6, and B1b). The SPO will compute 3 1/2% of the total value of lines A3, A6, and B1b.

4. Quality Control and inspection cost [Air Force Form(s) 204], if applicable. The SPO will extract the cost information from the AFSC Form 72, "Statement of Inspection Cost and Certificate of Inspection." AFAFC will send the Standard Form 1080, "Voucher for Transfers Between Appropriations and/Funds (Disbursement)," and check for these costs to AFSC. (Canada is exempt from the assessment of such costs, in accordance with the reciprocal inspection service agreement with the United States.)

5. Ground and flight risk insurance (if applicable). The SPO will pro rate this cost element by the number of aircraft being procured; for example, four aircraft on order, divided into insurance premium of $10,000, equals $2,500 per report.

6. Miscellaneous. This cost element is used by the SPO to identify costs not a part of the above elements. In-

clude pro rata share of nonrecurring costs (RDT&E only) for major programs. The case directive will reflect the total amount established for specific cases through offer/acceptance action by higher headquarters. This line item is limited to RDT&E because nonrecurring production costs are normally included in flyaway costs.[27]

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[27]These instructions are consistent with those provided in AFM 400-3.

APPENDIX F

F-4 FMS FLYAWAY COST STATEMENT

The flyaway cost statement shown below is the F-4 financial management team's adaptation of those cost statements presented as guidelines in AFM 177-112 and AFM 400-3. This cost statement is used as a basis for the computer algorithm used by this office for preparing a cost estimate for FMS cases. This statement is routed in the manner specified by AFM 177-112 and AFM 400-3.

I. FLYAWAY COSTS

A. Airframe Costs
Raw Materials
Contractor Furnished Equipment
Nonrecurring Expenses
Subcontract
Inter-company Work Orders
Direct Labor
Overhead-factory
General & Administrative & Others
Earnings

Air frame Total

B. GFAE Costs
Engine
Other GFAE

GFAE Total

C. Other Costs
Engineering Change Orders
Repair of Reparables
Pro Rata Research & Development
Accessorial Charges
Asset Use Charges
Production Shutdown Delta

Other Total

II. SUPPLEMENTAL COSTS

A. Technical Publications
B. Peculiar Age
C. Trainers
D. Ferry
E. Travel

Supplemental Total

TOTAL COSTS

APPENDIX G

STATISTICAL ANALYSIS ON F-4 FMS CASES

The FMS cases presented in this appendix are provided to support research question two. The components of flyaway cost are shown as percentages of the total flyaway cost. These data were provided by the financial team. The two cases for which the P&A was developed in FY 77 (TKSBA and TKSBB, TKSCB) are still being negotiated with the country.

	ISSFA 48 F-4E FY 73	IRSLA 12 RF-4E FY 74
AIRFRAME COSTS:		
Raw Materials	.0330	.0220
CFE	.1026	.1280
Nonrecurring Expenses	.0018	.2150
Subcontract	.0904	.0566
Direct Labor	.0897	.0689
Overhead-Factory	.1757	.1227
General & Administrative & Other	.0668	.0464
Earnings	.0703	.0912
Inter-Company Work Orders	.0131	.0054
Airframe Total	.6434	.7562
GFAE COSTS:		
Engine	.1757	.0975
Other	.1238	.1035
OTHER COSTS:		
ECOs	.0293	.0251
Repair of Reparables	.0047	.0063
Pro Rata R&D	.0149	.0076
Accessorial	.0082	.0038
Flyaway Total	4,269,623	7,969,667

	ISSFS 6 RF-4E FY 75	IRSPA 36 F-4E FY 75
AIRFRAME COSTS:		
Raw Materials	.0224	.0352
CFE	.0584	.1298
Nonrecurring Expenses	.0846	.0220
Subcontract	.0591	.0901
Direct Labor	.0718	.0645
Overhead-Factory	.1376	.1394
General & Administrative & Other	.0484	.0607
Earnings	.0891	.1005
Inter-Company Work Orders	.0071	.0163
Airframe Total	.5785	.6585
GFAE COSTS:		
Engine	.0871	.1632
Other	.2979	.1174
OTHER COSTS:		
ECOs	.0208	.0357
Repair of Reparables	.0040	.0070
Pro Rata R&D	.0075	.0118
Accessorial	.0042	.0064
Flyaway Total	8,156,000	7,831,043

	KSSBF 19 F-4E FY 76	GYSBD 10 F-4E FY 76
AIRFRAME COSTS:		
Raw Materials	.0466	.0454
CFE	.1603	.1105
Nonrecurring Expenses	.0046	-0-
Subcontract	.1063	.1010
Direct Labor	.0679	.0216
Overhead-Factory	.1313	.0854
General & Administrative & Other	.0539	.1430
Earnings	.1242	.0633
Inter-Company Work Orders	.0228	.1040
Airframe Total	.7179	.6742
GFAE COSTS:		
Engine	.1615	.1423
Other	.0692	.1347
OTHER COSTS:		
ECOs	.0287	.0263
Repair of Reparables	.0072	.0108
Pro Rata R&D	.0099	None
Accessorial	.0055	.0051
Flyaway Total	6,500,000	5,939,000

	TKSBA 32 F-4E FY 77	TKSBB TKSCB 8 RF-4E FY 77
AIRFRAME COSTS		
Raw Materials	.0431	.0365
CFE	.1439	.0991
Nonrecurring Expenses	.0243	.0040
Subcontract	.1008	.0817
Direct Labor	.0677	.0668
Overhead-Factory	.1309	.1280
General & Administrative & Other	.0556	.0604
Earnings	.1071	.1432
Inter-Company Work Orders	.0259	.0223
Airframe Total	.6989	.6422
GFAE COSTS:		
Engine	.1657	.1415
Other	.0934	.1646
OTHER COSTS:		
ECOs	.0140	.0257
Repair of Reparables	.0070	.0064
Pro Rata R&D	.0091	.0096
Accessorial	.0119	.0101
Flyaway Total	6,999,760	8,200,510

APPENDIX H

THE F-4 COMPUTER DATA BASE

The F-4 financial team uses a computer data base to store data required for their cost estimates.[28] The data base is operated as a real-time system where it is updated on a continuous basis as new cost information is received. This real-time system permits immediate access to current cost data for more realistic cost estimates. The primary data file is stored on disc packs with a backup data file stored on magnetic tape. The backup file is periodically updated with each major revision of cost data (21).

The data file is a composite list of all components used on the F-4. The file was assembled from McDonnell Douglas component listings and bill of materials. Over a period of three months, the components were consolidated where necessary and entered into the data file. The end result was a computer listing that enabled the financial team to have in one location all the information needed to start their cost estimation procedures. Figure H-1 is a portion of one page of the twenty-six page report. Listed below is an explanatory description of each of the column headings shown in Figure H-1.

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[28]The information reported in this section was obtained primarily from a personal interview with Sharon K. Minick, Financial Specialist at the Fighter/Attack SPO/F-4.

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SEQ #	IDENTIFIER	PRICE CODE	UNIT COST	UPP	PLANE COST	TOTAL COST	MFG	BUYAC	MPC	LT	DESCRIPTION
04395	22204606385	97231	1,029	01	1,029	5,145	L-S	OCALC	9011	71	CN-1050ASN-55 GYRO RATE SWI
04400	22205606329	97231	4,878	01	4,878	24,390	L-S	OCALC	9011	71	ADK-182A/A-24-G 1A ADAP COMP
04405	22206606358	97231	5,485	01	5,485	27,425	L-S	OCALC	9011	71	ARU-11/A INDIC ATTITUDE
04410	22207606381	97231	1,557	01	1,557	7,785	L-S	OCALC	9011	71	T-970/AJB-7 TRANS RATE GYRO
04415	22300606436	97231	4,855	01	4,855	24,275	L-S	OCALC	9011	71	GYRO DISPLAC ROLL&PITCH
04416	22401017001	97231	21,000	01	21,000	105,000		ASO	9315	90	AMP ASSY CONTROL C6563A-ASA-32
04417	22402017002	97231	5,000	01	5,000	25,000		ASO	9315	71	ACCELEROMETER LATERAL
04418	22403017003	97231	2,200	01	2,200	11,000		ASO	9315	71	GYROSCOPE ROLL RATE
04419	22404017004	97231	2,200	01	2,200	11,000		ASO	9315	71	GYROSCOPE YAW RATE
04420	22405017005	97231	2,200	01	2,200	11,000	GE	ASO	9315	90	GYROSCOPE PITCH RATE

Figure H-1

Sample of F-4 Computer Data Base Listing

Sequence Number

This is a five digit coding key used as a computer address to locate a specific line item in the computer data file. For example:

00000-03999: identifies "Airframe" and "GFAE" cost components for the F-4.

04000-08441: identifies "Airframe" and "GFAE" cost components for the RF-4.

90000-93999: identifies "Other" and "Supplemental" cost components for the F-4.

94000-99999: identifies "Other" and "Supplemental" cost components for the RF-4.

The separation of the components into specific groupings permits cost data calculation without having to sort the different components for each model. Those components that are common to both models are duplicated in the listing. For example, titanium bolts used on both aircraft are listed as #04003 for the RF-4 and #00003 for the F-4. A specific range of sequence numbers, e.g., 04000-08441, contains all the airframe and GFAE cost components required for that aircraft model. However, many low cost items are consolidated and not all numbers are used within that range. For example, Raw Materials contains approximately 6,000 line items that are consolidated in the report into major groups, i.e., nuts, bolts, grommets, regulators, pins, screws, etc. One of these major groups contains 150 components and only amounts to $10. By grouping these small dollar value components, computer processing time and core storage space are

minimized and the tremendous job of updating the unit cost of these items is greatly simplified (21).

Identifier

This code can be either the McDonnell Douglas part number assigned to that specific piece of Contractor Furnished Equipment (CFE) or a combination of a Government Furnished Equipment List (GFEL) number and an Aerospace Equipment Reference Number (AERNO). The GFEL was the identification code number assigned by the U. S. Navy while they had responsibility for the weapon system. The AERNO is a numerical reference code for a specific GFAE item. The AERNO is assigned by the Directorate of the Program Control, Plans and Documentation Office (ASD/AECP) and serves as a management control code for items which are related to denote their interchangeability as to form, fit, and function regardless of manufacturer (31:2). For example, sequence number 04415 (see Figure H-1) has an identifier code of "22300606436." The GFEL is the first five digits, i.e., "22300" and the AERNO is the remaining six digits or "606436." The AERNO can be cross-referenced in the Government Furnished Aerospace Equipment Book for a complete description of the item to include nomenclature, unit cost, vendor, part number, national stock number (NSN), etc. An example of an item identified by AERNO is shown in Figure H-2.

REPORT NR C01
SECTION 7 OF 7
REPORT PAGE NR 8 181

SECTION PAGE NR 181
RUN DATE 27JUL76
AS OF DATE 30JUN76

ITEM IDENTIFICATION
BY AERNO

SYMB PROJ MGR

AERNO	EP ST	ALC	C/P	NOMENCLATURE
60-6436	BB	OCALC	C	GYROSCOPE ASSEMBLY DISPLACEMENT, TYPE MS-3392-4, SPEC MIL-G-01620(AS), DWG MS-3992(AS) --- *REPLACES AERNO 60-5937 ON RF-4 A/C*

SUB-SYSTEM NR SUB-SYSTEM TITLE

UNIT COST	QPL	STOCK FUND
$3,552	NO	NO

NSN	TYPE NUMBER	PART NUMBER	DWG NR	VENDOR	NSN COMMENTS
6615-00-160-0295-	MS3392-4	152017-01-01	MS3392	LEAR SG	

WEAPON SYSTEM USAGE

MDS	AGENCY ID	NY 73	74	75	76	77	WEAPON SYSTEM COMMENTS	W/S CONT. NAME	W/S CO
RF 4E	FMS IR-SLA		1					MCDON ST LO MO	EY9108
RF 4E	FMS IS-SFS			1				MCDON ST LO MO	EY9108

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Figure H-2

Item Identification by AERNO

Price Code

This is a five digit code used to identify the component item by major cost categories and currency of cost data. For example, using sequence number 04415 in Figure H-1, the first digit of the price code is a "9" and identifies the gyroscope as a GFAE cost component. All other components with a "9" leading digit are grouped as GFAE components. The major category codes for this leading digit are:

0 - Raw Materials
1 - CFE
2 - Nonrecurring Expenses
3 - Subcontractor
4 - Inter-Company Work Orders
5 - Direct Labor
6 - Factory Overhead
7 - General and Administrative Expense
8 - Earnings
9 - GFAE

The second digit of the gyroscope's price code identifies the calendar year when its price was last updated. The "7" indicates that the gyroscope's price was updated during 1977. The third digit identifies the country code used in this instance as Iran. The fourth digit of the price code identifies the aircraft model being purchased. A "1" identifies the F-4, a "2" identifies the RF-4 and, in this example, the "3" is a special code used to identify a modified version of the RF-4E peculiar to Iran. The fifth and last digit of the gyroscope's price code identifies the number of major price revisions made on the item. The "1" identifies the gyroscope as having under gone one major revision during 1977. A major revision may involve a substantial change in

the overhead plan where the entire data base must be updated. At the beginning of each new year, this field is reset to "1".

Unit Cost

This field represents the purchase price of one component. Continuing with the gyroscope example, it has a unit cost of $4,855. This cost figure is based on the latest procurement cost of the item as established by its delivery schedule and cost projections of the gyroscope's buyer or the contractor.

Units Per Plane (UPP)

This figure represents the quantity of each component used in one aircraft. For example, only one gyroscope is required on the RF-4. Items that are consolidated have a UPP of "01". If the country does not want a particular option, the UPP is coded "00" to prevent its cost accumulation.

Plane Cost

This cost figure is calculated by the program for each component as: Unit Cost x UPP = Plane Cost. The resulting figure is the total cost of that component in one aircraft.

Total Cost

This cost figure is calculated for each component

based on the number of aircraft to be purchased. This particular FMS transaction was for five RF-4Es. Therefore, the total individual component cost is calculated as:

Plane Cost x 5 = Total Cost

The gyroscope has a total cost of $24,275 for this transaction ($4,855 x 5 ea. = $24,275).

Manufacturer (MFG)

This code identifies the company responsible for the component's manufacture. "L-S" identifies Lear-Sigler as the manufacturer of the gyroscope.

Buying Activity (BUYAC)

The BUYAC code identifies the government agency responsible for buying the component. The gyroscope will be procured through the Oklahoma City Air Logistics Center (OCALC).

Materiel Program Code (MPC)

This four digit code identifies where the item is being procured. The gyroscope has an MPC of "9011". The "9" represents the avionics group and the "011" identifies that procurement action is through the OCALC.

Lead Time (LT)

This code was originally used to identify the lead time required. It is now being used to identify the source of component's cost development. The "71" for the gyroscope

identifies the cost figure as being computed through the use of a price index. In other words, a real-time price was not obtained from OCALC and a price index was applied by the F-4 financial team to forecast the gyroscope's future delivery cost. A code of "90" indicates those items where actual buyer or contractor prices are quoted.

Description

Self-explanatory.

Updating the Data File

The financial team uses the NCR 796-201 remote terminal located within their office to update the component cost data. The remote terminal is linked to the CDC 6600 computer located in the ASD Computer Center. Specific components are updated by keying the sequence number on the remote, changing the necessary information, and then resaving the data back into the data base. After a major update, a quality control check is made of the input items by requesting a printout of the program and all components. An item-by-item verification of new cost data is then completed. Personnel who update the data base operate primarily from previous listings for code recognition (21).

The cost data are normally updated when a new FMS P&A study has been requested. The entire data base is not updated because of the volume and the low dollar values of many items. Instead, an arbitrary cut-off point has been

assigned -- a unit cost greater than $5,000. Those components meeting this requirement are updated for the case under development. The remaining items are priced at their current value as listed in the data base. These lower value components are updated on a continuous basis when the paperwork for any recent FMS case is routed through the financial team. A listing of the contractor's latest billing charges for those components common to the F-4 is the source of this input.

For those items valued higher than $5,000, either the contractor or the buyer of the component is contacted by the F-4 financial team. The buyer may be any of the Air Logistics Centers (ALCs), DSA, ASD, etc. The buyer, in turn, contacts the component's manufacturer. The component's value is actually an estimate of what the buyer or contractor expects to pay for it at some specific time period in the future. This time period is based on the delivery schedule of the item into the production line. The appropriate price index is applied to those components where a real-time quote has not been obtained prior to completion of the study. These price indices increase the component's cost to a close approximation of what the future price will be (48:5 Apr 77). The "ASD Cost Escalation Report 110-C" is used to provide the indices required to forecast these costs (30).

The main portion of the program itemizes airframe

and GFAE components. Figure H-3 is the summary page of the report. "Other Costs" and "Supplemental Costs" are also included in the program with a separate entry for each component. For example, charges that fall under "Other Costs" such as Engineering Change Orders (ECOs), Repair of Reparables, Pro Rata R&D, Accessorial Charges, and Asset Use Charges, each have their own sequence number for identification within the data base. The Production Shutdown Delta has not been added to the program. These numbers begin at 90000 for the F-4 and 94000 for the RF-4.

5 RF-4E PEACE ROLL V AS OF 77 APR 18

	PLANE COST	TOTAL COST
AIRFRAME COSTS		
Raw Materials	311,952	1,559,760
Contractor Furnished Equipment	1,386,961	6,934,805
Nonrecurring Expenses	--	--
Subcontract	779,613	3,898,065
Inter-Company Work Orders	452,347	2,261,735
Direct Labor	853,962	4,269,810
Overhead-Factory	1,686,463	8,432,315
General & Administrative & Others	700,959	3,504,795
Earnings	1,234,000	6,170,000
Airframe Total	7,406,257	37,031,285
GFAE COSTS		
Engine	1,160,000	5,800,000
Other GFAE	1,765,557	8,827,785
GFAE Total	2,925,557	14,627,785
OTHER COSTS		
Engineering Change Orders/Props	74,062	370,310
Repair of Reparables	74,062	370,310
Pro Rata Research & Development	86,000	430,000
Accessorial Charges	40,000	200,000
Asset Use Charges	43,000	215,000
Other Total	317,124	1,585,620
Flyaway Cost Total	10,648,938	53,244,690
SUPPLEMENTAL COSTS		
Technical Publications	--	--
Peculiar AGE	--	2,000,000
Trainers	--	--
Ferry	--	--
Travel	--	100,000
Supplemental Total	--	2,100,000
Price and Availability Total	10,648,938	55,344,690

Figure H-3

Computer Data Base Summary Page

APPENDIX I

COMPARATIVE ANALYSIS OF ORIGINAL P&A
TO LATEST REVISED ESTIMATED
COMPLETION PRICE

The seven F/RF-4 cases in this appendix represent those cases developed using the computer algorithm. Because of configuration requirements and the long production runs, none of these FMS cases are classified as closed. This precludes a comparison between the original P&A and the final price paid by the foreign country. However, the original P&A has been compared to the most recent revised estimate of the final price to be paid by the country.

The revised estimates in this research effort were prepared by the financial team as of 9 May 1977. The estimates were revised based on negotiated procurement contracts to date and that material for which contracts have not been completed. The financial team determines the excesses or shortages in these cases based on judgment and experience.

The comparisons include only flyaway cost components. Supplemental Cost components are not included because some countries purchase them while other countries do not. Additionally, these items are not estimated by the financial team.

The reader should be aware that these estimates could change again before the case is closed. Asterisked line items represent changes made to the estimate on 9 May 1977. Explanations concerning these changes are provided in footnotes for each case.

FY 74 FMS CASE: ISSFA 48 F-4E AS OF 9 MAY 77

	P&A (ORIGINAL CASE)	ESTIMATED TO COMPLETION
Airframe & CFE	131,854,224	126,605,007
GFAE:		
Engines	36,000,000	34,500,000
Other	25,375,680	22,617,224
ECOs	6,000,000	8,969,049
Repair of Reparables	960,000	400,000
Accessorial Charges	1,680,000	1,000,000
R&D Payback	3,072,000	3,072,000
TOTAL FLYAWAY	204,941,904	197,163,280

Percentage accuracy = $\frac{197,163,280}{204,941,904}$ = 96.2%

Percentage error = 3.8%

FY 74 FMS CASE: IRSLA 12 RF-4E AS OF 9 MAY 77

	P&A (ORIGINAL CASE)	ESTIMATED TO COMPLETION
Airframe & CFE	72,320,000	71,315,736
GFAE:		
Engines	9,324,000	8,655,368
Other	9,900,000	11,322,896*
ECOs	2,400,000	500,000
Repair of Reparables	600,000	150,000
Accessorial Charges	360,000	360,000
R&D Payback	732,000	732,000
TOTAL FLYAWAY	95,636,000	93,036,000

Percentage accuracy = $\frac{93,036,000}{95,636,000}$ = 97.3%

Percentage error = 2.7%

*The ECO estimate was too high which led to the original increase in GFAE. Presently, there is a perceived excess in GFAE which is reflected by the $1.5 million decrease in this line item.

FY 75 FMS CASE: GYSBD 10 F-4E AS OF 9 MAY 77

	P&A (ORIGINAL CASE)	ESTIMATED TO COMPLETION
Air frame & CFE	38,800,000	33,800,000*
GFAE:		
Engines		
Other	7,100,000	7,100,000
ECOs	1,560,000	1,560,000
Repair of Reparables	390,000	390,000
Accessorial Charges	300,000	300,000
R&D Payback	640,000	640,000
TOTAL FLYAWAY	48,790,000	43,790,000

Percentage accuracy = $\frac{43,790,000}{48,790,000}$ = 90%

Percentage error = 10%

*The $5 million decrease is a result of more F/RF-4 aircraft entering the McDonnell Douglas pipeline. The increased aircraft resulted in a lower airframe unit cost after the P&A study was accomplished.

FY 75 FMS CASE: ISSFS 6 RF-4E AS OF 9 MAY 77

	P&A (ORIGINAL CASE)	ESTIMATED TO COMPLETION
Airframe & CFE	28,272,000	26,208,380
GFAE:		
Engines	4,260,000	4,684,320
Other	4,116,000	3,500,000
ECOs	1,020,000	200,000
Repair of Reparables	180,000	180,000
Accessorial Charges	210,000	210,000
R&D Payback	270,000	270,000
SLAR	10,608,000	10,683,244
TOTAL FLYAWAY	48,936,000	45,935,944

Percentage accuracy = $\frac{45,935,944}{48,936,000}$ = 93.9%

Percentage error = 6.1%

FY 75 FMS CASE: IRSPA 36 F-4E AS OF 9 MAY 77

	P&A (ORIGINAL CASE)	ESTIMATED* TO COMPLETION
Airframe & CFE	110,571,420	128,199,600
GFAE:		
Engines	27,720,000	30,758,160
Other	19,928,580	19,777,798
ECOs	6,000,000	2,560,842
Repair of Reparables	300,000	300,000
Accessorial Charges	1,080,000	1,080,000
R&D Payback	2,304,000	2,304,000
TOTAL FLYAWAY	167,904,000	184,980,400

Percentage accuracy = $\frac{184,980,400}{167,904,000}$ = 110%

Percentage error = 10%

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*The causes for the estimate to completion being so much higher than the P&A estimate were due to McDonnell Douglas price increases in Airframes and expected price increases in GFAE due to inflation, cutback in F-15 production shifting overhead to the F-4, and price increases of aluminum and other important materials.

FY 76 FMS CASE: KSSBF 19 F-4E AS OF 9 MAY 77

	P&A (ORIGINAL CASE)	ESTIMATED TO COMPLETION
Airframe & CFE	87,400,000	79,548,000*
GFAE:		
Engines	19,950,000	20,140,000
Other	9,747,000	12,279,633*
ECOs	--	129,367
Repair of Reparables	760,000	760,000
Accessorial Charges	627,000	627,000
R&D Payback	1,216,000	1,216,000
TOTAL FLYAWAY	119,700,000	114,700,000

Percentage accuracy = $\frac{114,700,000}{119,700,000}$ = 95.8%

Percentage error = 4.2%

*This contract was negotiated at a lower price with the $5 million decrease reflected on a 50-50 basis between airframe and GFAE.

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FOREIGN MILITARY SALES WEAPON SYSTEM COST ESTIMATION PROCEDURE:--ETC(U)
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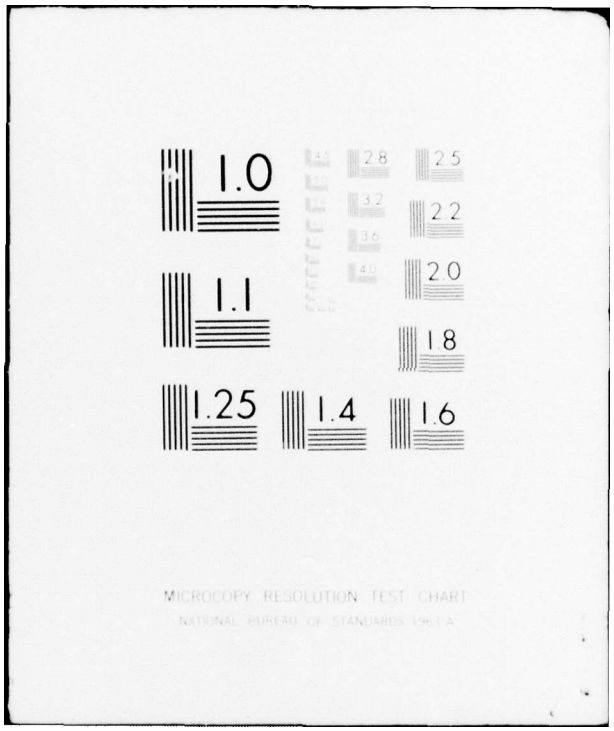
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