

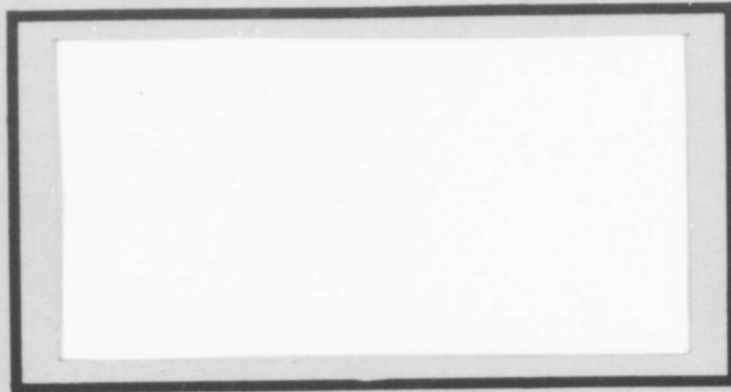
FOR FURTHER TRAN

①
B.S.

AD A 055850



AD No. ~~1~~
DDC FILE COPY



DDC
RECEIVED
JUL 3 1978
E

UNITED STATES AIR FORCE
AIR UNIVERSITY
AIR FORCE INSTITUTE OF TECHNOLOGY
Wright-Patterson Air Force Base, Ohio

78 06 30 022

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

AD A 055850

①

AD No. _____
DDC FILE COPY

6
FOREIGN MILITARY SALES PRODUCT SUPPORT.
AN EXPLORATORY STUDY OF THE SUPPORT PURCHASED
AS PART OF THE INITIAL ACQUISITION EFFORT FOR
THE F-5 WEAPON SYSTEM.

9 Master's THESIS

14 AFIT/GSM/SM/76S-5

10 James P. Dutcher, Jr.
Capt USAF

11 Sep 76

12 165p.

DDC
RECEIVED
JUL 8 1978
RECEIVED
E

DISTRIBUTION STATEMENT A

Approved for public release;
Distribution Unlimited

78 06 30 022

012 225

cl

FOREIGN MILITARY SALES PRODUCT SUPPORT:
AN EXPLORATORY STUDY OF THE SUPPORT PURCHASED
AS PART OF THE INITIAL ACQUISITION EFFORT FOR
THE F-5 WEAPON SYSTEM

THESIS

Presented to the Faculty of the School of Engineering
of the Air Force Institute of Technology
Air University
in Partial Fulfillment of the
Requirements for the Degree of
Master of Science

ACCESSION for	
NTIS	White Section <input checked="" type="checkbox"/>
DOC	Buff Section <input type="checkbox"/>
UNANNOUNCED	<input type="checkbox"/>
JUSTIFICATION	
BY	
DISTRIBUTION/AVAILABILITY CODES	
Dist.	AVAIL. and/or SPECIAL
A	

by

James P. Dutcher, B.S.
Captain USAF
Graduate Systems Management

September 1976

Approved for public release; distribution unlimited.

Preface

The author was fortunate in having knowledgeable people available in both the U.S. Air Force and the aerospace industry to assist and stimulate this research. Because of the large number of people and agencies who willingly cooperated to make this study possible, it is not possible to acknowledge all individuals or agencies. Nevertheless, the author would like to express his gratitude to those people and agencies.

Among those people and agencies assisting the author, special recognition is given to the following:

Lieutenant Colonel William C. Letzkus, my thesis advisor, whose interest, dedication, encouragement and standards of excellence inspired the author.

Personnel of the F-5 International Fighter Systems Program Office, who encouraged the research effort and provided valuable information, comments and research documentation.

Personnel of the Northrop Air Division F-5 organization, whose candor and cooperation provided insight into the complexity of this research effort.

Major Dennis Cogburn of the F-5 International Fighter System Program Office whose patience, willingness to communicate, exceptionally high professionalism and enthusiasm helped make this study into a truly valuable learning experience for the author.

Finally, this thesis was made possible through the understanding and patience of my wife, Erika, who singlehandedly has capably managed our family during the research period.

TABLE OF CONTENTS

	Page
Preface.	ii
List of Figures.	vii
List of Tables	viii
Abstract	ix
I. INTRODUCTION	1
Background.	1
Justification of Security Assistance Programs	2
Classification of Foreign Assistance Programs	4
Responsibilities for the Management of MAP and FMS.	7
Formal Organizations.	7
Informal Organizations.	8
Statement of the Problem.	10
Problems Identified in this Study	10
Inadequacy of Data.	11
Objective and Purpose of the Study.	13
II. PRODUCT SUPPORT ACQUIRED AS PART OF THE WEAPON SYSTEM ACQUISITION PROCESS.	14
Background.	14
Scope and Purpose of Chapter.	15
Product Support Definition.	16
Classification of Product Support	17
Pre- and Postdelivery Product Support	17
Production and Field Support.	21
Predelivery/Postdelivery Field Support and Predelivery/Postdelivery Production Support	24
Field/Production Support Provided to a Single Contract.	25
Implicit and Explicit Product Support Tasks	27
Program Support Interfaced.	28
Summary	32
III. METHODOLOGY.	35
Introduction.	35
Scope	35
Study Goals	36
Study Constraints	37
Research Approach	37
The Study	37

	<u>Page</u>
Limitations	41
Timeliness of the Study	41
U.S. Sources	42
Participating Foreign Governments	42
Interviews	42
Assumptions	43
Intentions of the U.S. Government and Involved Companies	43
Monitoring Postdelivery Product Support Requirements	43
IV. THE INTERNATIONAL FIGHTER SYSTEMS PROGRAM	45
Scope and Purpose of Chapter	45
Background of the F-5 Program	45
Unique Aspects of the F-5 System	46
Basic F-5 Models	47
The Scope of the F-5 Program	48
The F-5A/B, RF-5A Program	48
Location of F-5A/B Aircraft	49
Summary of the Cost for the F-5A/B and RF-5A Programs	49
The F-5E/F Program	52
Pricing of Product Support	54
Background	54
Support Capabilities	55
Support Included in the Acquisition Price	56
F-5 Product Support	57
Problems Associated with Product Support for the F-5	58
Summary	59
V. SELECTED ASPECTS OF F-5 PRODUCT SUPPORT	60
Background	60
Scope and Purpose	60
Product Support Classifications	61
Predelivery Product Support	62
Postdelivery Product Support	66
Product Support From the Perspective of the F-5A/B	69
Postdelivery Support, F-5A/B	69
Allocation of Postdelivery Field Support Costs, F-5A/B	71
Interdependence of F-5A/B Support and the F-5E/F Programs	72
F-5E/F PAPS Field Support	73
Presale/Postsale Support (PAPS) Background	73
Examples of Recognized PAPS Activities	74
Significant Concepts Concerning the PAPS Program	75
Examples of PAPS Support Activities	77

	<u>Page</u>
F-5E/F Non-PAPS Field Support.	78
The Allocation of F-5E/F Non-PAPS Field Support.	78
Organization of the F-5E/F Field Support	78
Non-PAPS 5E/F Field Support as Viewed by Northrop.	79
Product Support From the Perspective of Sustaining Engineering.	80
Sustaining Engineering, F-5A/B	81
Sustaining Engineering, F-5E/F	82
Field Support Requests	87
Sources of Field Support Requests.	87
Summary.	91
VI. SELECTED PROBLEMS RELATED TO POSTDELIVERY FIELD SUPPORT FOR THE F-5	94
Background	94
Scope and Purpose of Chapter	95
Postdelivery Field Support Policy.	96
Overall Responsibility and Control of Postdelivery Field Support.	96
Policy as to Establishing Levels of Field Support.	97
Problems Related to the Matching of Postdelivery Field Support Benefits with the Benefiting Customers	99
Matching of Postdelivery Field Support with the Benefiting Customers and Allocating the Associated Costs	100
Problems Related to Determining Postdelivery Field Support Costs.	104
Problems Related to F-5 Non-PAPS Postdelivery Field Support.	104
Responsibilities and Control	105
Initiation of Support Requests	106
Impact of Production Termination on Non-PAPS Field Support.	106
Allocation Problems Produced by the Timing of Contracts.	107
Selected Problems Associated with PAPS	108
Determining the Required Level for PAPS Funding.	109
Northrop Control of PAPS	116
Participating in PAPS Funding.	117
Summary.	118
VII POSTDELIVERY FIELD SUPPORT ALTERNATIVES	119
Background	119
Scope and Purpose.	120

	Page
Alternatives for the Assignment of Postdelivery Field Support Management Responsibility for New or Future Foreign Military Sales Programs.	120
Maintaining Postdelivery Field Support as Part of the Acquisition Process	122
Assigning Responsibility for Postdelivery Field Support Management to the Logistics Process.	123
The Sharing of Responsibility for Postdelivery Field Support Management with AFSC and AFLC.	125
Recommended Alternative.	126
Postdelivery Field Support Alternatives for the F-5 Program.	126
Background	126
Recommendations.	128
Summary.	131
VII. SUMMARY AND CONCLUSIONS	132
Introduction	132
Terminology and Definitions.	132
Product Support.	132
Predelivery/Postdelivery Support	133
Production/Field Support	134
Predelivery/Postdelivery Field Support and Predelivery/Postdelivery Production Support.	134
Explicit/Implicit Support.	135
Findings	136
Product Support.	136
Postdelivery Field Support Problems.	138
Conclusion	139
Recommendations for New Foreign Military Sales Programs	140
Recommendations for the F-5 Program.	141
Bibliography.	143
Appendix A, Definitions	147
Appendix B, Acronyms.	150
Vita.	152

LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
1. The Formal Establishment of Security Assistance Programs. .	9
2. Pre- and Postdelivery Support	18
3. Weapon System Life Profile.	19
4. Pre- and Postdelivery Product Support Viewed as a Unit. . .	22
5. Production Support Subdivided into Four Elements.	26
6. Product Support Provided to a Single Contractor	28
7. Support Program Interfaces.	31
8. The Predelivery Field Support Element of Product Support. .	63
9. The Predelivery Production Support Element of Product Support	65
10. The Postdelivery Production Support Element of Product Support	67
11. The Postdelivery Field Support Element of Product Support	68
12. Field Support Request Flow Paths.	89
13. Postdelivery Field Support Benefits Accrued and Costs Allocated in a Single Customer Program.	101
14. Postdelivery Field Support Benefits Accrued and Costs allocated in a multiple customer program.	102

LIST OF TABLES

<u>Table</u>		<u>Page</u>
I.	Quantity of F-5A/B and RF-5A Procured by Fiscal Year and Model.	48
II.	F-5A, F-5B and RF-5A Organized by Types of Funding and Country Involved.	50
III.	F-5A/B, RF-5A Summary Costs	51
IV.	Summary of F-5E/F Aircraft as of March 1976	52
V.	F-5E/F Programs Organized by Country.	53
VI.	Summary of Total Contract Dollar Value of the F-5E/F.	54
VII.	Participating Nations in Presale and Postsale Product Support (PAPS) Account.	77
VIII.	Factors Affecting Field Support for the F-5E/F.	85
IX.	Identification and Categorization of Product Support Tasks Performed Within Sustaining Engineering	88
X.	FMS/Direct Aircraft Deliveries and Support Lives (10 Years Useful Life).	113
XI	FMS/Direct Aircraft Deliveries and Support Lives (15 Years Useful Life).	114

Abstract

The United States Government is deeply involved in foreign military sales programs. In recent years, the foreign military sales programs have become increasingly complex and more difficult to manage. One of the reasons for this increasing complexity and resulting difficulties is due to support which is purchased as part of the initial acquisition effort (product support). That is, the U.S. government sells more than hardware to the foreign governments. The United States Government and its vast technological resources stand behind each item sold under a foreign military sales arrangement. Included in the acquisition price of each item are costs for providing such support.

The F-5 program, which is synonymous with foreign military sales, provides valuable insight into how this support is purchased, managed and funded. The implications of the support problems identified in this study is readily applicable to other foreign military sales programs.

The objective of this thesis is to present a detailed study of the support which is included in the acquisition process of foreign military sales programs. Thus, a set of definitions and concepts are developed in this study whereby this support can be identified, problems identified and suggested solutions developed. These concepts are then applied to the F-5 program in general as well as specific support efforts within this program so that support tasks can be categorized in a meaningful manner. Additionally, selected problems such as support cost allocation problems, the matching of support benefits with costs and problems associated with the funding of the support efforts are presented.

This thesis is an initial study of this support topic. It is intended to provide insight into the obscure area of product support and establish a framework of terminology and concepts whereby program managers can understand and better manage such support.

I INTRODUCTION

Background

Air Force Regulation (AFR) 57-4 defines military assistance as "Material and services provided by the United States (U.S.) to eligible allies as specified by Congress" (1:32). The practice of providing military assistance is, however, neither a modern concept nor a concept unique to the United States. Many examples of military assistance exist throughout history. The French provided "material and services" to the rebellious North American colonies over two hundred years ago. The French, the British, the United States, and a long list of other nations both at war and at peace provided military assistance to various countries during World War I. The list of nations to whom the United States provided military assistance prior to World War II is lengthy and even included fighter aircraft to Japan. Today practically every nation is involved in providing or receiving military assistance. French fighters are flown in South America, Australia, the Middle East, Africa, Asia, and Europe. United States aircraft are flown in North and South America, Australia, the Middle East, Africa, Asia and Europe. Military assistance is a pervasive kaleidoscope of various weapons systems from various suppliers which are distributed in most of the countries of the world. The types of weapons systems distributed range from outdated military hardware of relatively primitive design to some of the latest and most advanced equipment developed by any industrialized country.

Over the years, the type of equipment and services which the United States government has provided for military assistance has been increasingly more sophisticated, often representing state-of-the-art developments.

No longer are foreign governments content with aged surplus military hardware which may not meet their requirements. Today, the foreign governments which seek security assistance can be viewed as activist customers who are seeking partnerships with industrialized nations so that the assistance provided will be more closely tailored to their assistance requirements, their financial requirements and their technological abilities. These countries no longer accept their earlier roles as benefactors of the hand-me-down surplus from industrialized nations undergoing some modernization programs. Governments seeking foreign military sales (FMS) agreements are making their needs known to all industrialized nations and are prepared to pay for their role of becoming more active partners in the design and construction of Security Assistance Program weapon systems.

Justification of Security Assistance Programs

Even though security assistance programs have been in existence throughout the history of the United States, the character of the assistance programs has undergone recent changes. President Nixon acknowledged this change when he announced the Nixon Doctrine in 1969. The United States was attempting to achieve a new type of partnership and provide a new approach for international defense (2:19). The objectives of this approach was for the United States government to assist other countries that are considered to be in the "free world" assume the responsibility of their own defense. Such an action would be able to reduce its presence and visibility in many areas abroad, thus reducing both domestic and

foreign criticism. Also, this reduced profile which the United States military would display abroad would reduce the financial burden the United States tax payers must bear for defense spending.

Various officials of both the U.S. government and private industry have also noted that the sale of military equipment by the U.S. to foreign governments influences and favorably impacts the U.S. balance of payments. The funds the U.S. would be reimbursed for various Security Assistance Programs would aid in financing the sophisticated, costly U.S. aerospace industry and help maintain the highly advanced technological/ industrial expertise through periods when the U.S. Air Force is purchasing decreasing levels of new equipment. In this respect Security Assistance Programs may be viewed as a method for maintaining an important national resource.

In addition to the above mentioned considerations, the new partnership is justified by one other important benefit. The U.S. will retain much of its world influence by virtue of the dependence established through the partnership arrangement and the recognized United States technological preeminence. It is believed that the world will recognize that the U.S. can construct and deliver some of the finest equipment known with the assurance that the U.S. government and the vast American corporations will stand behind every transaction in "...quality, reliability, and integrity" (2:19-1). It is recognized that this support will be an invaluable asset, since most countries lack both the expertise and resources necessary to support such systems. Since the U.S. will be the primary source of such support, it is reasoned that the U.S. will inherit substantial influence.

Thus, security assistance has become one of the key elements of U.S. foreign policy. Security assistance programs are supposed to improve domestic production capabilities, increase aircraft manufacturing/engineering expertise, provide increased employment, improve the balance of payments and lower the visible profile of the U.S. abroad. All of this would occur while strengthening international defense and retaining the U.S. as a preeminent source of international influence.

Classification of Foreign Assistance Programs

All U.S. Government Foreign Assistance Programs fall into three broad categories; [1] Security Assistance Programs (SAP), [2] Welfare and Emergency Relief Programs and [3] International Development Assistance Programs. Security Assistance Programs constitute the primary programs for providing military assistance to foreign governments. Behind the security assistance programs are five types of individual programs: [1] Grant Aid Programs, also known as Military Assistance Programs (MAP), [2] Military Assistance Service Funded (MASF) programs, [3] Foreign Military Sales (FMS) efforts, [4] Direct Sales efforts, and [5] Coproduction (2:19-1).

Grant Aid is authorized by the Foreign Assistance Act of 1961, although its history precedes that date. Military assistance provided under this program is provided at no cost to the foreign government. The U.S. receives no reimbursement for either materials or service provided. Within the Air Force, Grant Aid Programs are developed by the Military Assistance Advisory Group (MAAG) on behalf of the concerned countries. Funds for Grant Aid programs are provided by the U.S. government and

thus are not provided by the concerned branch of the U.S. military. United States Air Force procedures for administering military assistance programs are outlined in Air Force Regulation (AFR) 400-2.

Military Assistance Service Funded programs are also authorized under the Foreign Assistance Act of 1961, but were not employed until the Vietnam crisis of 1968. Under this program the concerned branch of the U.S. military incurs all costs associated with providing the materials and services to specified allies for specified programs. The concerned foreign government does not reimburse either the involved U.S. military department or the U.S. government. These programs are funded under the regular appropriations of the concerned military department and are not reflected in any military assistance program budgets. Military Assistance Service Funded programs have been authorized by Public Law 89-367, as amended.

The third program under Security Assistance, Foreign Military Sales, is expanding more rapidly than any other program. Authorized under the Foreign Military Sales Act of 1968, foreign military sales is defined as "...the selling of U.S. produced military equipment and services to friendly governments and international organizations..." (3:A1-3). All defense articles, services, and training are strictly on a reimbursable basis (1:32). As a service to the foreign governments, the U.S. government will supervise and manage foreign military sales programs. In order for the U.S. government to be reimbursed for this Department of Defense (DOD) support, an arrangement is usually made whereby the foreign government will pay an additional two percent surcharge on the equipment and spares. In those situations when the two percent surcharge is considered to be inadequate to cover the costs incurred by the U.S. government, a

negotiated "cost to do the job" may also be added to the purchase price (2:19-4). These additional charges are the only reimbursements the U.S. government receives for providing support. The foreign military sales transaction is conducted on a government-to-government level and is performed on a nonprofit basis by the U.S. government for the benefit of the purchasing country. However, the concerned companies are allowed to receive a controlled profit. Additionally, sales are to be at no cost to the U.S. government.

Sales from new procurement are authorized in Section 22 of FMSA, subject to the promise of the purchaser to pay the full amount which assures the United States Government against any loss on its procurement contract including damages or costs of termination (3:2-5).

Air Force Manual 400-3 establishes the framework under which the U.S. Air Force is required to operate.

The fourth program, Direct Sales, is often mistaken to be the same as foreign military sales. Both direct sales and foreign military sales involve the selling of U.S. equipment to foreign governments. However, direct sales and foreign military sales differ in one major way: direct sales are conducted mainly on a manufacturer-to-foreign government level instead of a government-to-government level as in foreign military sales. The U.S. government must, however, approve the direct sale and maintain control over certain items such as government furnished equipment (GFE). Nevertheless, a direct sale is a transaction ostensibly between commercial sources and foreign countries. The current authority for direct sales lies in the International Traffic in Arms Regulation of January 1972.

Air Force Manual 400-3 discourages the Department of Defense from acting as a sales agent, such as is required in foreign military sales

activities, and encourages direct purchase of military equipment from the contractor.

Whenever practicable, foreign countries are encouraged to purchase directly from U.S. commercial sources rather than from the Department of Defense (3:1-1).

The fifth security assistance program, Coproduction, is in reality a program which is a subset of one of the other four programs. Coproduction is the term applied to any program wherein the U.S. government, either directly or indirectly, enables foreign countries to manufacture, assemble, repair, or maintain specific parts of the system. Air Force Manual 400-3 encourages less-developed countries to meet their requirements from coproduction rather than through external procurement.

Responsibilities for the Management of MAP and FMS

An elaborate formal and informal organization exists for the management of military assistance programs and foreign military sales. This structure reflects the complexity and sensitivity of MAP/FMS programs. It should be emphasized, however, that both the formal and informal organizations are not rigid, inflexible organizations. A multitude of circumstances can exist which will change the relationships of the organizations.

Formal Organizations

Under the direction of the President of the U.S., the State Department has the responsibility for granting authorizations for foreign military procurement through licensing agreements. The Secretary of State is

responsible for the continuous supervision and the general direction of security assistance programs. This authority includes, but is not limited to "...determining whether there should be a program or sale and if so, the amount" (2:19-26).

The Assistant Secretary of Defense for International Security Affairs (ASD/ISA) acts for the Secretary of Defense as his principal representative and spokesman on security assistance matters. Within the Department of Defense ASD/ISA has the responsibility of formulating policy and guidance for foreign security assistance.

The Military Assistance Advisory Group provides in-country representation for the Office of the Secretary of Defense. The focal point for the U.S. Air Force is the Director of Military Assistance and Sales, Headquarters, United States Air Force (HQ USAF/LGF). Within the U.S. Air Force, Air Force Systems Command (AFSC) provides the development, test and acquisition management. Logistics support management is shared by both the Air Force Systems Command and the Air Force Logistics Command (AFLC). Air Training Command (ATC) provides operations and maintenance training, while Air Force Communications Services (AFCS) provides support to Aerospace Defense Command (ADC) and Tactical Air Command (TAC) in developing operational requirements. Other agencies provide support when required (2:19-1 to 19-2). Figure 1 represents a macroview of the way an U.S. Air Force Security Assistance Program occurs through the formal channels.

Informal Organization

In practice security assistance programs can be initiated or modified in any number of ways. Congressional pressure can cause the President or

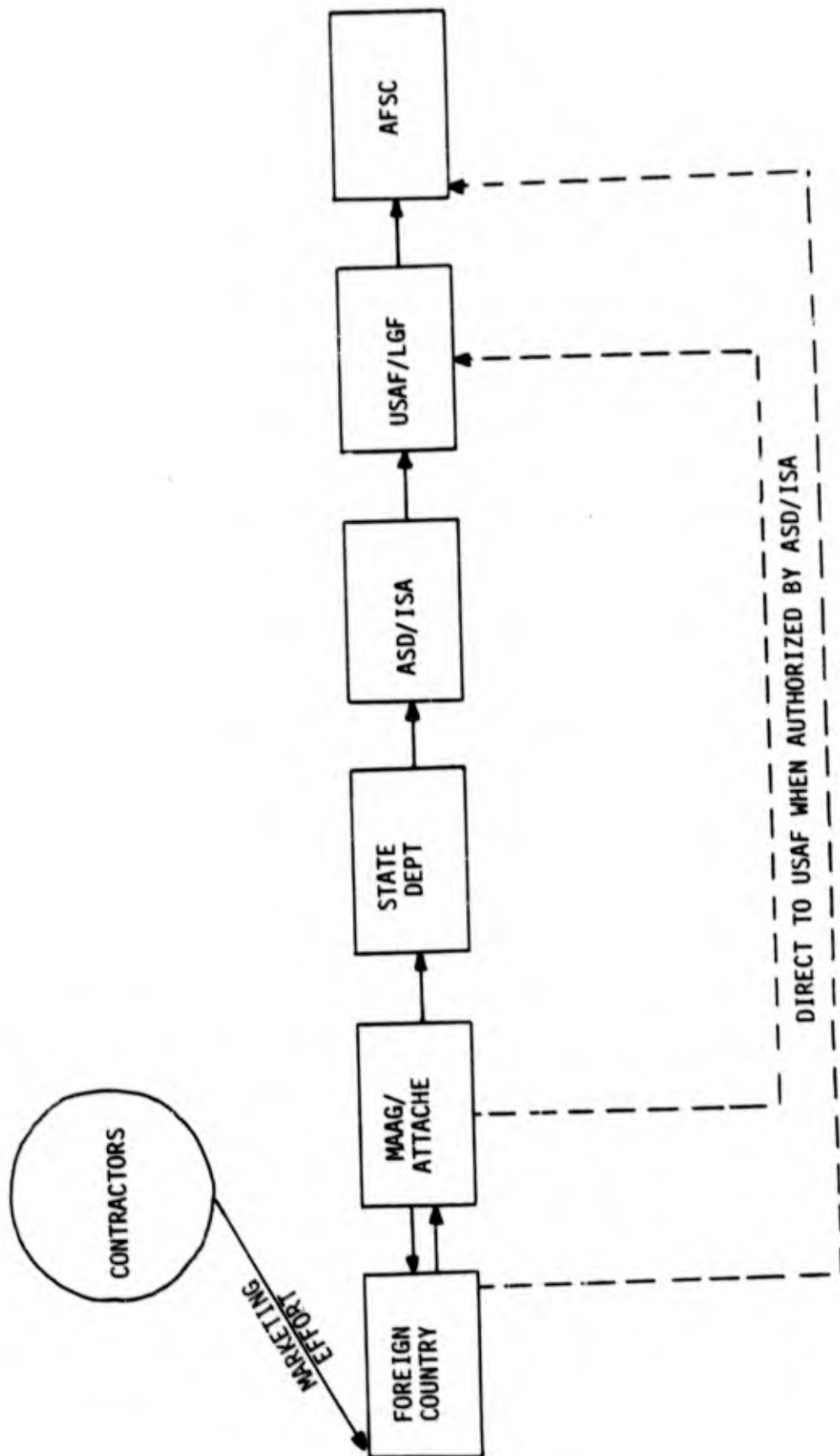


Figure 1. The Formal Establishment of Security Assistance Programs

State Department to initiate or modify security assistance programs. An example of this occurred in 1974, when Congress prohibited delivery of arms to Turkey during the Cyprus conflict. The supply of weapons is a volatile question with which many congressmen have concerned themselves. Additionally, the public media often assumes a specific view-point which influences public opinion. A strong public opinion either in the U.S. or in the foreign country may modify security assistance plans.

The formal structure is also fractured by virtue of the relationships of organizations and individuals. A country with unencumbered access to the State Department might use the State Department as its U.S. contact for foreign military sales, while another country without such access may use different sources. These sources are numerous and vary in effectiveness. For example, sometimes a country will approach an official of a U.S. corporation and request that that corporation present its case to influential organizations. Also, visiting elected U.S. government officials, military members, and foreign officials visiting the U.S. have all played a part in the formal organization. The foreign government will usually seek any source of contact which may possible bring about its desired results (4).

Statement of the Problem

Problem Identified in this Study

The desired results most foreign governments seek are both the acquisition of and support for weapon systems which will meet their requirements. In many instances, this acquisition will be made possible through the U.S.'s foreign military sales programs.

Several weapons systems such as the F-104, F-4, F-5 and C-130 aircraft have played major foreign military sales roles. It is reasonable to expect such weapons as the Maverick Missile, the F-16 and possibly the F-18 aircraft to play an even larger foreign military sales role in the future.

Some concern has been expressed by various U.S. government officials, as well as officials from private industry, about the requirements which arise from the foreign military sales effort. These requirements are largely due to the support which was included as part of the acquisition process. While it is generally recognized that some support of the system is both expected and provided in foreign military sales programs, the extent and nature of this support is controversial. This support, which is purchased as part of the acquisition process, is called product support for purposes of brevity and is the focus of this study.

This study has identified four major problem areas associated with product support. First, product support is difficult to identify. Second, there exists no criteria for classifying product support in a meaningful manner. Third, a problem exists concerning the allocation of support costs. Fourth, product support is not adequately controlled.

Inadequacy of Data

One reason these problems exist is because the data bases of prior foreign military sales programs are inadequate to develop the product support efforts required by the foreign military sales programs which are in being or projected to be in being in the near future.

The inadequacies of the data from prior systems stem from two deficiencies. The first deficiency results from the fact that systems

such as the F-104, F-4 and C-130 were fully developed and were fully incorporated into the U.S. Air Force inventory prior to being sold to foreign governments. Thus, the support costs associated with developing an operationally proven system were funded by the U.S. Air Force and were not included in the foreign military sales costs. The data from these programs do not indicate how much the support efforts would have cost had the foreign governments been the primary user of the system.

The second deficiency is that the data provided from prior programs are too "contaminated" to provide meaningful information for examining product support. "Contamination" of the data has occurred because support costs for foreign governments were not properly identified and were improperly allocated. For example, in the F-4 program data concerning the support of aircraft owned by foreign governments is misleading. When a problem in the field was encountered and a resulting study for the support of this problem produced the issuance of a corrective time compliance technical order (TCTO) kit, the U.S. Air Force funded all study and related support efforts and the TCTO kit was provided to the foreign government at a cost which represented only a fraction of the printing effort. The massive research effort, including the data reporting and collecting effort, was charged to the U.S. Air Force (5:3). By passing along support benefits to foreign governments, while charging these governments only a fraction of the support costs, data detailing prior product support costs for foreign governments were "contaminated."

Since many of the support efforts and their resulting costs were allocated to the U.S. Air Force, foreign military support cost figures from prior programs thus cannot be considered to be accurate representations of the actual support provided.

As a result of the limitation and contamination of support data from prior programs, those data which pertain strictly to the support of the foreign governments and that support which is common to both the U.S. government and foreign governments have not been separately identified. These cost data have instead been combined into cost pools from which separate identification becomes impossible.

Objective and Purpose of the Study

The objective of this study is to systematically develop the definitions and concepts concerning product support and thus to establish a framework whereby product support can be examined. The definitions and concepts developed will be utilized to identify the product support efforts. Once these efforts are identified, the specific tasks which constitute these efforts will be classified. Once the tasks are identified and classified, the methods of allocating the costs of the support tasks will be identified. Throughout the study the interrelationship of support efforts will be explored and selected specific problems will be presented. A few alternative approaches for providing and controlling support efforts will also be discussed. However, the purpose of this study is primarily exploratory and will not attempt to rigorously examine all possible alternatives or problems. Although this study has general applicability to any major foreign military sales situation, for reasons which are addressed in Chapter III, Research Methodology, this study will concentrate upon the F-5 programs, with primary emphasis on the area of customer (field) support provided after the delivery of the weapon system to the customer.

II PRODUCT SUPPORT ACQUIRED AS PART OF THE WEAPON SYSTEM ACQUISITION PROCESS

Background

The foreign military sales market is an intensely competitive area wherein the potential gains can be great and potential errors costly. The competition is not just among competing U.S. contractors. Many countries, including Sweden, France, the Soviet Union, China, Israel and even Brazil are committed to participating in the foreign military sales market. Each country sees itself competing for much more than just a piece of the market: it is competing for national stature and greater international influence.

The foreign military sales marketplace consists of numerous customers who represent their individually unique countries. These countries have unique capabilities, unique requirements and are at various levels of technological development. Some countries like Switzerland are small, mountainous and highly advanced. Countries like Brazil are large, tropical and technologically emerging. Topography varies from the frigid arctic regions to remote mountainous areas to below sea level deserts of the Dead Sea area. Apart from the wide ranging topography and climates, technical expertise and financial capabilities are two other important variables. Some countries are nearly impoverished while others are extremely wealthy. Technologically, some nations have yet to develop an elementary technical base while others have a technical base second to none.

With such unique customers constituting the foreign military sales market, there is still one general requirement which is common to all. All of the countries want to purchase a highly reliable, quality product from a source which has the integrity to stand behind and support the product. Without this support most countries realize that the full potential of their weapon systems would not be realized and the system may even become prematurely useless "junk."

One of the major reasons why the U.S. has moved into a dominant position in the foreign military sales market, preempting many other established foreign military sales suppliers, is the reputations of both the systems that the U.S. provides and the support provided by both the U.S. government and U.S. contractors. Several foreign countries have indicated that the lack of support from such countries as France and Sweden has been the deciding factor in choosing a U.S. system over the others. Recognizing this fact, Sweden has been studying the types of support that the U.S. provides and France has been reviewing its support programs.

Scope and Purpose of Chapter

The background and nature of product support are of importance when one tries to understand what has been and will be occurring within foreign military sales programs. Since the concept of product support conjures up diverse opinions among experienced program managers, the development of general definitions of support terms will serve as the basis for this chapter. This chapter will then define product support which is included

as part of the acquisition process and, using various criteria, subdivide this support into elements. This approach will allow product support to be categorized as explicit or implicit support, predelivery or postdelivery support and field or production support. The overlapping relationship of these elements will also be presented in this chapter.

Product Support Definition

When an aircraft is sold to a foreign government, tasks may be required which normally would not be required if the sale had been for DOD utilization. A proposed change to the Armed Services Procurement Regulation (ASPR) has defined one aspect of product support by describing the associated tasks (6). Examples of the allowable tasks and associated expenses are:

1. Selling tasks and expenses such as:
 - a. International sales and service organizations;
 - b. Sales commissions and fees paid in accordance with ASPR 1-505.4 and 6-1305.
 - c. Sales promotions and demonstrations for the purpose of sales to foreign governments and related travel;
 - d. Configuration studies and related technical services undertaken as a direct selling effort to a foreign country.
2. Product support and postdelivery service tasks and expenses such as:
 - a. Operations or maintenance training, training or tactics films, manuals, or other related data;

- b. Technical field services provided for a foreign country related to accident investigations, weapons system problems, operational tactics enhancement and related travel to foreign countries.

This product support is often purchased as part of the acquisition process and included in the unit price of a weapon system.

Classification of Product Support

There are four ways in which product support will be categorized in this study. The first method divides product support chronologically, the second method divides the support functionally, the third method divides product support both chronologically and functionally, and the fourth method divides the support according to the nature of the explicitness of the support agreements.

These definitions and divisions of the support elements are those of the author. No commonly accepted concise definitions or subdivisions of product support were discovered by this research. Most of the aerospace officials and U.S. government officials contacted indicated that they found the definitions and divisions developed by the author and presented in this chapter conceptually correct.

Predelivery and Postdelivery Product Support

The first approach used for subdividing product support can be viewed as a chronological approach. As the root word indicates in Predelivery

and Postdelivery support, the event which serves as the dividing line is the event of system delivery. After delivery the customer maintains possession and control of the system. Prior to delivery the system is processed and controlled by the manufacturer.

Occasionally the terms presales and postsales are used within manufacturing industries. Since most major foreign military sales programs consist of a number of orders or "sales" to various countries, each individual order is usually delivered over a fairly short period as soon as the specific items are manufactured and tested. While there is some difference in elapsed time from the letting of the sales contract to the actual delivery, this study considers this time difference to have minimal implication. Unless otherwise noted, predelivery/postdelivery and presales/postsales are considered to be synonymous.

Predelivery and Postdelivery Support for a Single Contract. Figure 2 depicts how product support can be divided when considering a single contract. Predelivery and postdelivery elements are the two elements which combine to form product support.

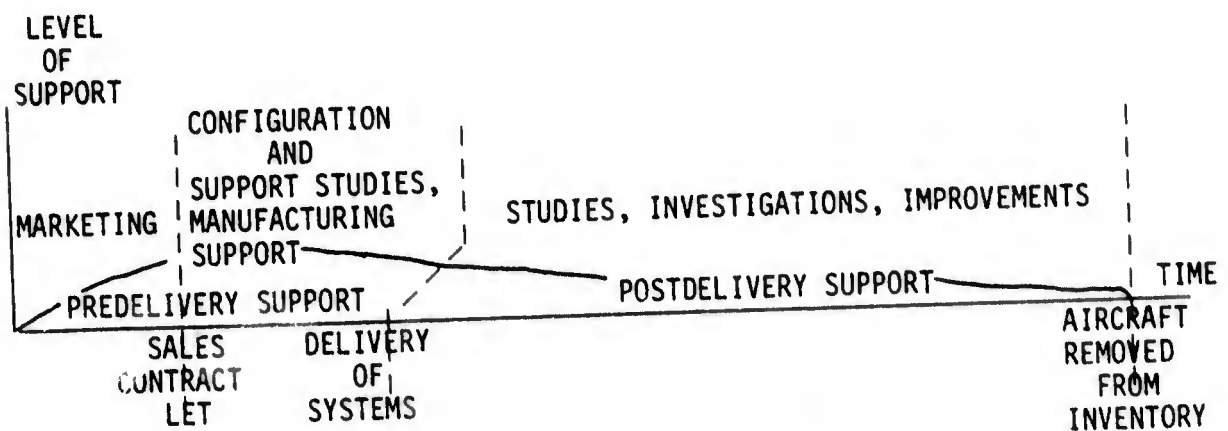


Figure 2. Predelivery and Postdelivery Support

Predelivery and Postdelivery Support for Multiple Contract. In order to expand the concepts of predelivery and postdelivery support from a single contract to all of the multiple contracts for a specific system, the concept of a weapon system life profile was developed by the author. Figure 3, Weapon System Life Profile, graphically displays the chronological relationships of the three stages which comprise the total profile.

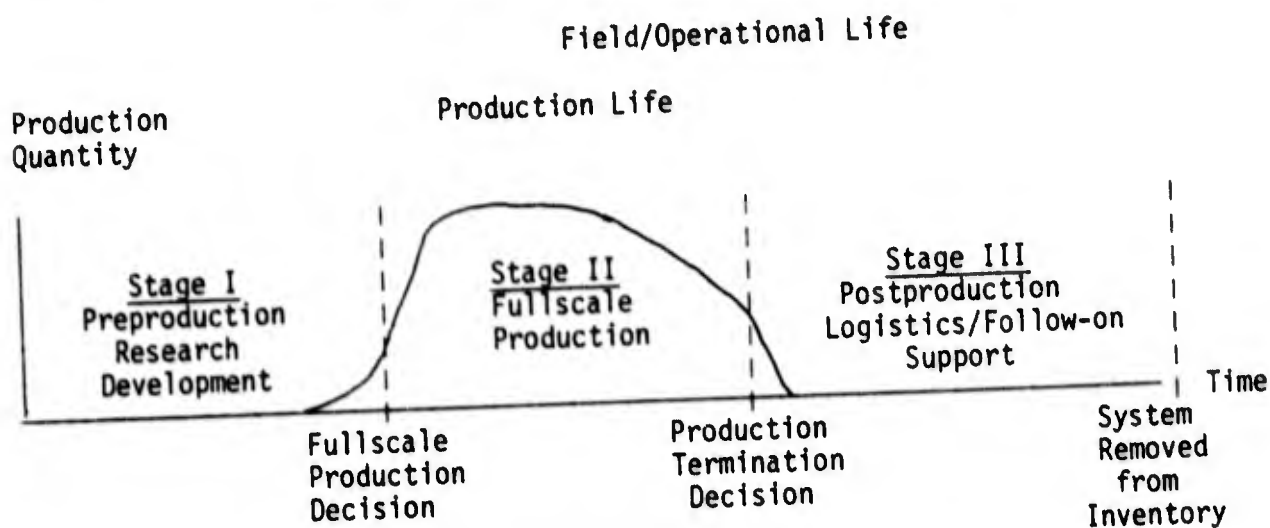


Figure 3. Weapon System Life Profile

Stage I is the period of time when the weapon system is being initially designed, researched and developed. Although a few aircraft will be produced in Stage I, these aircraft are mainly for validation of the design and the development of manufacturing techniques.

At some time in Stage I the fullscale production decision is made. At this point the design of the system is supposed to be fully developed and require only minor modifications for technological improvements. The Production Life of the system is depicted as Stage II in Figure 3. At some time after the completed production models are tested for final

acceptance, the aircraft are delivered to the customers in the field. The operational life of the system is defined to be that period of time beginning with the delivery to the customer and ending when the system is deleted from the customer's inventory of operational aircraft. Clearly, the field or operational life spans both Stages II and III.

In Stage II the manufacturer will eventually arrive at a point in time when the production of the aircraft will no longer meet company objectives. This point is usually identified by lower sales orders and declining profits. At that time a decision is made to terminate production of the system and Stage III, postproduction, is entered.

With the foregoing terminology established, predelivery and post-delivery support for multiple contracts can be identified. Support provided prior to production, Stage I in Figure 3, is predelivery support. In addition to the support for the research and development of the system, the proposed manufacturing process is receiving support in the predelivery phase. Also, countries may be making initial contact with the manufacturers during this period and placing orders for future delivery. Predelivery support is also being provided throughout Stage II. Again, the production process will require support and potential customers will be in contact with the company and will required support for their specific orders. Since there are no aircraft in the field in Stage I and only a few in the field in the early part of Stage II, most of the support through the early part of Stage II would logically be predelivery efforts, and that customer support would be closely related to marketing efforts. Toward the end of Stage II, when it becomes obvious that the production will soon terminate, it is logical to assume that little predelivery support would be provided.

In addition to predelivery support occurring during Stage II, post-delivery support has begun. Aircraft are being delivered and customers are receiving assistance for these delivered aircraft. Postdelivery support should be fairly small in relation to predelivery support at the beginning of Stage II. At the end of Stage II and on through Stage III, postdelivery support will be the only support provided.

Predelivery and Postdelivery Support Viewed as a Unit. If product support were viewed as a single effort comprised of two parts, pre-delivery and postdelivery support, the comparative magnitude of these two elements could be established. Figure 4 is an illustration of such a comparison. This figure is indicative of the relative magnitude of pre-delivery/postdelivery support as perceived by the author based upon this study.

Production and Field Support

The second approach used for dividing product support, which is purchased as part of the acquisition process of a system, is to determine the purpose or function of the support. In this case the purpose of the support is considered to be the provision of support for either the production process or for customers and potential customers (the "field").

Production support, sometimes called in-house support, is defined as that support required to keep the production system operating and current. Clearly, production support ends at or near the time that the production of the weapon systems ends, which is the beginning of Stage III in Figure 3. The level of production support reflects company policy as to this support and other factors such as expected production quality and

PRE- AND POSTDELIVERY PRODUCT SUPPORT

VIEWED AS A UNIT

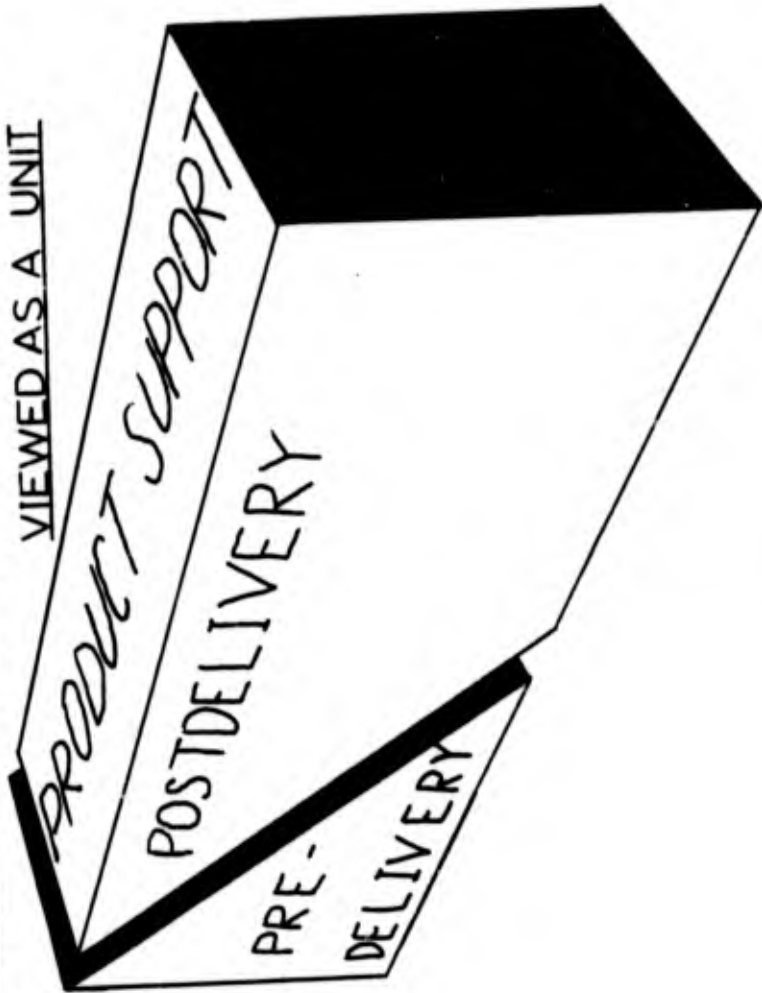


Figure 4

quantity, production time allowed, complexity of the production process and even the level of expertise of the employees utilized for production.

Field support, which is the support of customer and prospective customers, can be performed in the field or at the factory. Since field support is that product support which is directed at satisfying customer requirements, it should be noted that it is the function of the product support which differentiates field from production support, not the department which performs the effort nor the location where the effort is performed. Since both production and some field support can be performed at the factory, the term in-house support which connotes location rather than function will not be used further in this study.

For customers, field support can be considered to be that effort directed at providing such items as technical improvement and changes in operational/maintenance procedures and techniques. Field support essentially encompasses all efforts which are directed at providing resources and expertise for identifying and solving problems related to operational aircraft.

For prospective customers, field support can be defined as that effort directed at answering prospective customers' questions, providing guidance and direction for the prospective customer, demonstrating systems and all other marketing related efforts. Since, however, prior customers sometimes expand their purchases or purchase newer models, this type of presale field support is not limited to new customers.

Predelivery/Postdelivery Field Support and Predelivery/Postdelivery
Production Support

The third approach for dividing product support combines both chronological and functional criteria. This approach produces four distinct classifications of support elements (Figure 5). The relative magnitude of all elements as perceived by the author is also presented in Figure 5.

Predelivery Field Support. Predelivery field support, the smallest element of the four, is defined as that support which is provided to potential customers and customers awaiting aircraft delivery. The majority of the efforts associated with predelivery field support are intended to assist the marketing function and promote aircraft sales. However, capability studies, surveys, training efforts and so forth are also provided as part of postdelivery field support.

Predelivery Production Support. Predelivery production support is defined as that support provided the production process so that the process will be technologically up to date and the process will be able to produce the contractually required quality and quantity of aircraft on schedule. Such efforts result in studies, engineering drawings, procedural changes and so forth.

Postdelivery Production Support. Postdelivery production support is defined as the follow-up and tracking of problems in operational (delivered) systems so that the production process can receive corrective feedback. The data which are collected from delivered systems are utilized as corrective information which is applied to the production process. Thus, postdelivery field support can be viewed as an extension of the quality control efforts.

Postdelivery Field Support. Postdelivery field support, the largest element of the four, is defined as those support efforts which are directed at operational aircraft with the purpose of keeping those systems operational, improving the system, improving the maintenance of the system or correcting any deficiencies. This support is customer oriented and directed at maintaining or increasing the operational effectiveness of the delivered system.

Field/Production Support Provided to a Single Contract

For the purpose of illustration it can be assumed that a hypothetical country is considering the purchase of a U.S. weapon system. The purchase will be a Foreign Military Sales program. The weapon has been in full scale production for several years and is expected to remain in production for years to come. At some point in time official contact is made between the prime manufacturer, the U.S. government and the foreign government. The foreign government requests information regarding specific capabilities, potential modifications and logistics requirements. At this time no contract exists, yet the manufacturer is expanding resources to support the requests and studies.

After several months of study and consideration, the country elects to let a contract with the U.S. government for the purchase of a specific number of aircraft to be delivered over a twelve month period. Pre-delivery field support is continuing and the company has been dedicating support resources to the production effort. This production support actually began prior to the letting of any contract and will continue up to the day delivery is completed.

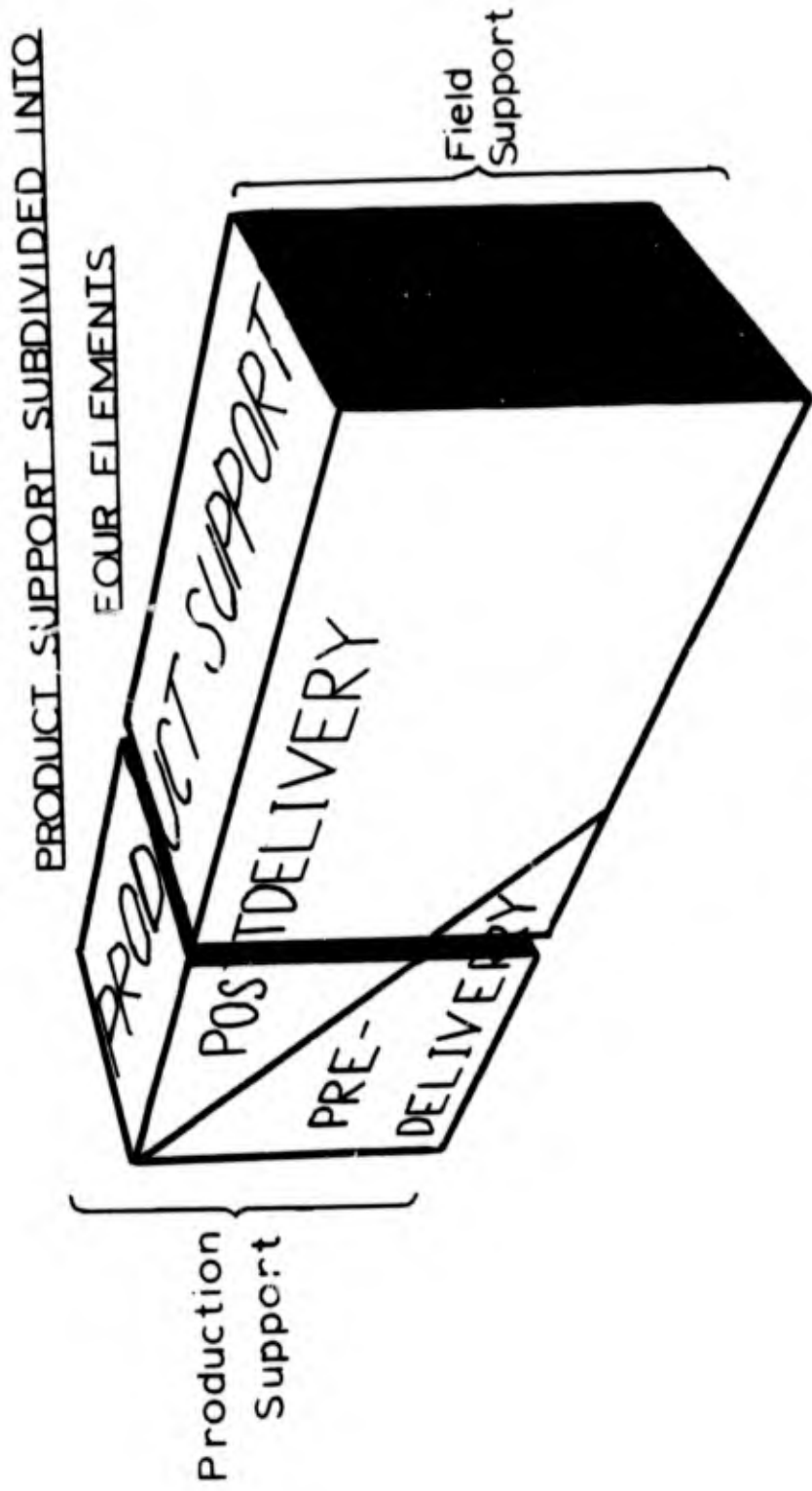


Figure 5

At the specified time the completed aircraft will begin to be delivered to the country. The deliveries will continue over a twelve month period. Postdelivery field support began as soon as the first aircraft was delivered and the customer began seeking assistance to specific questions and problems concerning the aircraft. This postdelivery field support will continue throughout the operational life of the system.

In addition to the product support provided the customer directly, the customer received support benefits which were produced by other contracts. That is, many improvements which were produced by studies originating from other customers were incorporated in the basic aircraft or passed along to the customer as the new improvements became known.

Graphically, Figure 6 displays the support benefits as would be viewed from this hypothetical contract.

Implicit and Explicit Product Support Tasks

The fourth way of classifying product support is by dividing product support into those efforts which are identified as either implicit or explicit support.

As explicit product support task is a task which has been negotiated between the contractor and the concerned program office and is understood and accepted by the U.S. government, the participating foreign government and the contractor. The tasks listed in the proposed Armed Services Procurement Regulation 6-1304.3 and discussed earlier in this chapter constitute many of the explicit product support tasks. These tasks are general in nature and vague in definition.

PRODUCT SUPPORT PROVIDED TO A SINGLE CONTRACT

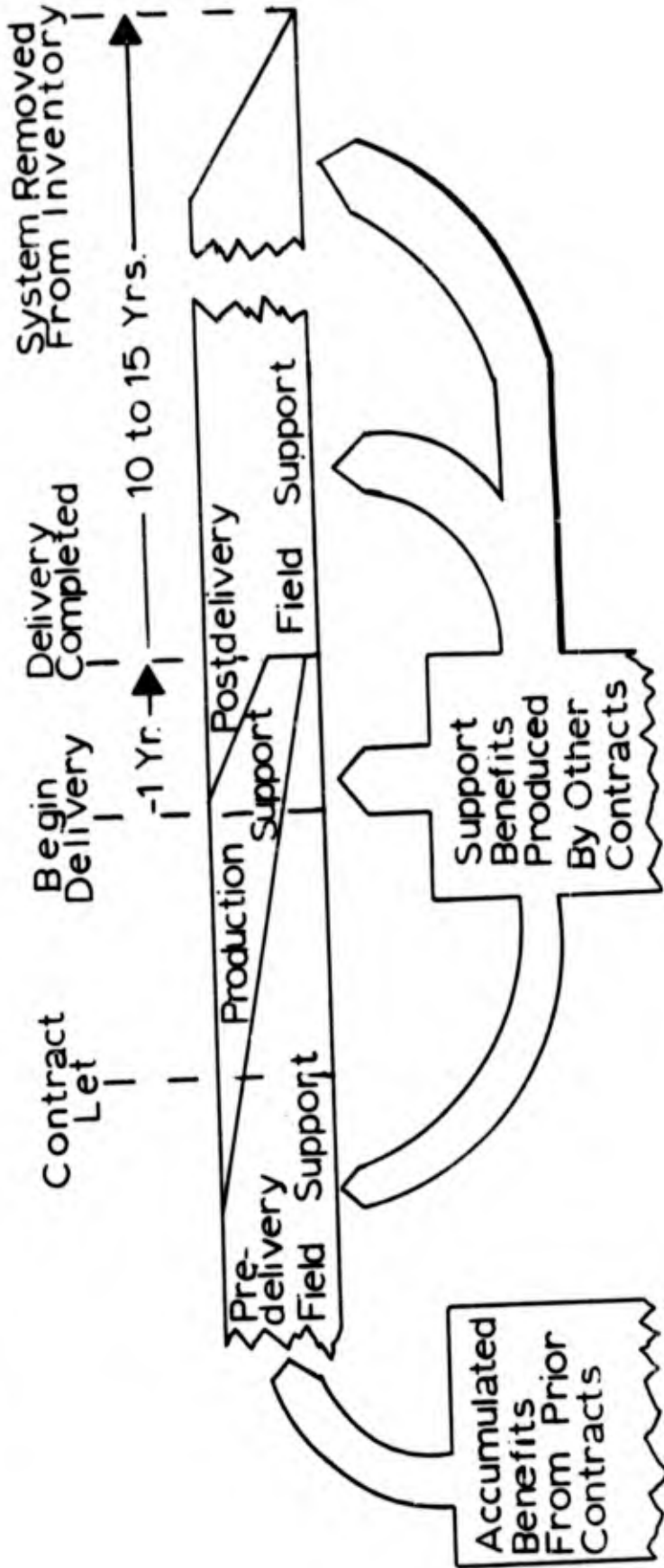


Figure 6

These poorly defined explicit tasks allow a great deal of latitude for the interpretation of what specific tasks belong to the product support function. In fact, the product support criteria are so broad in definition and general in nature that it is difficult to determine what level of product support is expected by the foreign government or intended by the U.S. government.

An implicit task is defined to be a task heretofore unexpressed in the sales agreement, which is required to comply with the agreement to provide product support. An implicit cost is the cost associated with the implicit task. An example of an implicit task can be found in the area of field support for weapon systems problems, an explicit task allowed under ASPR 6-1304. To provide the field support a contractor may find it necessary to conduct regular studies into material failures. The task of conducting regular material failure evaluations has not been defined as an explicit product support task. Since this task is considered to be necessary to comply with the agreement to provide field support, however, this task would be considered to be an implicit task resulting from an explicit obligation. Implicit tasks may be used for field support, production support, or both.

Within the foreign military sales programs, one soon discovers that not all obligations are explicit. An implicit obligation cannot be succinctly defined, but it should be recognized that these obligations exist. Usually the obligation can be traced back to the concept of providing comprehensive product support. Many times, since some support has either been provided in the past or is provided to others, one or more of the concerned parties in the foreign military sales operation will assume

that the support is obligated to continue. Since implicit agreements are determined by the perceptions of the manufacturer, the contracting agency and the purchasing agent, these perceptions may change over time. There thus is no practical way of relating the magnitude of implicit or explicit product support as was done in Figures 4 and 5.

However, manufacturers seem to be aware of what explicit and implicit support they will provide. This understanding becomes evident in the pricing of the system. Included in the unit price of a system is a price charged by the seller to perform some support effort. Many of the support efforts which are anticipated are explicitly stated and understood by all concerned, while there are many support tasks which are not explicitly stated. As a result, an understanding exists among one or more of the concerned parties that future product support will be provided at no additional expense. Thus, if product support is to be provided, manufacturers anticipate a certain level of implicit support and include these costs along with the explicit support costs in the unit price of the system.

Program Support Interfaced

Program support is provided by various manufacturing and support departments. The management and control of this support is often approached with a matrix type organization which has a complex arrangement of support interfaces. The manufacturing concern is usually organized into functional organizations as depicted in Figure 7, and the program managers and support management cut across the functional boundaries of the departments. Product support is not specifically identified with any department and is thus not managed as a specific entity.

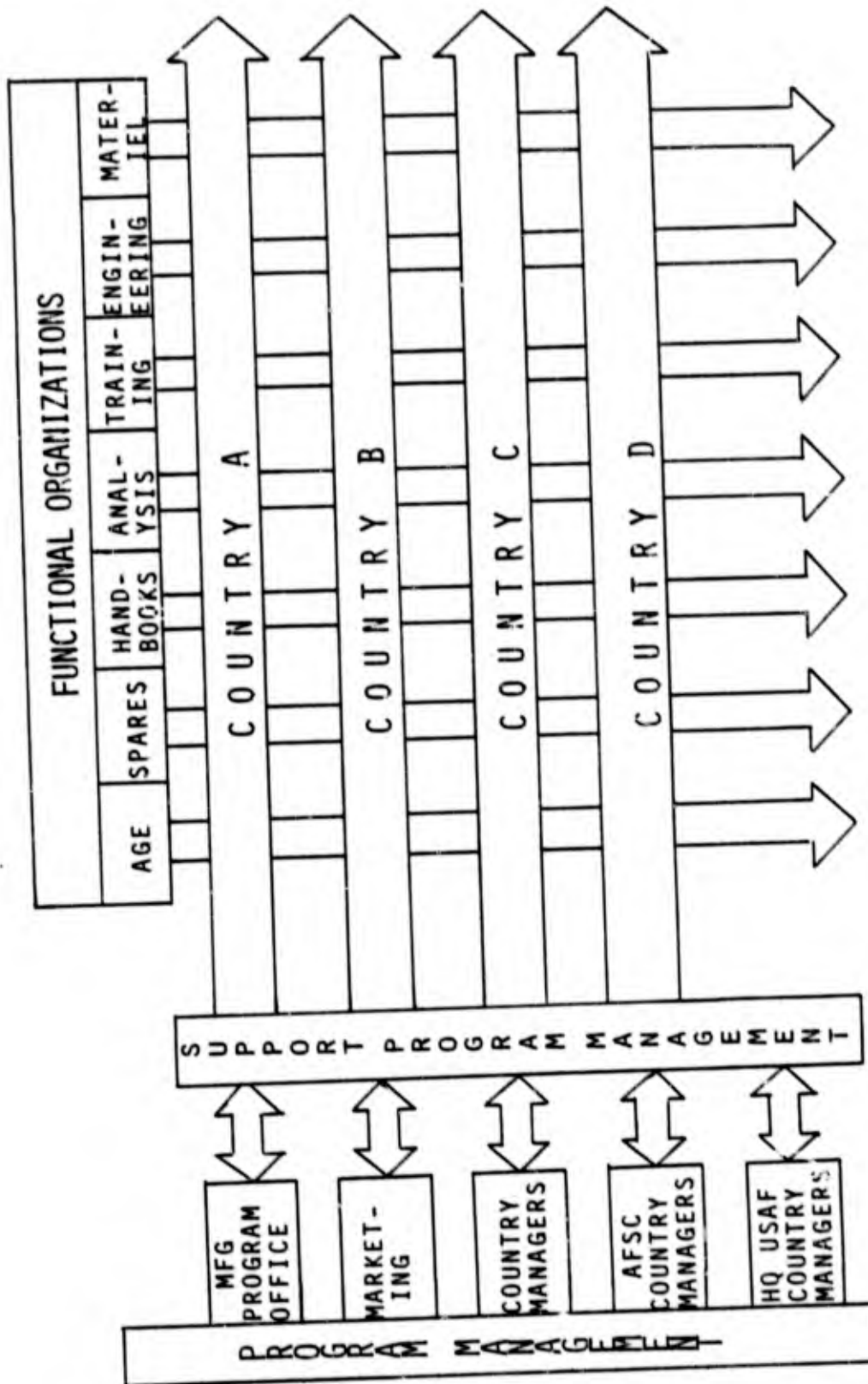


Figure 7. Support Program Interfaces

Summary

Product support is defined to be that support which is provided a system (product) and included with that system as a result of the initial acquisition process. This support may be in the form of studies, engineering drawings, documentataion updates, customer training, data collection, technical advice and so forth. When subdivided on the basis of various criteria, a set of terms can be defined which will help identify and categorize such support. These subdivisions are called "elements" of support.

Since this study could find no commonly accepted terms which adequately describe some of the support concepts, it was necessary to define a set of terms. The purpose of these terms is to assist Foreign Military Sales managers to identify, categorize and manage the support which is purchased as part of the acquisition process.

The first subdivision of product support utilizes chronological criteria. This subdivision produces two terms, predelivery and post-delivery product support. As the root word indicates in predelivery and postdelivery, the event which serves as the dividing line is the event of systems delivery. Predelivery support is that support provided prior to production, that support provided for the manufacturing process and most marketing support efforts. Postdelivery support is that product support which is provided to delivered aircraft and customers of delivered aircraft so that the aircraft can be maintained and effectively utilized. Also, postdelivery support can be viewed as an extension of quality control efforts which utilize data from operational systems to evaluate and improve the production effort.

associated with product support. An explicit support requirement is a requirement which has been clearly delineated in a purchase contract.

These terms will be applied in future chapters of this study so that the actual support efforts as they exist within the Foreign Military Sales environment can be identified, classified and managed. Specifically, terms developed in this chapter are applied to the F-5 program with emphasis on the postdelivery field support element.

III. METHODOLOGY

Introduction

The history of foreign military sales programs indicates that product support has been a problem area in most major foreign military sales operations. Some concern has been expressed by various U.S. government officials and officials from some of the major aerospace contractors that the product support provided under foreign military sales agreements is not adequately delivered, identified or understood by the U.S. government, foreign governments and the contractors. Because of the ambiguous nature of product support, especially in the area of field support, a number of problems continue to exist in this area.

In order to assist in identifying and understanding the characteristics of product support, the F-5 Program Office has been researching the area of product support as it exists within the foreign military sales environment. This study will also concentrate upon the F-5 program, with primary emphasis on postdelivery field support. The basic purpose of this study is to analyze the product support effort as it has evolved within the F-5 foreign military sales program. Although the scope of this study focuses on the F-5 program, the concepts and methodology developed in this study may be applicable to other foreign military sales programs.

Scope

The F-5 program is the focal point of this study, because it is the only major U.S. Air Force managed weapons system which is devoted

primarily to foreign military sales requirements. As such a program, the F-5 is reasonably uninfluenced by DOD requirements. Thus, the support which can be identified and analyzed in the F-5 program will be support resulting from the foreign military sales environment.

The primary emphasis of this study will be on that area which the author has identified as postdelivery field support. As indicated in Chapter II, this element of support seems to be the most costly element. Not only is this element costly, it also seems to be the element most poorly identified and understood by all parties involved. Other support elements will be discussed to the extent necessary to differentiate between the elements and establish the interrelationships which exist in product support.

Study Goals

There are four distinct goals established for this study. The first goal is to develop a set of definitions and concepts whereby the area of product support can be analyzed, problems identified and suggested solutions developed.

The second goal is to apply these concepts to a specific support effort (sustaining engineering) so that the tasks which comprise this effort can be categorized in a meaningful manner.

The third goal is to analyze the problems associated with the allocation of support costs among the various foreign military sales customers. Related to the analysis of support cost allocation, this study also addresses the funding of the support effort over the life of the system.

The fourth goal is to identify potential support problems, both as they exist and as they are predicted to exist. This is not to say that

the study will rigorously examine all support problems. Rather, this study will highlight some of the more significant problems which should be considered. As a result of this problem analysis, some suggested alternatives to product support are provided. These alternatives are not all possible solutions. Neither are the alternatives subjected to detailed analysis. These alternatives are intended to provide a basis from which other studies can identify and select an optimal support alternative.

Study Constraints

Political Implications. Political overtones and legal requirements are major forces in the environment in which military assistance programs/foreign military sales (MAP/FMS) programs exist. Because of the sensitive nature of such issues and the limited political and legal expertise of the author, these issues are addressed only in general terms in this study. This is not to imply, however, that these aspects are not significant. Many of the decisions regarding postdelivery product support for foreign military sales systems will be strongly influenced by political and legal exigencies and warrant further study.

Research Approach

The Study

Whenever several foreign countries acquire a weapon system from the U.S. government, problems often arise because of the diverse multinational requirements. Before a study of the F-5 postdelivery product support could begin, the requirements of the U.S. laws and regulations

applying to MAP/FMS had to be studied and understood. Additionally, a review of previous postdelivery product efforts provided MAP/FMS programs was performed to learn what type of situations have been and are currently being encountered.

Following this background study, the research effort was directed toward F-5 product support requirements. Several conferences were attended and numerous documents were reviewed in depth. Among the conferences attended were the Cost and Price Analysis Team (CAPAT) conference with Northrop Air Division. This team was composed of representatives from Aeronautical Systems Division (ASD), International Fighter Systems Program Office (IFSP0), the Air Force Plant Representative Office (AFPRO) representatives assigned to Northrop Corporation and Defense Contract Audit Agency (DCAA) staff. The team met at the Northrop Corporation in Hawthorne, California with Northrop representatives to evaluate the calendar year 1978 (CY 78) F-5 production proposal. Through participation in the conferences, which were conducted over a two week period in April 1976, and review of various plans developed by representatives of the U.S. government and Northrop, the decision was made to direct this research toward postdelivery field support problems. These problems were the most demanding problems identified in the conference.

Although the formal conferences and the supporting documentation provided important inputs to this study, additional valuable inputs to this study were realized from interviews with persons responsible for developing, writing and managing the various plans. Among the personnel interviewed were U.S. Air Force program managers, contracting officers, logistics officers, industrial contracting officers, industrial product support

managers, sustaining engineering managers and numerous other key personnel.

Many key personnel within Northrop, the F-5 airframe prime contractor, were also contacted. In order to obtain complete cooperation and candor, anonymity was guaranteed to those individuals who requested that their comments not be attributed to them. Only those individual who provided inputs as part of their official duties and those who have given consent to be quoted will be recognized and their inputs duly attributed.

These interviews were conducted in person, by telephone and by mail, depending upon the nature of the data sought, time constraints, and efficiency considerations. The information gained from these interviews proved to be crucial for this study.

Though not all of the data sources are used directly in the body of this study, all sources provided direction, depth and insight into the potential problem areas associated with the F-5 postdelivery product support. Because of the large number of interviews which were conducted and the voluminous archival material reviewed, however, only the most relevant data sources are included in the Bibliography.

The data collected were analyzed and categorized according to the terminology developed in Chapter II. Product support was examined to determine chronological relationships (predelivery/postdelivery support), functional relationships (production/field support), both chronological and functional relationships (predelivery production/field support and postdelivery production/field support), and the explicitness of the support. Based upon this analysis, selected potential problems were identified and a few alternative solutions presented.

The Presentation

Based upon the study, a number of issues, requirements and tasks were identified and organized into three main sections. The first section includes Chapter I, Introduction; Chapter II, Product Support, and Chapter III, Methodology. Chapter I provides the background and general information necessary for the further development of this study. Chapter II develops the terms, definitions and methodology whereby an analysis of product support can be attempted. Chapter III delineates the scope, research approach, limitations and assumptions of this study.

The second area of this study addresses the primary purpose of this study: the analysis of product support within the content of the terms and concepts developed in Chapter II. This section consists of Chapter IV, The International Fighter Systems Program, and Chapter V, Selected Aspects of F-5 Product Support. Chapter IV addresses the F-5 program in general terms and begins to apply product support concepts which have developed in the F-5 program. Chapter V examines product support for the F-5 program in detail. Actual support efforts are identified and the control of these efforts is discussed. Chapter V then classifies the support tasks of one Northrop classification of a support effort within the F-5 program and examines the expected trends in field support.

Based upon the analysis in Chapter IV and V, selected support problems are identified in the third area of study. This area includes Chapter VI, Selected Problems Related to Postdelivery Field Support for the F-5, Chapter VII, Selected Postdelivery Field Support Alternatives; and Chapter VIII, Summary and Conclusion. In addition to discussing selected support problems, which were identified in Chapter VI, Chapter VII presents four alternatives for assigning responsibility for field support management.

Three of the alternatives are applicable to any major foreign military sales program, while the fourth alternative is applicable mainly to the F-5 program. The last chapter in this section, Chapter VIII, provides a summary of the entire study and presents the conclusions drawn from the study.

Limitations

The preceding section described the scope of this research and discussed constraints as to the area which was studied. This section addresses those factors which limited the actual research effort itself. It is felt however, that these limitations did not significantly affect the research effort.

Timeliness of the Study

As this research effort began, the International Fighter System Program Office (IFSP0) was starting to negotiate the calendar year 1978 purchase of the F-5 aircraft. While this research was in progress a number of problems and suggested solutions were brought forth by the IFSP0, Northrop, and various other officials from both private industry and the U.S. government. As this study progressed some of the suggestions were already beginning to be implemented within the program. In order to ensure the timeliness of this study it was necessary to utilize the existing data without always being able to verify its accuracy and completeness. Only those significant changes were incorporated in the study when the sources which supplied the information were considered to be in a position to be informed and provide reliable information.

U.S. Sources

While foreign military sales programs involve large numbers of people and many agencies, only a limited number of people have been able to become familiar with many of the subtleties of the foreign military sales support requirements. As a result, some of the sources contacted concerning the foreign military sales postdelivery product support requirements who were expected to be able to provide a different perspective were unable to do so. The comments of these individuals thus may reflect a lack of knowledge rather than a different perspective. The lack of any significant input from these sources is a limitation imposed upon this research.

Participating Foreign Governments

Because of time, travel and the magnitude of the undertaking, it was not possible to interview various officials from other nations which are involved in the F-5 program. The omission of this perspective creates a significant gap in this study. The experience and opinions of these customers would have provided an extremely valuable input to this study. The absence of such significant data is the primary limitation of this research. The absence of these data does not, however, invalidate either the developed terminology or the findings of this study.

Interviews

Because of the physical distance between Northrop in Hawthorne, California, and the IFSP0 at Wright-Patterson Air Force Base, Ohio, access to several key personnel within the firm as well as resident AFPRO and DCAA personnel was hampered. Time, money, travel and the lack of availability of the concerned individuals created this problem. Whenever

personal interviews proved to be impractical, the concerned individuals were contacted by either telephone or mail. In such cases some of the valuable candidness which existed in the interviews was lost. Although these methods were not the preferred techniques for obtaining data, it is felt that much valuable information was nevertheless obtained.

Assumptions

Intentions of the U.S. Government and Involved Companies

It is assumed that the U.S. government and the involved companies intend to fulfill their obligations arising from foreign military sales contracts. These obligations are both implicit and explicit in nature. Historical information indicates that the U.S. government does not distinguish between fulfilling explicit and implicit obligations, and the involved foreign governments expect these obligations to be fulfilled. It is thus assumed for the purpose of this study that the involved foreign governments will continue to expect the U.S. government and the concerned companies to fulfill all obligations, and the U.S. government and the involved companies will seek ways to continue to meet all obligations.

Monitoring Postdelivery Product Support Requirements

In numbers of systems, numbers of countries and total dollar figures the U.S. government has been increasing the volume for foreign military sales over the past decade and appears likely to continue to do so in the near future. Because of the political impact and the large dollar value of the programs, it is assumed that the U.S. Government, Participating

Foreign Governments and concerned companies will desire to be made continually aware of the status and degree of fulfillment of the postdelivery product support commitments. It is further assumed that without a thorough understanding of the postdelivery product support requirements and an ability to adequately identify, manage and track the support tasks, it will be most difficult for the IFSP0 to accurately report on the status of postdelivery support.

IV. THE INTERNATIONAL FIGHTER SYSTEMS PROGRAM

Scope and Purpose of Chapter

The background and structure of the F-5 International Fighter Systems Program are of importance when one tries to understand the characteristics of foreign military sales product support requirements. Relevant international considerations and historical aspects of the F-5 program are discussed in this chapter to aid in understanding the evolution of foreign military sales and product support. This chapter then investigates the unique foreign military sales aspects of the F-5 system, describes the various models of the F-5 and discusses the scope of the F-5 program. The pricing of product support for foreign military sales programs is studied, and the differences between support requirements are presented. This chapter then once again focuses on the F-5 program and discusses F-5 product support. The chapter concludes with a brief outline of problems associated with F-5 product support.

Background of the F-5 Program

On the first of January, 1963, the International Fighter System Program Office (IFSP0) was established at Wright-Patterson Air Force Base, Ohio. This program office is assigned to the Aeronautical Systems Division, which in turn is part of the Air Force Systems Command. The purpose of the IFSP0 is to manage acquisition of the F-5 International Fighter (7).

The F-5 was an outgrowth of the U.S. Air Force T-38 supersonic trainer aircraft. The small, relatively fast F-5 aircraft has the potential of

being utilized both as a trainer and a weapon system. The basic concept behind the development of the F-5 was to produce a simple, economical aircraft that could be adapted to meet a variety of requirements.

Unique Aspects of the F-5 System

There are two aspects of the F-5 which have made the management of this program singularly different from any of the other major weapons programs. The first aspect is that the F-5, a U.S. system, was not designed to be a standard weapons system for the U.S. Air Force or any other Department of Defense agency. The intended primary purpose of the F-5 is to fulfill specific requirements for military assistance programs.

The second aspect which makes the F-5 unique among major weapon systems is related to the first aspect. Of the ten largest foreign military sales contractors up through 1974, the Northrop manufactured F-5 is the only system which is not in the U.S. inventory of operational weapon systems. Even though the F-5 was the second largest foreign military sales program in total sales dollars and the largest foreign military sales aircraft program through 1974, the F-5 was never incorporated in the U.S. inventory as a weapon system. The F-5 was and is a U.S. designed, U.S. manufactured and U.S. managed program expressly committed only to the rapidly expanding foreign markets (8).

Because of these two aspects, the unique F-5 program presents some product support problems which are also unique. Before these unique problems can be addressed, an understanding of the basic F-5 and the scope of the F-5 program is required.

Basic F-5 Models

The basic F-5, without any of the options, is called a "vanilla" aircraft. The "vanilla" model is not what is sold to foreign governments. Rather, it is a basic configuration on which various options are added so that a complete weapons system can be tailor-made for the individual customer.

There are four primary F-5 models designated the F-5A, F-5B, F-5E and F-5F. The A and B models are the earliest versions of the F-5 while the E and F are the latest versions. A model designation does not of itself indicate different options. Rather, each basic model constitutes one of the four F-5 "vanilla" models that have been or will be produced. The F-5A and B can be thought of as similar models with the major difference being that one is a single-seated model while the other is a two-seated model. They can be considered to form a compatible team of fighter aircraft and trainer aircraft with fighter capabilities. Special reconnaissance models designated RF-5A were also manufactured. The F-5E and F are likewise similar models with the most notable difference again being the E model is a single-seated version and the F model is a two-seated version. After 1976, only the E and F models will be manufactured by Northrop. The F-5E does resemble the F-5A, a single-place, supersonic aircraft powered by two engines; however, the E model has more powerful engines, an increased range, speed, rate of climb, payload and increased air combat capability over the F-5A and B aircraft. The F-5F is similar to the E model in capabilities except that the armament differs significantly. The F-5E has two twenty millimeter cannons with a

total capacity of 480 rounds, while the F-5F has one cannon with 140 total rounds. Together the E and F models combine into the compatible roles of weapons system and weapon system trainer, just as the F-5A/B have done (9).

The Scope of the F-5 Program

The F-5A/B, RF-5A Program

One indication of the success of the F-5 program is the large numbers of aircraft produced and sold. The earlier production phase of the F-5 program consisted of the F-5A/B and RF-5A aircraft. This phase of the program has terminated and no additional F-5A/B and RF-5A aircraft are planned to be produced. There have been 621 F-5A aircraft, 179 F-5B aircraft and 89 RF-5A produced. Table I chronologically displays the number of aircraft sold within this phase of the program.

Table I

Quantity of F-5A/B and RF-5A Procured by Fiscal Year and Model (10).

Fiscal Year	Description and Quantity				
	F-5A	F-5B	RF-5A	Total	Cumulative
1963	71	15	-	86	86
1964	71	12	-	83	169
1965	106	14	-	120	209
1966	121	15	-	136	425
1967	101	17	13	131	556
1968	8	2	-	10	566
1968	43	11	19	73	639
1969	48	4	37	89	728
1970	35	8	9	52	780
1971	17	2	11	30	810
1972	-	34	-	34	844
1973	-	11	-	11	855
1974	-	28	-	28	883
1975	-	6	-	6	889
TOTAL	621	179	89	889	

Location of F-5A/B Aircraft

These aircraft were delivered to countries around the world. A total of 17 countries, plus training and test aircraft located in the U.S., account for all aircraft produced. The aircraft located in the U.S. are not part of the U.S. weapon systems inventory, but are for the support of foreign governments. The location of these aircraft by country and the type of funding used to purchase these aircraft are detailed in Table II. The data presented in this table reflect a few internal changes and adjustments in the numbers and location of aircraft. This table is current as of June 1976.

Summary of the Cost for the F-5A/B and RF-5A Programs

The total quantity of F-5A/B and RF-5A aircraft produced and sold indicate that this F-5 program was a large program. Another way of indicating the size of the program is to examine the total dollar "cost" or the total dollars generated by the contractor for the basic (vanilla) F-5A/B and RF-5A aircraft. Table III summarizes the contract dollars or "cost" of the F-5A/B and RF-5A programs.

The figures cited in Table III do not include the actual manpower costs that the U.S. government incurred or any of the related support expenses which may have been intermingled and absorbed by the F-5E/F program. Before this point can be further explored, however, an understanding of the F-5E/F program should be developed.

Table II
F-5A, F-5B and RF-5A Organized by Types of Funding and Country Involved

Total Military Sales Aircraft	Type Funding			Training-United States	Test United States	Iran	Korea	Greece	Philippines	Taiwan	Turkey	Norway	Ethiopia	Morocco	Thailand	Vietnam	Libya	Saudi Arabia	Jordan	Malaysia	Brazil	
	FMS	MASF	MAP/GA																			
F-5A 621	100					38			19			23		12			8					
		61					4								8	49						
			460		1	66	83	52	19	72	75	55	13	6	4							
F-5B 179	71					10	13			12		8		1				3	20	2	2	6
		11														11						
					1	13	22	9	3	11	13	6	2	3	2							
RF-5A 89	18 (5)																					
		14																				
			57																			
TOTALS	189	86	608																			

Table III
 F5A/B, RF-5A Summary Costs

Aircraft Model	Types of Sales	Quantity	COST (IN MILLIONS)		
			Production	Research and Development	Total
F-5A	FMS	100			
	MASF	61			
	Grant Aid	460			
		621	\$ 50.86	\$46.9	\$555.5
F-5B	FMS	71			
	MASF	11			
	Grant Aid	91			
	Direct Sales	6			
		179	\$200.5	Included Above	\$200.5 ¹
RF-5A	FMS	18			
	MASF	14			
	Grant Aid	57			
		89	\$75.4	\$ 2.2	\$ 77.6
TOTAL	FMS	189			
	MASF	86			
	Grant Aid	608			
	Direct Sales	6			
		889	\$784.5	\$49.1	\$833.6

(1) The only dollar figures included from direct sales are for government furnished aeronautical equipment

The F-5E/F Program

The F-5E/F aircraft are currently being produced and are to be produced at least through calendar year 1979. The general status as of March 1976 of the F-5E/F programs is summarized in Table IV.

Table IV
Summary of F-5E/F Aircraft as of March 1976 (13)

Aircraft Model	Delivered	Programmed for Delivery	Total
F-5E	322	534	856
F-5F	-0-	91	91
TOTAL	322	625	947

Table V summarizes the F-5 sales by country or, in one case, program title. The program title is used in place of the name of the country, since negotiations are in progress and information beyond that given in Table V is considered sensitive. The figures in Table V have been adjusted to reflect the relocation of some aircraft and the attrition of others. Also, since Table IV uses data current as of March 1976 and Table V uses data current as of 23 July 1976, the total quantities of aircraft differ.

Table V
F-5E/F Programs Organized by Country (14)

Country	Aircraft Model		Method of Acquisition
	F-5E	F-5F	
Brazil	36	-0-	Direct Sales
Chili	15	3	FMS
Tiawan ¹	162	18	Direct/Coproduction
Iran	142	28	FMS
Jordan	42	2	Grant Aid
Kenya	10	2	FMS
Malaysia	14	-0-	FMS
Saudia Arabia	72	24	FMS
Switzerland	66	6	FMS
Thailand	13	3	FMS
Korea	12	-0-	Grant Aid
Korea	54	6	FMS
Peace Lion	16	-0-	FMS
U.S. Test Aircraft ²	4	2	
U.S. Navy ³	8		
U.S. Air Force ³	67		
U.S. ⁴	75		

(1) The figures shown for Tiawan reflect total aircraft delivered and under contract to be delivered through June 1980. All other figures reflect delivered aircraft and aircraft under contract through March 1979.

(2) The test aircraft are for the support of the Security Assistance Programs, not U.S. Air Force support.

(3) The aircraft owned by the U.S. Air Force and U.S. Navy are for playing the role of aggressor aircraft for combat crew training for other fighter systems. These aircraft are not operational U.S. weapons systems.

(4) The 75 MASF aircraft belonged to the Republic of Vietnam. These aircraft are not all serviceable, Some are in storage, some are on loan to other organizations and some were captured by North Vietnam.

As the data indicate, the F-5E/F program is a large program as was the F-5A/B. Table VI further demonstrates the size of the F-5E/F program by summarizing the total "costs" or contract dollar value of the F-5E/F aircraft which have been delivered or are under contract to be delivered.

These figures exclude direct sales, except for government furnished aerospace equipment. All other types of sales are included.

Table VI
Summary of Total Contract Dollar Value of the F-5E/F (15)

Aircraft Model	Development	Production	Total
F-5E	\$239.6	\$2,119	\$2,358.6
F-5F	122.8	407.4	530.2
GRAND TOTAL	\$362.4	\$2,526.4	\$2,888.8

NOTE: Dollars in millions

Of the total dollar figure of 2,888.8 million dollars for F-5E/F aircraft delivered or under contract to be delivered, 2,173 million dollars are generated by foreign military sales programs. These dollar figures represent the fly-away price which is charged to F-5 customers. It is generally conceded by the prime manufacturer of the F-5, Northrop, and the IFSP0 that a very large portion of these costs are the costs related to F-5 product support. A further discussion of product support, the underlying philosophies and the pricing policies will indicate how product support relates to the foreign market and provide some perspective to problems relating to product support.

Pricing of Product Support

Background

Since the U.S. government manages all security assistance programs except direct sales, the U.S. government is charged with negotiating

a "fair price" for the procurement of foreign military sales efforts.

When the Department of Defense undertakes procurement for sale to a foreign country...the Department of Defense assumes responsibility to see to it that no more than a fair price is paid for the procurement. Accordingly, Foreign Military Sales contracts shall be priced on the same principles and with the same care as are used in pricing normal defense contracts (6).

It is recognized, however, that pricing principles for these foreign military sales can produce different results than would occur on a strictly Department of Defense contract. The reason for this difference is explained by the fact that "...certain kinds of costs may reasonably and allocably arise..." which are not the same for foreign procurements and U.S. procurements (16).

Support Capabilities

The basis for these costs is due to the differences between the support/operational requirements of the U.S. procurements and the support/operational requirements of foreign procurements. Because the U.S. Air Force has large support oriented commands such as the Air Force Systems Command and the Air Force Logistics Command and most foreign military sales client countries lack such resources, a difference in the levels and types of support procured in the acquisition phase exists.

Because of the U.S. Air Force owned support agencies, the U.S. Air Force either possesses vast technological expertise or has access to civilian organizations with vast expertise. An entire command (Air Force Systems Command) is dedicated toward research, development and procurement. A second support command (Air Force Logistics Command) is dedicated toward resupply, field support and overall logistics for the

systems within the U.S. Air Force. These two commands have access to the latest data systems, engineers, immense historical libraries, scientists, analysts, and so forth. From the moment an idea for a weapon system is conceived until that system has been removed from the inventory, procedures exist within the U.S. Air Force for the application and management of these resources. While problems do occur in the weapon systems, per se, no other nation is known to have a better support system.

Support Included in the Acquisition Price

Often a foreign country interested in procuring a weapon system from the U.S. depends upon the U.S. Air Force to determine the actual capabilities of the country, identify its requirements, assist in making purchases and monitor the deployment of the weapon system. These countries thus expect more from the U.S. than just a piece of hardware. Although on the surface it may seem as if a typical foreign military sale is for a specific piece of hardware, both explicit and implicit product support are usually assumed to be a part of the purchase agreement. With the exception of follow-on support, most countries expect the prices quoted to them for the completed system to include whatever cost is required to insure that the system purchased is indeed "complete" (17).

For a number of reasons, most countries would strongly object to the discovery that additional payments for additional service costs would be required of them after they had already paid the negotiated price for the system. When the aircraft comes off of the assembly line, and a final unit price is calculated, the foreign government expects the purchase price to be finalized. Future billings for additional support

costs or the curtailment of expected support for which the customer has assumed entitlement could be damaging to the foreign country and the prestige of the U.S. Such difficulties can discourage countries from pursuing separate follow-on support contracts from the U.S. and also lead to the termination of additional foreign military sales/direct sales efforts.

Each time a foreign government is required to obtain additional unexpected funds for a program, the purchase becomes vulnerable to internal pressures and criticism. In essence, the foreign government depends upon the U.S. to provide it with a single bill which is accurate and complete and covers all explicit and implicit support requirements. The costs for this support are generally expected to be included as part of the unit price, which in turn is also expected to be at or close to the negotiated price (18).

F-5 Product Support

Not all countries expect or want to have that product support purchased in the acquisition phase explicitly stated. One source within the F-5 program stated that one of the larger F-5 purchases would not have occurred if all of the support had been detailed. Within the government of that country many recognized that these support costs were included in the unit price, and the government, in fact, expected all of the support. However, as the chief official of that country noted, internal opposition and misinformation would have made the sale impossible if it appeared that the country was paying for anything other than a piece of hardware. That country, like many other foreign governments, wished to

minimize the appearance of having an insufficient technological base to provide its own support and thus becoming dependent upon the U.S. for military or technical support.

In an attempt to satisfy the support requirements of foreign governments and at the same time satisfy all U.S. regulations and laws, the method of purchasing the F-5 has been continually evolving. As of June 1976, the IFSP0 negotiates for a specific number of aircraft to be manufactured by Northrop over a given period of time. This arrangement is somewhat flexible in an attempt to accommodate anticipated quantity, configuration and delivery dates of perspective customers. The negotiations are for "vanilla" configured aircraft, which can be tailored for the specific configuration requirements of each country as the requirements become known.

The innovative method of purchasing the F-5 aircraft is generally accepted as successful. However, the inclusion of product support with the acquisition process has presented some difficult problems.

Problems Associated with Product Support for the F-5

Since the sale of F-5 aircraft are to a number of countries and occur over the production life of the system, a problem arises in distributing support costs to all benefiting countries. An expensive service provided in one year often benefits other nations which either have purchased or will eventually purchase the system. Another problem is determining exactly what level of services should be included in the purchase price and how long these services should be provided. An additional problem is identifying what specific tasks are to be performed

in providing these services and identifying their actual costs. Within the F-5 program, no acceptable final answer has been developed for these questions. Essentially the support is provided by various departments in Northrop and purchased by the IFSP0 as a level of effort. For pricing proposal purposes most of these support costs are derived by Northrop, supposedly as a function of fabrication and assembly hours. These hours in turn are classified as part of the airframe manufacturing expenses (18).

Summary

The F-5 system is a unique weapon system in that it is designed, developed and manufactured primarily in the U.S. for the purpose of satisfying foreign military sales customers. As such, the F-5 is not a standard weapons system within the U.S. Air Force or any other Department of Defense agency.

Since the F-5 is a major foreign military sales weapons system and is not supported as part of the Department of Defense inventory, the F-5 presents some unique product support problems. Since the F-5 is a very large program, reaching several countries and costing hundreds of millions of dollars, the impact of the support problems can be significant.

The product support for the F-5 has been traditionally included in the purchase price of the aircraft. The customer receives one billing which covers both the hardware and the product support for the hardware. The support costs are derived by Northrop, as a function of the aircraft fabrication and assembly hours.

V. SELECTED ASPECTS OF F-5 PRODUCT SUPPORT

Background

Since the F-5 is a U.S. manufactured system primarily utilized by foreign governments, some unique support problems exist within the program. Within the International Fighter System Program Office (IFSP0), many individuals have expressed concern over the lack of precedence concerning foreign military sales product support problems. While it is true that a certain amount of product support is purchased as part of any weapon system acquisition process, there is little guidance as to how much support is proper and how this support is to be managed. By utilizing in-house Air Force resources when possible and initiating outside contracts on a "call" basis as needed, the Air Force Systems Command and Air Force Logistics Command have been able to somewhat control product support. However, when the element of MAP/FMS is introduced into a program, product support becomes a problem. When foreign governments become dominant customers, such as is the case with the F-5 program, product support becomes a major problem.

Scope and Purpose

This chapter applies those theoretical terms and definitions developed in the earlier chapters to an ongoing foreign military sales program. This program (the F-5) was discussed in general terms in the preceding chapter. In this chapter the actual F-5 product support will be examined from various perspectives in an attempt to identify

what the support is, how the support is controlled and how the support is generated. After discussing product support as it pertains to the F-5 and Northrop, a single Northrop classification of product support, sustaining engineering, is singled out for a more detailed study. The purpose of this more detailed study is to further apply the concepts developed by the study and identify and categorize field support efforts within a single Northrop support effort.

The overall support trends and interrelationship of the support efforts are discussed. The implication of the support trends are examined with an emphasis on future ramifications. Specific postdelivery field support problems, however, are not addressed in this chapter. Such problems will be presented in Chapter VI.

Product Support Classifications

As discussed in Chapter II, product support can be viewed as a unit which can be subdivided into distinct elements. By viewing product support from a chronological perspective, the resulting two elements are predelivery and postdelivery support. Predelivery support is that product support provided to the production process, the weapon system and the customers of the weapon system prior to weapon system delivery. Postdelivery support is all other support provided the weapon system and customer after delivery.

By dividing product support functionally, two elements are also produced. These are production support and field support. Production support can be defined as that product support which is required to keep the production system operating and current. Field support is defined as that product support provided customers and prospective customers and

is directed at providing expertise and resources for the identification and solution of problems related to operational aircraft.

The classifications of predelivery and postdelivery and field/production support can be combined to further subdivide product support into four distinct elements. The first two elements are predelivery production and postdelivery production support. The second two elements are predelivery field support and postdelivery field support.

Because of the interrelationship of all of the product support elements, it is necessary that all elements be addressed. However, as stated in Chapter III, the scope of this study is primarily concerned with the most costly element of product support, postdelivery field support. The three other elements will be addressed only to the extent necessary to identify their interrelationships with postdelivery field support.

Predelivery Product Support

Predelivery Field Support. As long as a program can be marketed, a level of marketing effort in the field will be required in order to secure the sale. This predelivery field support is not only provided prior to delivery, it is provided prior to any sale contract.

The requirement for predelivery product support began to be recognized as a problem for private industry in the 1963-1964 time period (19). Previously, this predelivery field support had not always been of concern to private industry. United States Military Assistance Programs were now, however, being severely reduced. During this same period of time, foreign military sales/direct sales were encouraged and on the

to be provided (17). This led to revisions of the Armed Services Procurement Regulation (ASPR) and the development of ASPR 6-705.3, which was in turn recently updated in a proposed ASPR revision 6-1304.3, dated March 1976.

Armed Services Procurement Regulation (ASPR) 6-705.3 recognizes that certain costs of doing business with foreign governments will be incurred by the manufacturers and are therefore allowable costs of conducting business. The predelivery field support task associated with these allowable costs are primarily oriented toward one marketing function. Obviously, such tasks will no longer be required once production of the system has terminated.

Significant Questions Concerning Predelivery Field Support. Since the ASPR and related regulations are general and intended only as guidelines, many unanswered questions exist. These questions assume considerable significance within the IFSP0, since the F-5 is utilized almost totally by foreign governments. In the predelivery field support phase, one should recognize that most of the field support occurs prior to an actual sales agreement. As a result, the questions which plague the IFSP0 are quite complex. Examples of some of the presale support questions which have arisen are:

- (1) How much should a company be allowed to spend in this phase?
- (2) Will competing companies be restricted to the same levels of expenditure for this marketing type activity so that no comparative advantage is given? Can such a policy be extended so that it applies to companies owned by other countries?

- (3) When a country does not buy, how will the presale expenses be absorbed or allocated?
- (4) What criteria should be used to allocate presale expenses among contracts?
- (5) How are funds which are used for this support to be managed?
- (6) What specific tasks should be permitted in the name of pre-delivery product support?

Officials within the Northrop Corporation, the International Fighter Systems Program Office, and the Defense Contract Audit Agency all agree that no mutually acceptable answer to these questions has yet been developed. A number of stop-gap measures have thus been attempted. The primary measure, Predelivery and Postdelivery Product Support (PAPS), will be discussed in more detail later in this chapter.

Predelivery Production Support. Virtually all manufacturing contracts expect and require a certain level of production support as a weapon system moves through the production process. This support has been defined by Northrop personnel as "...that support required to keep the production line operating and current..." (20). The predelivery production support element is depicted in Figure 9.

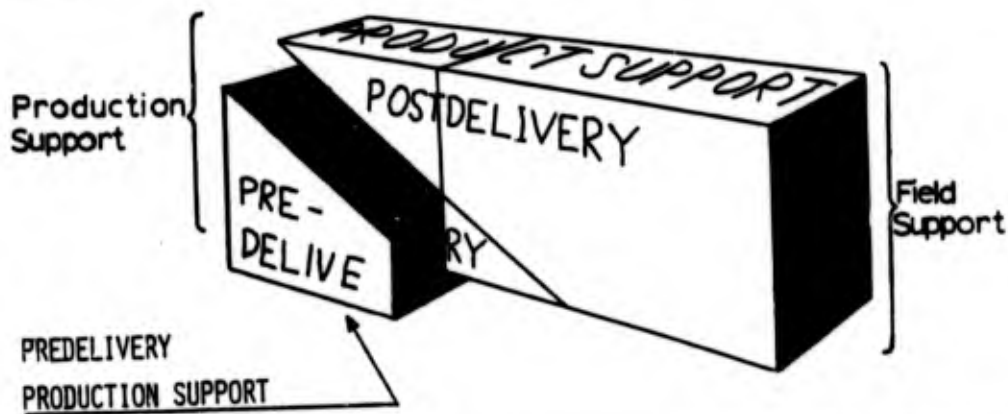


Figure 9. The Predelivery Production Support Element of Product Support

Most of the personnel and expertise involved in providing this production support also provide some field support during the predelivery phase and during most of the postdelivery phase. Thus, over any given period, a single department or an individual within a department may be providing production support for future delivery, presale field support for prospective sales and postdelivery support for past sales. The implications of this will be discussed further in Chapter VII.

The production support provided for the actual manufacturing process for the F-5 program is not significantly different from the traditional nonforeign procurement situation. Thus, further discussion of production support for the F-5 is not considered to be necessary for this study.

Postdelivery Product Support

"Product support is much like an iceberg: selling and manufacturing tasks are the tip and postdelivery product support is the large mass out of sight below the surface..." (21). Postdelivery product support is the area of support purchased during the procurement phase of a contract which causes the greatest concern among the contract managers of both the IFSP0 and Northrop. Since postdelivery product support has had no generally accepted definition and has not been properly categorized in the past, it is difficult to identify and manage this support. Although most of this support is oriented toward operational systems in the field, there are implications for aircraft still in the production process. These implications will become clearer in the next two sections of this chapter where field support is broken down into postdelivery field support and postdelivery production support.

Postdelivery Production Support. Postdelivery production support (Figure 10) can be defined as that support which is provided the production process as a result of data collected for operational aircraft.

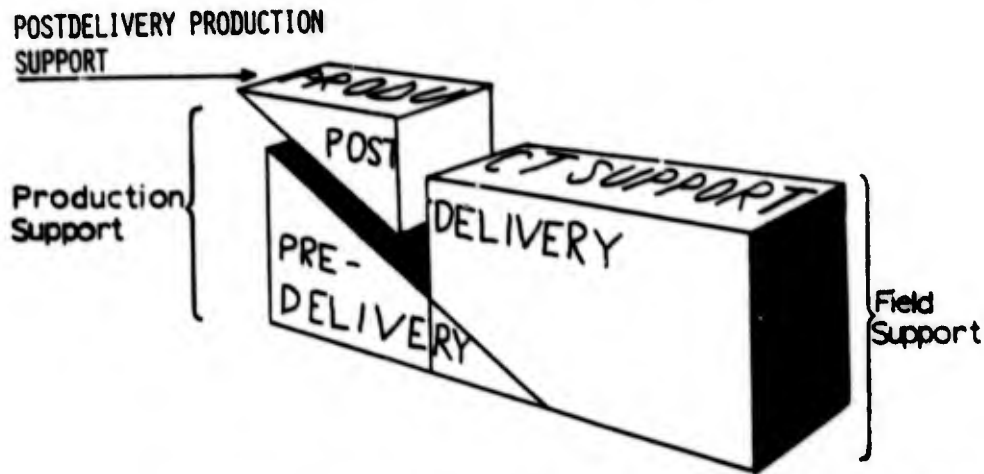


Figure 10. The Postdelivery Production Support Element of Product Support

After a single system has been manufactured and delivered to the customer, follow-up as to the operational history of that single system can provide information useful in updating and changing the continuing production process. Reports on aircraft already delivered can be viewed as an extension of the quality control and testing program conducted at the plant. Thus, when items are identified as exceeding or not meeting expected requirements, the production process can be modified. Although this modification will not necessarily affect aircraft already delivered, these delivered aircraft can have a significant impact on future production models by providing quality control feedback to the production process.

Postdelivery Field Support. Postdelivery field support is defined to be that support provided customers to help maintain aircraft safety, operational effectiveness and other support improvements throughout the operational life of the aircraft. Postdelivery field support (Figure 11) is the largest single product support element. This is not to imply that at any given moment the level of effort which is directed at postdelivery field support is greater than the other levels of effort directed at the other product support elements. Rather, the postdelivery field support will be provided over the longest period of time, and the cumulative effort will be greater than the effort for each of the other single elements.

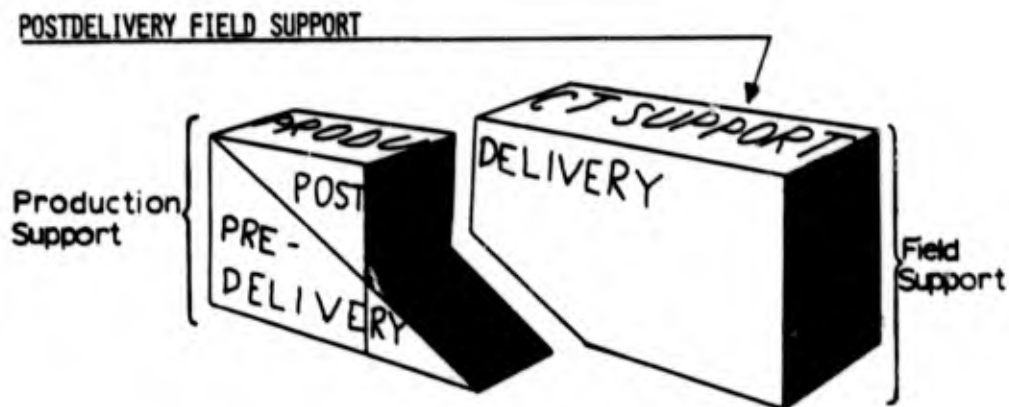


Figure 11. The Postdelivery Field Support Element of Product Support

To help identify the actual F-5 support efforts and categorize them according to the elements developed earlier in this study, product support will be examined from the perspective of the particular aircraft models produced.

Product Support From the Perspective of the F-5A/BPostdelivery Support, F-5A/B

In earlier attempts to identify and manage postdelivery support tasks and their associated costs for the F-5A/B and RF-5A programs, the IFSPD estimated that postdelivery field support had grown from 1.2 percent of the unit flyaway price in 1963 to seven percent of the flyaway price in 1971 (22:1-5). It was also noted that the closely related system, the T-38, experienced a growth in postdelivery field support costs from 1.7 percent of the unit price in 1963 to 3.9 percent of the unit price in 1970. The accuracy of these figures are questionable, however, since the data collected were improperly identified and categorized.

The data were improperly identified because it was the source of the support request rather than the nature of the support which was used to identify and classify field support efforts. This improper identification resulted in many field support efforts being improperly categorized as production efforts. It is also possible that some production support was categorized as field support in those cases where the problem was first identified in the field. Thus, those cost figures attributed to field/production support are "contaminated." Despite this "contamination," the increase in the support costs is discernable. It is only the actual increase attributable to postdelivery field support costs which cannot be accurately determined.

Inaccurate identification and reporting of product support tasks and costs also occurred because many of the same facilities and resources were utilized to provide efforts and tasks which comprise all

elements of product support. Neither predelivery/postdelivery nor field/production support efforts and tasks have been accurately identified and subdivided either for managers within Northrop or the U.S. government. Thus, the large and costly area of product support was treated by Northrop like a pool which could be utilized to address all aspects of product support. The effect of treating product support as one large effort has been to diminish the utility of the data. It should be noted, however, that the pooling of product support was a predictable and logical approach by Northrop in that Northrop perceived product support primarily as a funding problem, not an allocation problem.

Agencies of the U.S. government have tended to ignore the area of product support. Left to their own devices, Northrop tried to simplify the product support situation. The allocation of costs associated with product support tasks has been treated by Northrop largely as an accounting type problem. The division of field/production support is the only division of product support attempted by Northrop and has been kept simple for the sake of expediency. Whenever a problem is recognized in the field or a customer generates a query, all resulting efforts are charged to field support. If the problem is recognized within Northrop or any other source not in the field, the support is usually charged to the production effort (20). This procedure does not consider to whom the benefits will accrue nor attempt to reflect the actual field/production support cost relationships. It is a procedure developed mainly for accounting purposes. It does have limited utility as a reporting procedure, but it is not a rigidly accurate procedure developed for managerial control.

Therefore, because of the accounting and reporting procedure for product support for the F-5, the reported increases in support costs for the F-5A/B which were first discussed at the beginning of this section should be evaluated carefully. The primary implication those figures convey is that the general area of product support for the F-5A/B did indeed increase over time. In view of the diminishing production effort which occurred near the end of the F-5A/B program, it is reasonable to assume production support costs were decreasing. Since product support costs were increasing during this period of decreasing production support costs, it is thus reasonable to conclude that postdelivery field support was driving the increase.

Allocation of Postdelivery Field Support Costs, F-5A/B

Postdelivery field support, unlike production support, does not terminate when the production process is terminated. If all F-5 production were to cease immediately, postdelivery product support requirements would still exist. This simple fact has led to some difficult situations. In actuality, when a country purchased aircraft, it was paying for both a part of its production support costs and a part of the post-delivery field support costs for aircraft sold under earlier contracts (22). That is to say, the unit price of the aircraft included actual production costs, production support costs, and all postdelivery field support costs for the support provided to aircraft sold under prior contracts and supported during a specified time interval. In essence, the product support element of an aircraft's total unit cost was calculated by dividing all product support costs for a given period by the total number of aircraft produced in that period.

Product support for those countries that were purchasing aircraft during the final years of production could not continue indefinitely as it had for the earlier customers. The reason this support could not be continued indefinitely was that no new contracts to fund this support would be forthcoming. Thus, the method of calculating the expected costs for postdelivery field support and allocating these costs to contracts for undelivered aircraft as part of their production effort became infeasible.

Interdependence of F-5A/B Support and the F-5E/F Programs

One of the major sources of salvation for the F-5A/B postproduction field support dilemma was the F-5E/F programs. While F-5A/B tasks and costs were not supposed to be allocated to F-5E/F efforts, the similarity of the F-5E/F and the A/B models allowed much of the expertise necessary to support the A/B models to be retained by Northrop. An interdependence of F-5A/B support efforts exists with the F-5E/F production and support efforts, even though the support for the F-5A/B is managed by AFLC and the F-5E/F procurement and support is managed by AFSC. Management of product support by the two commands differs, however. Air Force Systems Command provides a level of support which is part of the procurement process, while AFLC utilizes a "call" type of support. Whenever AFLC determines that Northrop support is required, the support is requested. If the resulting study results in an Engineering Change Proposal (ECP), the concerned countries, as with any ECP action, would let a contract and pay for the support (9).

If the support does not result in an ECP, no "call" is issued and Northrop supposedly absorbs the costs. The point to note here is that

the costs for all of the support which is necessary for the studies to determine if an ECP is required are incurred prior to the letting of a contract and will not be funded by the U.S. government. Since Northrop is a profit-making institution, it can be assumed that the costs for this support will be passed along to other contracts when possible. If the costs are not passed along or offset by other contracts and the support requests continue to increase, it is difficult to imagine Northrop being able to remain responsive to the support requirements.

Many of the operations in the field which initiate the support requests for the A/B models are the same sources responsible for initiating the E/F support. The AFLC "call" type contract does not pay for the costs of E/F personnel in the field even though they often assist the A/B program, nor does AFLC pay for the costs which Northrop incurs for maintaining the cadre of expertise at Northrop which is available to respond to support requests. Air Force Logistics Command only pays for actual A/B support which results in an ECP and a contract. The fact that Northrop can maintain this call response ability is primarily due to the E/F programs (23).

F-5E/F PAPS Field Support

Presale/Postsale Support (PAPS) Background

The IFSP0, with the assistance of Northrop officials, has attempted to approach product support differently for the E/F systems. It was recognized that, given the assumption that product support should be provided, a major difficulty would be finding an equitable and acceptable

manner to allocate the costs for providing this support. A few product support tasks were thus identified and segregated from the other product support tasks. These identified tasks have become known as the Presale and Postsale Product Support (PAPS). By identifying these tasks and segregating them, they have been easier to manage and control.

Examples of Recognized PAPS Activities

The PAPS activities are foreign military sales support activities which are allowable under both ASPR 5-704.3 and the proposed ASPR revision 6-1304.3. Examples of PAPS activities recognized by both the IFSPO and Northrop include:

1. Predelivery selling expenses.
 - a. Sales promotion costs, configuration studies, and other related technical service.
 - b. Demonstration costs.
 - c. Travel relating to sales and demonstrations for the promotion of sales to foreign governments.
 - d. Any other related selling expenses.
2. Postdelivery product support and other postsales service expenses.
 - a. Training films, training data, tactics manuals, planning guides, component repair data or any other such items not specified or procured by the U.S. Air Force as data items.
 - b. Technical field services monitors, including vendor/ Northrop interdivision personnel when required.
 - c. In-flight demonstrations by contractor pilots for using countries.

- d. Operational effectiveness programs.
- e. Response to requests from operational units for configuration studies.
- f. Travel to foreign military sales user countries in support of delivered aircraft, delivered contractor furnished equipment, support equipment or any end item (24:2,3).

Significant Concepts Concerning the PAPS Program

There are three major justifications for the establishment of the PAPS program. First, the PAPS program has identified specific types of support efforts and segregated these efforts from other support efforts, thus increasing the controllability of the support. Presale and Postsale Product Support has, however, identified only a small portion of the total product support efforts. Second, the PAPS program is an attempt to fairly allocate some of the support costs among all customers purchasing the F-5E/F. Third, a pool of PAPS funds has been established so that some product support can be provided over an anticipated ten to fifteen year operational life of an aircraft without depending upon future sales contracts to fund future support. In this respect, the PAPS program is an attempt to create a self-sustaining program which would provide some product support (25).

While the program is designed to become self-sustaining, a number of limitations and restrictions have been incorporated within the PAPS program. These limitations are intended to insure that the program has sufficient definition so that the support efforts do not expand into areas not in the PAPS agreement. The restrictions are intended to insure

that the program is adequately controlled and audited so that full accounting of the program is constantly possible. A summary of the limitations and restrictions within the Northrop/IFSP0 agreement concerning PAPS is presented below:

1. All sales commissions and fees are excluded.
2. Costs associated with the maintenance of international sales organizations are excluded.
3. PAPS funds are jointly administered by the IFSP0 and Northrop.
4. Funds are subject to full and complete auditing by DCAA.
5. PAPS costs are not profit bearing, and PAPS support thus is provided to the F-5 program at cost.
6. PAPS receipts are booked into costs accounts, not profit accounts, so that the profit and earnings statement for Northrop will not reflect a false profit due to the PAPS pool.
7. All foreign purchases of the F-5 aircraft contribute to the PAPS account.
8. The allocation of PAPS costs is based upon the pooling concept whereby 100 percent of the purchasing customers participate. This allows the assessed PAPS cost to be kept to a predictable minimum level among all contracting countries (26).

a listing of the countries that are participating in the PAPS program (Table VII) indicates how extensive this program has become (8).

Table VII
Participating Nations in Presale and Postsale
 Product Support (PAPS) Account

Norway	Korea
Morocco	Malaysia
Iran	Brazil
Republic of China	Chile
Saudi Arabia	Germany
Libya	Jordan
Switzerland	Kenya
Thailand	

Examples of PAPS Support Activities

Between 1 January 1975 and 14 November 1975, PAPS support activities included over 21 identified efforts. Examples of the type of efforts which were identified are listed below:

- Iranian Coherent Radar/Electronic Countermeasures Study.
- F-5 Common Repair Data Book.
- F-5 Recipient Country Projected Spares Requirements.
- Worldwide Technical Data Symposium.
- F-5E/F Demonstration Tour.
- Completion of the F-5E Pilot Techniques Film
- Technical Visits to Malaysia, Jordan, Thailand, Morocco, Netherlands, Norway, Taiwan, Brazil and Iran.
- Iranian Intermediate Maintenance Study.
- F-5A/B Fatigue Life Test Study, F-5 Technical Digest and Update of the F-5A/B Tactics Manuals (27).

As noted by the last example above, the F-5A/B receives support which is funded by the F-5E/F PAPS account. None of the 1975 PAPS efforts can be classified as production support and should be considered as field support. These PAPS efforts represent, however, only a small portion of the field support which is purchased in the acquisition phase of the F-5E/F aircraft.

F-5E/F Non-PAPS Field Support

The Allocation of F-5E/F Non-PAPS Field Support

Most of the product support not included under PAPS is purchased on an incremental basis. This means that most of the product support for a given period is allocated to the production process of that period, and the costs for that support become part of the annual F-5 purchase price. For example, in the calendar year 1978 purchase of 120 F-5E/F aircraft between 16 million and 22 million dollars in costs were added to the total purchase price to cover field support (28). Most of the annual product support costs are allocated to newly produced aircraft which are to be delivered during that given year. However, the postdelivery field support and predelivery production support costs are intermingled with the basic aircraft costs and thus become impossible to reliably identify and accurately verify.

Organization of the F-5E/F Field Support

As discussed in Chapter II, the organization of the support functions is yet another reason why the identification and categorization of the support efforts have been impossible. Field support is not organized

into any single department nor under any single source of control within the F-5E/F program. Postdelivery field support is performed by engineering departments, product support departments, documentation and data departments and so forth. With this organization, the tracking of actual field support efforts becomes difficult. Since the matrix organization utilized for the F-5 has not identified any one source as responsible for monitoring field support, the actual field support tasks become intermingled among the various functional departments and the various project managers.

Non-PAPS F-5E/F Field Support as Viewed by Northrop

The F-5E/F field support is thus purchased as an ill defined concept which in turn is included with the production tasks for the F-5 system. This support often utilizes the same Northrop resources as the production effort. As a result of this use of resources located at Northrop facilities, some misleading terminology has developed within the F-5 program. For example, the term "in-house" support is sometimes used to mean all support performed at the factory, and, at other times, "in-house" support is used to mean production support only. Thus, field support efforts are often mistakenly considered to be production support efforts.

Many Northrop sources within the various departments of the company stated that they felt the terminology utilized to describe support efforts lacked clarity. As a result of this ambiguity in terminology, several Northrop managers stated that they viewed the entire area of product support as simply resource pools from which many nonrecurring problems could be solved on a recurring basis (29). Thus, in addition

to providing production/field support capabilities, these managers contend that these support funds give Northrop the ability to respond to AFLC and AFSC, Northrop technical advisors, U.S. government officials, foreign officials, and any other sources which may request some support or information.

By approaching the study of product support from the perspective of one of Northrop's classifications of its support efforts, the actual support situation as it exists within the F-5 program can be better understood. The area of support called sustaining engineering has been selected for this further analysis.

Product Support From the Perspective of Sustaining Engineering

Sustaining engineering has a two-part definition. First, it is defined to be that engineering effort necessary to maintain and improve the production process. Second, sustaining engineering is defined to be that engineering effort necessary for the support of customers, prospective customers and operational aircraft. In line with the second part of this definition, sustaining engineering provides engineering inputs into studies, accident investigations, field problems and related operational requirements.

"Sustaining Engineering involves research, design, development and test efforts for configuration changes needed for an efficient manufacturing process and for technical improvements to the aircraft" (30).

Since the F-5E/F is in the full scale production phase, all research, design, development and test efforts are either for the fully developed

production version of the aircraft (actual hardware), the production of these fully developed aircraft, or the postdelivery support of that fully developed production aircraft. Sustaining engineering includes some of the support tasks for production efforts and actual hardware. Actual sustaining engineering tasks include reviewing and validating reported problems, trouble reports (TR's), unsatisfactory reports (UR's) and exhibits and providing reports on the adequacy of country maintenance abilities. Sustaining engineering also performs the tasks of evaluating and reviewing aircraft accidents, incident reports, and revisions of technical data; the preparing of all engineering change proposals (ECP's); and the preparing of configuration engineering change proposals (CECP's) which are required for aircraft configuration changes. Configuration engineering change proposals are related to design deficiencies. The notifying and provisioning of aircraft and systems changes for flight safety, structural integrity and systems/component reliability also result from the sustaining engineering effort. Additionally, this effort is supposed to produce improved maintenance and systems operation procedures, inspection techniques and improved aircraft maintainability with higher reliability (30).

Sustaining Engineering, F-5A/B

Sustaining Engineering, F-5A/B Field Support. In January 1971 the IFSP0, with the cooperation of the AFPRO assigned to Northrop, utilized the available sustaining engineering data supplied by Northrop, which was "contaminated" with data from the T-38 program, and estimated the percentage of field support charged to sustaining engineering from 1963

through 1971. Over that nine year period, field support charged to sustaining engineering was estimated to have grown from 33.86 percent of total sustaining engineering in 1963 to 69.70 percent in 1971 (22). Since much of the actual field support was not properly identified, a conservative minimum estimate is that over 32.6 million dollars which was charged to sustaining engineering for the F-5A/B over that nine year period was for field support.

The Effect of Sustaining Engineering Costs on the F-5A/B Unit Cost.

From 1963 to 1973 sustaining engineering costs increased from 1.2 percent to 10 percent of the unit cost of new production F-5 aircraft. The high cost of sustaining engineering, apparently driven by field support, could not be supported by the low production rate of the F-5A/B aircraft toward the end of the F-5A/B production life.

The Necessity of Sustaining Engineering. Northrop officials pointed out that Northrop controls only about 10 percent of the end items which are sold as spares, yet Northrop is expected by the U.S. government, the Air Force and foreign countries to be the focal point for product support problems (30). Thus, such support functions as sustaining engineering seemed to develop and grow out of exigencies, not some established plan. However, since no alternatives to this support approach have developed and, in a manner of speaking, the sustaining engineering effort "worked" for the F-5A/B program, the sustaining engineering organization was carried over to the F-5E/F program.

Sustaining Engineering, F-5E/F

Sustaining engineering presents a typical example of how predelivery/postdelivery field and production efforts are combined within the F-5E/F

programs. One purpose of sustaining engineering is to provide engineering support necessary to maintain the flow of aircraft on the production line to a contractually defined configuration and schedule. Sustaining engineering also provides the engineering support necessary to respond to inquiries from the field requiring engineering evaluation, analysis and test (31).

The sustaining engineering effort for the F-5E/F is incurred by 34 engineering organizations. Within the F-5E/F programs, this support is charged either to field problems support or production line support. If sustaining engineering is required on spare equipment before it has been installed on an aircraft and flown, the sustaining engineering is charged to a separate spares contract. However, if spares items such as an actuator have been installed and flown, the sustaining engineering is charged to the current production contract (32).

Reported Sustaining Engineering Manhours. In calendar year 1975, 36.6 percent of the manhours within sustaining engineering were charged to field support services (33). While the percent of manhours which were charged to field support fluctuated monthly from a little over 50 percent to approximately 30 percent of the total manhours for sustaining engineering, little can be drawn from either the overall figures or trends. Any increases or decreases in manhours may reflect an increase in the complexity of the problems, more problems, or a different reporting source for the problems. This study could find no way of identifying what the actual cause of the fluctuations were. However, one Northrop official stated that the 36.6 percent of the sustaining engineering manhours attributed to field support efforts is very conservative.

Factors Influencing Sustaining Engineering, F-5E/F. Within the engineering organizations at Northrop, several opinions concerning sustaining engineering were advanced. While the personnel advancing these opinions are highly qualified within this area, no data were available to substantiate these opinions. According to these opinions, both field and production support efforts are highest when the system is new. The field support effort will be on a fairly high level per aircraft in the field, but the high production rate will establish a large base over which the field support costs can be absorbed, producing the appearance that field support costs per aircraft are rather small. The manhour accounting for sustaining engineering disputes these claims and indicates total sustaining engineering manhours increase over time, while production support and field support should be decreasing.

All sources agreed, however, that production support is a function of the relative newness and sophistication of a system throughout the production life, while field support is more complex. By synthesizing all of the factors that Northrop and IFSP0 sources claimed affect the level and duration of sustaining engineering field support efforts, the complexity of determining field support becomes clearer. Table VIII is a summary of those factors which are supposed to affect field support.

Table VIII
Factors Affecting Field Support for the F-5E/F

-
- NUMBER OF AIRCRAFT IN THE FIELD
 - NUMBER OF CONFIGURATIONS OF AIRCRAFT IN THE FIELD
 - NUMBER OF COUNTRIES
 - NUMBER AND LOCATION OF BASES
 - MATURITY OF AIRCRAFT IN THE FIELD
 - QUALITY OF PRODUCTION
 - QUALITY AND FREQUENCY OF MAINTENANCE
 - QUALITY OF FLIGHT CREWS
 - DATA RECORDING AND REPORTING ABILITIES
 - SUPPORT EXPECTATIONS ESTABLISHED BY THE FOREIGN GOVERNMENTS
 - PREDELIVERY TESTING AND QUALITY CONTROL
 - AIRCRAFT OPERATING ENVIRONMENT
-

Method of Purchasing Sustaining Engineering, F-5E/F. Sustaining engineering is purchased as part of the annual production aircraft costs. In determining how much sustaining engineering is to be charged to each country contracting for the delivery of aircraft in a particular year, several factors are considered by the IFSP0 and Northrop. For example, in the 1976 study of the Northrop F-5E/F pricing proposal for the calendar year 1978 buy, the IFSP0 was told that the number of bases determined much of the sustaining engineering costs. In 1975 there were only six configurations of the F-5E/F in eight countries flying from sixteen bases. In 1978 there will be ten configurations in fourteen countries flying from at least twenty-four bases. The 1978 increase in configuration, countries and bases was used to help justify the increasing levels of sustaining engineering Northrop predicts for calendar year 1978 (34).

To determine its predicted costs for sustaining engineering, Northrop estimates the manhours required to provide a certain level of this support. In 1974 there were 397,827 total manhours charged to sustaining engineering. By 1975 total sustaining manhours had increased to 416,527. The early trends in 1976 indicate that the sustaining engineering manhours will increase again (33).

In the final analysis, it is the sustaining engineering manhour "costs" which are purchased by the U.S. government and added to the purchase price of each new F-5. It is noteworthy, however, that for the U.S. government these costs are computed as a percentage of the manufacturing costs and are not computed as either a defined level of effort or as a function of configurations, countries or bases.

Since most of the supporting data supplied by Northrop for sustaining engineering costs were directly related to field support, it is assumed that much of sustaining engineering is related to providing field support or those hours which were both field/production support. Thus, sustaining engineering is purchased as an ill defined level of support effort.

Identification and Categorization of Support Tasks as Found in Sustaining Engineering. Within F-5E/F sustaining engineering, work breakdown structure (WBS) number 10 was analyzed by the author, and the support tasks included therein were identified and categorized in Table IX as field and/or production support. These tasks were analyzed so that some understanding of the field support portion of sustaining engineering could be established.

Utilizing the criteria developed in Chapter II, the author was able to identify nine tasks which are directly related to production support.

Six tasks were categorized as being directly related to field support and fourteen tasks were related to both field and production support. This means that only thirty-one percent of the sustaining engineering tasks are strictly production support tasks. This study was not able to determine if those tasks categorized as common to both field and production support were predominately field or production oriented. Most Northrop managers and officials from the Air Force Plant Representative Office agreed that if field support were not performed within sustaining engineering, over fifty percent of the tasks could be deleted.

Field Support Requests

In order to understand how field support is functioning, one must consider more than the tasks which are performed. The system for identifying and reporting field related problems has a significant impact on the level of field support provided. Thus, this section will address the field support request system and is applicable to all F-5E/F field support.

Sources of Field Support Requests

Requests for field support for the F-5 flow into Northrop through both formal and informal channels (Figure 12). The requests may be formal trouble reports, unsatisfactory reports, letters, personal visits, phone calls or even simple informal notes. Field support requests arrive at Northrop from no single source and with no single flow pattern. Only a few of these sources and channels for field support requests are depicted in Figure 12 (23).

Table IX
 Identification and Categorization of Product Support Tasks Performed
 Within Sustaining Engineering

PURPOSE OF SUPPORT	TITLE OF TASK
Production Effort	Liaison with fabrication and assembly operations Design change request from manufacturing Advance material requests Material substitution action Action on functional equipment withholding tags Coding of aircraft effectiveness of drawings Drawing clean-up for data submittal Standard aircraft characteristics, stress, weight reports Liason with vendors
Field Support Effort	Actions on unsatisfactory reports from the field Actions on trouble reports from the field Accident investigations Air material center support Field service correspondence Design studies for peculiar field problem solutions
Field and Production Effort, Common	Defective parts review and failure disposition Corrective action requests Engineering change orders Time compliances technical order preparation Materials failure evaluation Compatability engineering change proposal implementation Engineering change orders and document change release incorporation on drawings Stress analysis and approval Weight and center of gravity calculations Incorporation of subcontractor changes on SCDS Interchangeability Lists Design test work orders and inspection work orders Review and submittal on vendor item; contractor furnished equipment qualifications data Customer coordination and correspondence

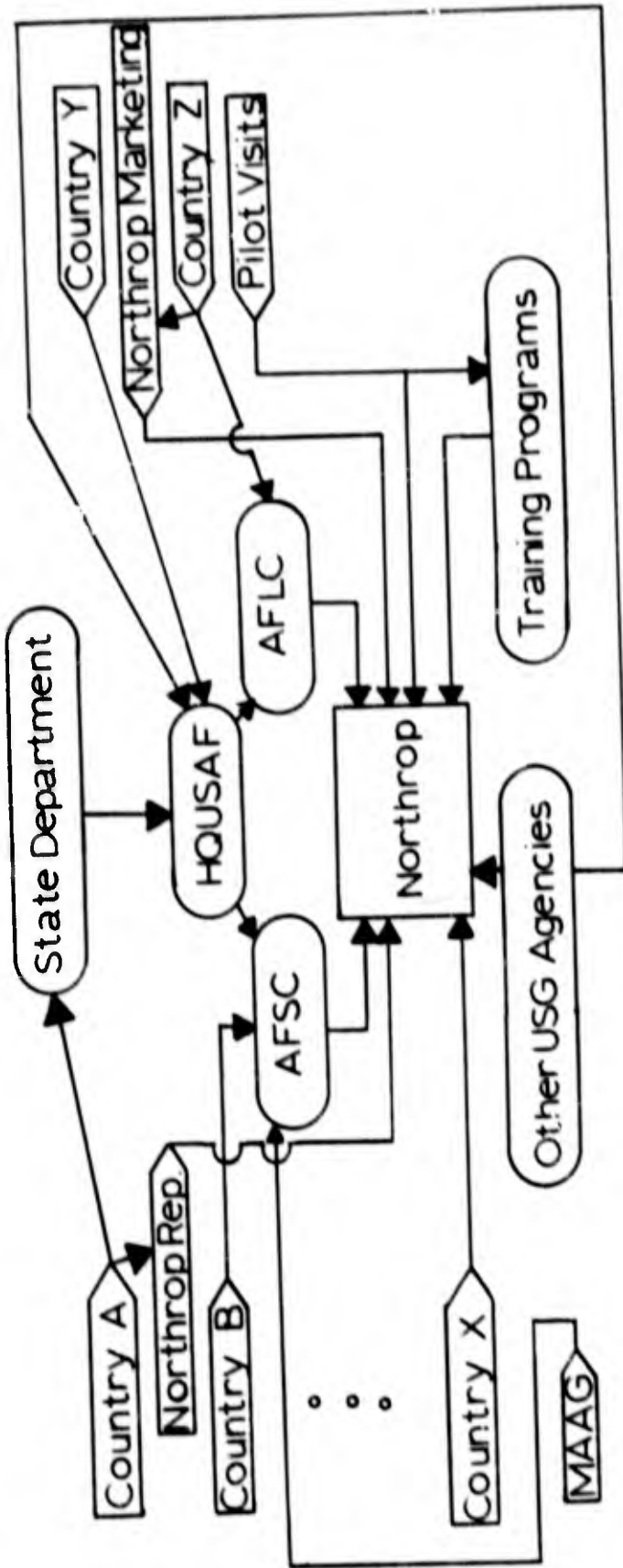


FIGURE 12. FIELD SUPPORT REQUEST FLOW PATH

Trends in the Number of Unsatisfactory/Trouble Reports. The number of UR's and TR's received by Northrop has been increasing. From 1973 to 1975 the number of UR's/TR's received by Northrop for the F-5E/F were 83, 419 and 513 respectively (34). The increasing trend in UR's/TR's is somewhat deceptive. Many of the reports may be for the same problem and from different countries or for the same problem and from the same country and routed through various channels. Also, the increase in UR's/TR's could be due to changes in Northrop reporting policies, increased U.S. personnel in the field, increased flying hours, or any of a number of factors. The only definite conclusion which can be drawn from the trends in the UR's/TR's is that Northrop is receiving a rapidly increasing volume.

Northrop Focal Point for Field Support Requests. The Product Support Division at Northrop is supposed to be the focal point for most of the support requests. However, the support request may have been funneled through the Marketing Division, Contracts Division or any other division which may have contact with any of the sources requesting support. Thus, the Product Support Division serves as one possible link in the complex flow of the field support efforts for the F-5. While the Product support Division may eventually be informed of some support requests and the resulting support effort, this division is often circumvented. Thus, there is no single Northrop department which actually manages and controls field support.

Overall Trends in Field Support. Product support manhours for engineering data and abilities (a field support effort) provide an

indication of how the trends in field support costs are developing for the F-5E/F. This product support effort is another area which interfaces with the sustaining engineering effort. However, the data from the data and abilities effort do not contain manhours charged to sustaining engineering. Nevertheless, other departments such as the Product Support Department can and do pass along field support requirements to sustaining engineering. Since several departments within Northrop provide field support for the F-5, an increase in the efforts in one department can cause increases in other departments.

An analysis performed by the author on aircraft product support labor hours for the engineering data and abilities effort indicates that product support hours for this support department at Northrop are increasing rapidly. These hours could not be broken down into actual field/production support, but all Northrop/IFSP0 personnel contacted for this study stated that field support was the major cause for the increase. The impact that the increase in manhours will have on other support departments could not be determined by this study. However, due to the interrelated nature of the support efforts, it is reasonable to assume that other departments will also continue expanding and utilizing increasing amounts of manhours for field support efforts.

Summary

This chapter utilized those support terms developed in Chapter II to analyze the F-5 program. Because of deficiencies in the data reporting system for the F-5, it was necessary to investigate the product support from the perspective of the aircraft models F-5A/B and F-5E/F.

It was found that product support is a factor in driving the cost of the aircraft to greater heights. The dominant cause for these cost increases is postdelivery field support. The method utilized for allocating support costs also tends to increase the unit price of the aircraft, and would do so even if product support costs were constant. This increase in unit cost is due to the fact that product support costs are largely allocated to the new aircraft sales. When sales fluctuate, the unit costs due to allocated product support also fluctuate.

Both the F-5A/B and F-5E/F have an interdependent support system. That is, both the same personnel and departments are routinely utilized to provide support to the A/B and E/F models. This interrelationship is true even though the support for the F-5A/B is managed by AFLC and the support for the F-5E/F is managed under different contracts by AFSC.

The IFSP0 has developed two methods of funding and allocating field support efforts. The first approach is called Presale and Post-sale support (PAPS) and attempts to maintain a pool of funds to provide a small level of field support efforts. Presale and Postsale Support allocates the costs for such support on a prorata share to all customers so that the pool will be self sustaining throughout the support life of the aircraft. The second method charges the field support costs for a given period to those aircraft produced and sold in that period. This support is thus funded incrementally and depends upon future sales to fund future support.

Actual management of the field support efforts has been hampered by the lack of precedence, poorly developed terms, and the lack of clearly assigned managerial responsibility.

One Northrop categorization of product support, sustaining engineering, was analyzed in great detail. The results of this analysis is a set of classifications of the actual support tasks for this effort. Also, the trends in manhour support costs for this effort were also discussed. These trends in manhour support costs reinforced the earlier findings that product support costs are increasing and the product support efforts are increasing. Due to the interrelated nature of the support functions, an increase in one function can produce increases in other functions.

However, it was found that no single cause for the increase in support efforts could be identified. The increases could be due in total or in part to the poorly organized support request system, policy changes, aircraft deficiencies or any of a number of factors.

VI. SELECTED PROBLEMS RELATED TO
POSTDELIVERY FIELD SUPPORT FOR THE F-5Background

Two different approaches in allocating costs and funding product support for the F-5 were discussed in Chapter V. The first approach treated product support as if it were strictly a production cost. All product support costs provided under this approach are pooled into several cost pools such as engineering support, data, technical orders and so forth. These cost pools fund the support efforts on an annual basis. In turn, these support effort costs are allocated as part of the production costs to each annual purchase of F-5 aircraft. Thus, all product support, including that field support which is provided to prior customers, becomes part of the apparent annual production costs for any given year. Those customers that purchase aircraft in any given year will, in turn, depend upon future sales to provide the revenue necessary to fund their postdelivery field support.

The second approach in allocating costs and funding product support for the F-5 was identified as presale and postsale support (PAPS). PAPS recognizes a few of the field support tasks which usually benefit all customers and establishes a level at which this support is to be performed. This approach recognized the fact that much of the field support effort is required throughout the operational life of the aircraft. In an attempt to fund some of these efforts and allocate the cost of these efforts among all benefiting customers, PAPS was created by the IFSPD and Northrop.

Thus, the expected total costs for a limited level of future postdelivery support were calculated by Northrop. Once Northrop had established the minimum level of expected support and the future costs were calculated, all foreign military sales/direct sales customers were charged a prorata share for this support. The funds collected under this approach are utilized to establish a self-sustaining pool of funds whereby future support requirements can be funded. Thus, under the PAPS concept all F-5 customers involved in either foreign military sales or direct sales pay for a portion of their future support at the time of aircraft acquisition. As noted, however, this support is very limited and includes only a few predelivery/postdelivery field support tasks.

Scope and Purpose of the Chapter

This chapter examines selected problems related to the postdelivery field support provided for the F-5 system. The first section addresses postdelivery field support policies and discusses the problem of the matching of support costs with support benefits. The first section is applicable to both PAPS and non-PAPS postdelivery field support. Those problems resulting from field support policies or the lack of such policies will be so identified. The second section addresses selected problems in the non-PAPS postdelivery field support area. The third section addresses selected problems in the postdelivery field support area of PAPS.

Postdelivery Field Support PolicyOverall Responsibility and Control of Postdelivery Field Support

Postdelivery field support can be described as one aspect of the acquisition process which has neither father nor mother, governor nor governed. Postdelivery field support, as it exists within the F-5 program, seems to exist within a policy vacuum. No source within industry or the government could or possibly would identify the extent of the vacuum, the nature of the vacuum nor a single source assigned the responsibility for establishing policy and controlling the programs which have evolved in the name of product support. Some individuals within the IFSPD and Northrop stated that as of 1976 the field support for the F-5 was an unidentifiable conglomeration of numerous efforts. However, these same individuals often stated that some postdelivery field support seems to be required, and, since in their opinion whatever support being provided is better than no support, the existing support program should be left undisturbed, especially in light of the support policy vacuum.

The absence of definitive support policy does not imply that field support serves no useful purpose to foreign military sales efforts. If field support is completely removed and no longer provided to any foreign governments, the impact on foreign military sales must be recognized. Since many countries recognize and expect field support, such a policy might well decrease sales and cause international repercussions. If field support is allowed to continue uncontrolled and poorly managed, however, the increased support costs could result in decreased sales and lead to unfulfilled support promises. Somewhere between these two extremes a level of support should exist which would maximize sales and minimize support problems.

Policy as to Establishing Levels of Field Support

Field support is a great deal like marketing: the expenditures can usually be justified at any given level. By spending more for field support efforts, Northrop may be able to decrease production and quality control costs. Conversely, field support costs may be decreased by improving manufacturing and quality control efforts. Also, as one Northrop source noted, if a country is not on good terms with the U.S. or is being ignored by both the U.S. government and private industry, field support efforts for that country will likely decline. Thus, field support in some instances may be related to support policies, rather than the field support requirements of the customer (23).

What field support, if any then should the U.S. government promise and the foreign governments expect? One should recognize that even though the U.S. government may object to the support efforts and levels provided by Northrop, no official agency has been assigned the responsibility for establishing and providing Northrop with an alternative policy.

Assignment of Postdelivery Field Support Policy Responsibility within the United States Air Force. Indicating "how" to fill the policy vacuum which exists in the area of postdelivery field support is not by itself sufficient to solve existing support problems. The solution of field support problems also requires the identification of "who" should be assigned the responsibility for developing and implementing post-delivery field support policy. Within the existing support situation, the "who" is never clearly identified. Thus, many conflicts have developed due to the lack of clearly assigned responsibility for postdelivery field support management.

An indication of the extent of these conflicts can be seen in the F-5 program. Some officials within the F-5 International Flighter System Program Office stated that AFLC, rather than AFSC should have the responsibility for managing all postdelivery field support. These sources contend that postdelivery field support is more closely related to logistic type efforts than the research, development, and acquisition efforts assigned to AFSC. Thus, according to this view, it is logical to assign postdelivery field support to the command responsible for logistics efforts (AFLC) and not expect the command responsible for research, development and acquisition efforts (AFSC) to manage the support.

However, some officials within AFLC have indicated that that command is averse to the concept of dedicating resources for non-DOD support requirements. AFLC is aware that a properly managed support program requires significant expenditures of resources and manpower. AFLC is also aware that the Air Force is not provided additional manpower authorization to provide non-DOD support. Thus, whenever manpower is dedicated to non-DOD support such as foreign military sales postdelivery field support, other U.S. Air Force programs will have to forfeit some of their manpower.

Northrop officials are aware of the policy vacuum for postdelivery field support. In fact, some Northrop officials have indicated that many field support problems for the F-5 exist because of the policy vacuum. These officials cited examples of poor communication within the U.S. Air Force, which sometimes complicate support decisions. According to these Northrop officials, the poor communications, especially as they exist

between AFSC and AFLC, not only complicate support decisions, they produce misinformation and misunderstanding among U.S. government officials. In such an environment, the Northrop sources contend many ranking U.S. government officials resort to trying to treat foreign military sales programs as if they were strictly DOD programs. This means that the U.S. might be entering foreign military sales agreements without realizing the actual foreign military sales field support requirements.

Most personnel contacted in both the IFSP0 and Northrop indicated that they felt most high level U.S. government policy decisions regarding foreign military sales are made without any consideration for postdelivery field support requirements. According to this theory, companies are encouraged to "sell" their systems abroad and address postdelivery field support as an afterthought. These persons go on to state that the U.S. government avoids resolution of the problem and thus acknowledges only very general and very vague categories of field support costs which are allowable under the Armed Services Procurement Regulation. Thus, the U.S. government by default depends upon the company to develop, manage and control actual postdelivery field support. This study could find no single agency, organization or person involved in the foreign military sales contracting process that is assigned overall responsibility for developing policies, resolving conflicts or establishing controls of post-delivery field support.

Problems Related to the Matching of Postdelivery
Field Support Benefits with the Benefiting Customers

Even if the problem concerning the assignment of postdelivery field support responsibility were resolved and the optimal support level were

known, three major problems concerning the management of postdelivery field support would remain. First, there exists the problem of matching the support benefits with the benefiting customers. Second, the allocation of postdelivery field support costs among numerous foreign military sales customers is a major problem. Third, the funding of postdelivery field support efforts throughout the operational life of the system presents a major problem.

Matching of Postdelivery Field Support Benefits with the Benefiting Customers and Allocating the Associated Costs

Whenever there are numerous foreign military sales customers and contracts for a single weapon system such as the F-5, a problem of matching field support benefits to the benefiting customer exists. Related to the problem of matching postdelivery field support benefits with the individual customer is the problem of allocating costs for the field support to the benefiting customers. These problems can be better understood when a multiple customer foreign military sales situation is contrasted with a program having only one customer.

Single Customer Program. For purposes of illustration, it can be assumed that there exists a DOD type system with the U.S. government as the only customer. Under such a situation, the matching of support benefits to the customer receiving the benefits becomes trivial. The benefits accrue to the U.S. government alone. Since there is only one customer, the matching of support benefits and the allocating of costs for these benefits is not a problem. The postdelivery field support benefits accrued and the costs allocated under such a system are shown in Figure 13.

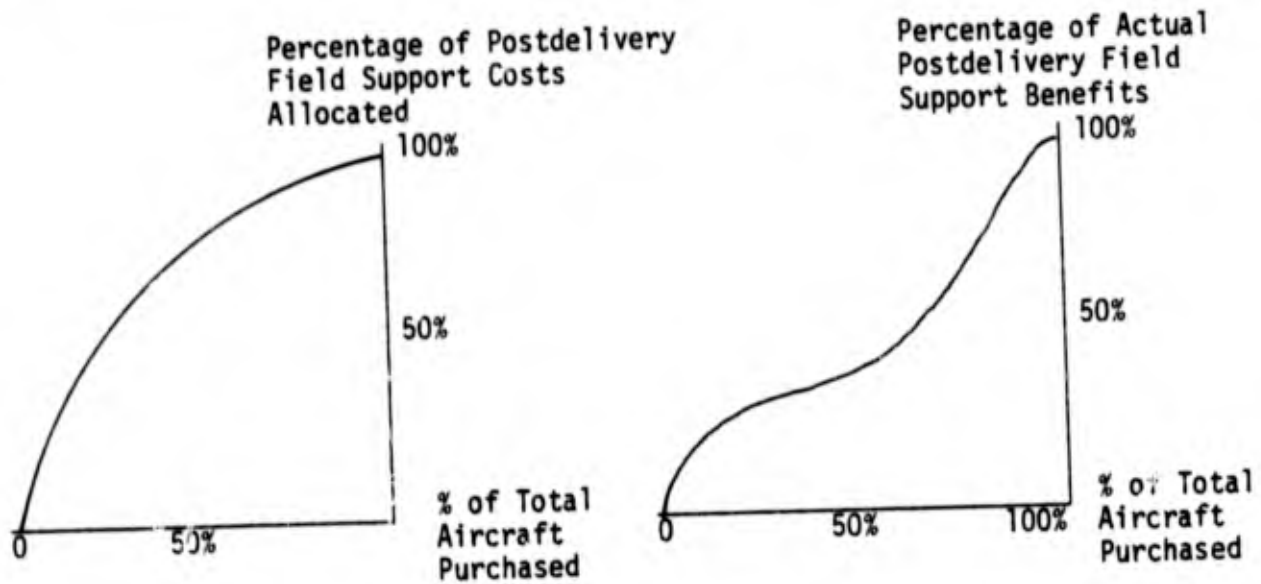


Figure 13. Postdelivery Field Support Benefits Accrued and Costs Allocated in a Single Customer Program

These two figures indicate that over the life of the system the single DOD customer will be allocated 100 percent of the postdelivery field support costs and will receive 100 percent of the benefits which are derived from the postdelivery field support efforts. The tracking of support benefits to specific aircraft and the allocation of the support costs to specific customers is not a problem in this case, since there is only one benefiting customer. Even though the timing of the support may not have been congruent with the timing of the benefits, in the final analysis the costs for all field support benefits received were allocated to the customer receiving all of the benefits.

Multiple Customer Program. When, however, there is more than one major customer involved in purchasing a system, the matching of support benefits with costs takes on greater significance. Figure 14 indicates the hypothetical relationship which could occur with the mismatching of support benefits with costs for specific hypothetical customers.

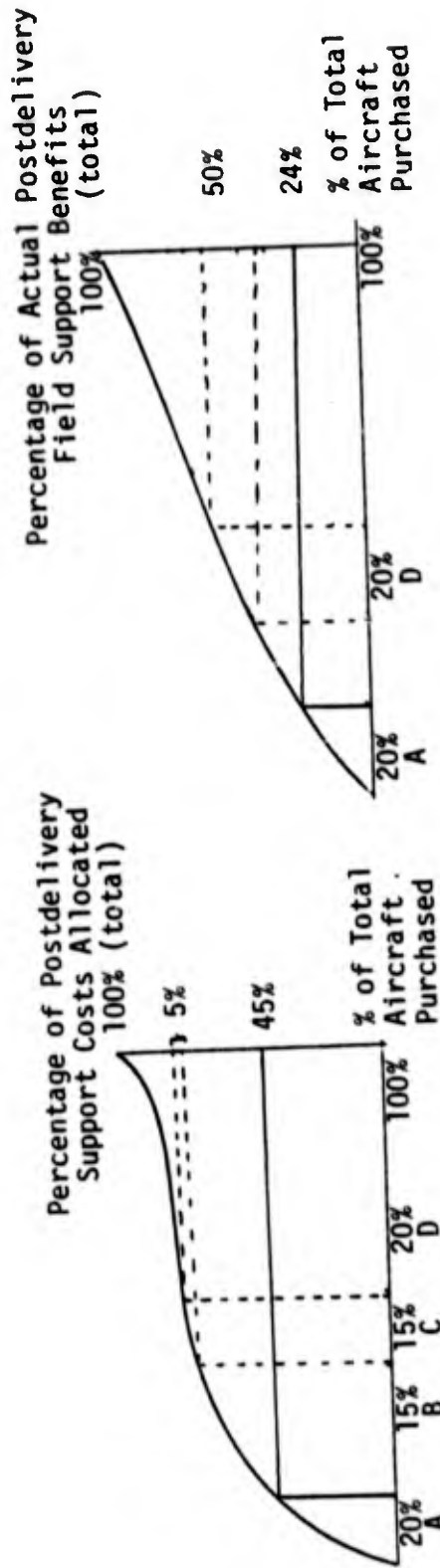


Figure 14. Postdelivery Field Support Benefits Accrued and Costs Allocated in a Multiple Customer Program

As indicated in Figure 14, customer "A" purchased 20 percent of the total number of aircraft, but was allocated 45 percent of the support costs. Furthermore, customer "A" received only 24 percent of the actual product support benefits. This mismatch could have occurred because of a number of factors. One of the major factors could have been due to the timing of the aircraft purchase. As indicated in Chapter V, a customer purchasing aircraft when the production rate is low is allocated more field support costs. That is, as the allocation base (aircraft produced in a given period) decreases, each customer is charged more for post-delivery field support.

Other factors such as errors in estimating postdelivery field support requirements, failure to accurately identify field support tasks, or allocating field support benefits on the basis of some arbitrary method which does not match benefits and costs by customer could account for the disparity of field support benefits provided and support costs allocated to the various customers in Figure 14. As a result of this mismatching, customer "D", which also purchased 20 percent of the total aircraft produced, paid for only five percent of the total support cost. Since 24 percent of the postdelivery field support benefits was provided to "D", the mismatch of costs and benefits is quite evident.

While it can be argued that such matching and allocating efforts are complex and costly, the hypothetical illustration discussed above indicates what the results of mismatching can be. The individual customer will either benefit or lose from such mismatching. When the disparity in matching costs to the customer becomes too great, the Foreign Military

Sales program can suffer, the reputation of those managing Foreign Military Sales programs can suffer, and international unrest may result.

Problems Related to Determining Postdelivery Field Support Costs

As discussed in the preceding paragraphs, the timing of postdelivery field support creates problems. By definition, postdelivery field support efforts are performed after the customer has taken delivery of the aircraft. The customer has thus presumably reached a negotiated procurement price for the aircraft and taken delivery of the aircraft before postdelivery field support is begun. This means that both the support efforts and the costs of the support efforts are estimated. Whenever an estimate error occurs in either the level or costs of field support, there is no easy way of "adjusting" the price of the system already delivered.

While it legally is possible to adjust the amount charged the customer, the consequence of requesting more funds from a customer years after delivery may carry political or international implications which the U.S. government will find objectionable. Since postdelivery field support is expected to be required for ten to fifteen years after delivery of the purchased aircraft, it is reasonable to assume that errors in the predicted costs do exist.

Problems Related to F-5 Non-PAPS Postdelivery Field Support

Non-PAPS postdelivery field support does not attempt to predict the long term support requirements or costs. As discussed in Chapter V, this support is treated as if it were part of the annual production costs. Thus, non-PAPS postdelivery field support is charged to current production

contracts. Current production contracts will depend upon future sales to fund their non-PAPS postdelivery field support. As a result of this method of procurement, a number of problems have developed.

Responsibilities and Control

The field support which is purchased on an annual basis is not under the direct control of the IFSP0. The actual control of the field support procured in this manner is a Northrop function. It is Northrop policy which determines the level and type of field support which is actually provided. Thus, the U.S. government seems to have assumed the responsibility for ensuring the support, yet relinquished control of the support to Northrop.

By virtue of the procurement process, the IFSP0 is in the unenviable position of falling heir to managing support efforts over which they exercise little or no control. With the exception of the PAPS account, Northrop can initiate field support, allow others to initiate field support, define what constitutes product support, establish the level of support to be provided, control the support and manage the support. However, there is no single Northrop department or manager assigned the overall responsibility to identify, manage, control or coordinate field support for the F-5. Essentially, after field support requests reach Northrop, Northrop activates whatever departments necessary to respond to the support requests. Thus, largely because of the postdelivery field support policy vacuum throughout the U.S. government and, according to the IFSP0, because the IFSP0 lacks the resources and manpower to assume positive control of field support, Northrop by default has been allowed to manage field support.

Initiation of Support Requests

As indicated in Chapter V, Figure 12, field support can be initiated by Northrop, AFSC, AFLC, foreign governments and so forth. By virtue of default by the U.S. government, Northrop has assumed the responsibility for controlling the field support. However, no single department within Northrop is responsible for managing field support. It is thus Northrop policy which determines the responsiveness of the various departments to field support requests. Since various sources can access field support, the possibility for questionable support requests and conflicts exists. Again, no mechanism exists whereby problems of this nature can be resolved. Northrop attempts to resolve these problems by being as responsive as possible to any and all official and quasi-official sources. Thus, it is possible for AFLC to request support and charge the support to the production contract managed by AFSC. Other U.S. government and non-U.S. government sources can also initiate queries which will ultimately utilize postdelivery field support resources and funds.

Impact of Production Termination on Non-PAPS Field Support

Since the non-PAPS efforts of postdelivery field support depend upon each annual buy of F-5 aircraft to fund the field support, field support will require alternative funding after production termination as long as field support is to continue. AFSC sources contend that postdelivery field support after production terminates is a problem which should be managed by AFLC. AFLC in turn contends that a "call" type contract, such as discussed for the F-5A/B in Chapter V, would be sufficient for whatever support is required.

Both AFSC and AFLC sources have stated that repercussions would probably result, when the foreign governments discover that the traditional field support is no longer available. Those countries which receive little or no field support, yet have observed countries which purchased the F-5 earlier receive years of field support at no additional costs, may well question why product support made their F-5 aircraft so costly. They may logically question the inclusion of product support costs in the acquisition price, especially since they may be required to pay for all forthcoming field support under a "call" type contract. As one IFSP0 source indicated, the inclusion of field support as part of the annual production cost can create a situation leading to crisis management, and the slowdown and termination of aircraft production can be expected to produce a major crisis.

Allocation Problems Produced by the Timing of Contracts

A simplified equation for the allocation of non-PAPS postdelivery field support is

$$\begin{aligned} & \text{(Allocated postdelivery field support cost per aircraft)} = \\ & \text{(Total postdelivery field support costs for a given period)} + \\ & \text{(Total number of aircraft to be delivered in that period)}(23). \end{aligned}$$

Since postdelivery field support costs fluctuate from one period to the next, it can be seen that the timing of aircraft delivery plays a significant role in determining the allocated support costs. The problem is further compounded by the fact that the number of aircraft delivered is not the same in each period. Even if postdelivery field support costs

were to remain constant from year to year, as the production level and deliveries fluctuate, the allocated support costs would fluctuate inversely. For example, when postdelivery field support is purchased on an annual basis as a level of effort and funded by aircraft delivered in that period, as production decreases and/or support costs increase, the unit price of the aircraft will increase and vice versa.

The increased costs are not easily sold to other countries, especially since these countries gain little from such charges. When these support costs become disproportionate, some countries will reject all or most all of the increasingly expensive support costs, resulting in the eventual collapse of postdelivery field support. Few countries are willing to pay for the support of other countries, especially when they realize that that support may not be provided to them. At some point in the production process the number of aircraft produced, which is the base used for allocating support costs, will not be able to sustain existing levels of field support. Additionally, after all production is terminated, all field support which was purchased on an incremental basis as part of the acquisition process will require new sources of funding if the support is not to be also terminated.

Selected Problems Associated with PAPS

As discussed in Chapter V in the section on PAPS, not all of the postdelivery field support for the F-5 program is purchased on an incremental basis. In an attempt to identify, control and fund a segment of field support, the IFSPD and Northrop established the PAPS concept.

According to the IFSP0, the PAPS approach gives the IFSP0 some control over a small portion of the field support area and establishes a single manager within Northrop who is assigned the management responsibility of this small portion of field support efforts. According to Northrop, PAPS accomplishes two things. First, PAPS establishes a method of allocating a portion of field support costs proportionally among the customers. Second, PAPS establishes a pool whereby field support can be funded even when production levels are low or after production has stopped. However, the PAPS approach does present some troublesome problem areas.

Determining the Required Level for PAPS Funding

PAPS is supposed to insure the availability of funds for a certain level of some field support efforts. The general formula for calculating the total postdelivery field support costs to be funded under PAPS is

$$\begin{aligned} & (\text{cost for one aircraft support year}) \times \\ & (\text{total aircraft support years remaining}) = \end{aligned}$$

(total postdelivery field support costs to be funded by PAPS)(23).

The difference between the available PAPS funds and the total postdelivery field support costs to be funded by PAPS is then allocated to the purchasing customers. These allocated costs become part of the aircraft purchase price. From this equation it can be seen that a change in either the total aircraft support years remaining or the cost for the aircraft support year or a change in both will change the total postdelivery field support funds required by PAPS as well as the aircraft purchase price.

Estimating Aircraft Support Years for the F-5. The total support years are determined by the following equation:

$$\begin{aligned} & \text{(total support years) =} \\ & \text{(the number of systems delivered) x} \\ & \text{(expected operational life of the aircraft) -} \\ & \text{(support years provided to date)(23).} \end{aligned}$$

In this equation the support years provided to date and the number of systems delivered can be calculated with reasonable accuracy. The one part of the equation which generates problems is the expected operational life of the system. The actual life of the aircraft is a function of such factors as flying conditions and most other factors listed in Chapter V, Table VIII. Primarily, though, the life of the aircraft is a function of flying hours. According to both Northrop and IFSP0 sources, however, no one knows how long the F-5 will actually be in operation. Thus, the expected operational life of the F-5 is an estimate and subject to estimate errors.

Even if the operational life of the aircraft were known with a high degree of certainty, another problem exists. The operational life of the aircraft is in flying hours, not calendar year age. This presents a problem, because there exists no uniform or formal flying hour reporting system available for all of the various F-5 customers. It is thus not possible to reliably determine either past or future flying hours. This deficiency means that a country flying aircraft at a higher rate than estimated would theoretically age its aircraft faster than expected. Conversely, if an aircraft is being flown less than expected, the aircraft is not aging as quickly as expected. Thus, both the overall level and duration of postdelivery field support can be altered by the flying

program of each country. The fact that many officials from both the IFSP0 and Northrop treat the operational life of the aircraft as if it is ten to fifteen calendar years sometimes obscures the fact that it is the flying hours which play the dominant role in determining the actual operational life.

Impact of Increased Service Life on the F-5 Program. Whenever an error as to total support years for the F-5 is introduced into the total support years equation, the impact on the allocated postdelivery field support costs can be significant. The following discussion indicates how an error can impact both total support years and the total support costs.

In most documentation provided by Northrop to establish the required funding level for PAPS, the aircraft is assumed to have a service life of ten years. Since it is accepted by Northrop that some countries have a flying program in which aircraft are flown less than one-half the hours as other programs, it is possible that those aircraft may require twenty or thirty years of support instead of ten to fifteen. Again, it should be noted that the actual flying hours of other countries are not available to either the U.S. government or Northrop nor is the actual life of the aircraft known.

Table X summarizes the cumulative aircraft support years for PAPS given the assumption that field support will be required for ten calendar years after delivery. Table XI summarizes the support years for PAPS support with the assumption that all aircraft will require fifteen years of postdelivery field support. Given a five-year increase in the operational life of the aircraft and a corresponding increase in the field support years to fifteen calendar years per aircraft, an additional 3,640 aircraft support years will be required (35).

The estimated impact of an additional five years of life beyond the ten-year life currently anticipated for the F-5 would mean that in 1975 alone an additional 16.8 million dollars would have been required above the actual funded levels (35).

TABLE X

FMS/Direct Aircraft Deliveries and Support Lives
(10-Year Useful Life)

<u>Year</u>	<u>Aircraft Deliveries</u>	<u>Aircraft Support Years</u>	<u>Cumulative Aircraft Support Years</u>
1965	11	-	-
1966	22	11	11
1967	52	33	44
1968	16	85	129
1969	55	101	230
1970	44	156	385
1971	26	200	586
1972	14	226	812
1973	22	240	1,052
1974	89	262	1,314
1975	172	351	1,665
1976	106	512	2,177
1977	99	596	2,773
1978	-	643	3,416
1979	-	627	4,043
1980	-	572	4,615
1981	-	528	5,143
1982	-	502	5,645
1983	-	488	6,133
1984	-	466	6,599
1985	-	377	6,976
1986	-	205	7,181
1987	-	99	7,280
1988	-	-	-

Reference (35).

TABLE XI

FMS/Direct Aircraft Deliveries and Support Lives
(15-Year Useful Life)

<u>Year</u>	<u>Aircraft Deliveries</u>	<u>Aircraft Support Years</u>	<u>Cumulative Aircraft Support Years</u>
1965	11	-	-
1966	22	11	11
1967	52	33	44
1968	16	85	129
1969	55	101	230
1970	44	156	386
1971	26	200	586
1972	14	226	812
1973	22	240	1,052
1974	89	262	1,314
1975	172	351	1,665
1976	106	523	2,188
1977	99	629	2,817
1978	-	728	3,545
1979	-	728	4,273
1980	-	728	5,001
1981	-	717	5,718
1982	-	695	6,413
1983	-	643	7,056
1984	-	627	7,683
1985	-	572	8,255
1986	-	528	8,783
1987	-	502	9,285
1988	-	488	9,773
1989	-	466	10,239
1990	-	377	10,616
1991	-	205	10,821
1992	-	99	10,920
1993	-	-	-

Reference 35.

Determining the Cost for One Aircraft Support Year. The costs for one aircraft support year is based mainly on historical PAPS support cost. However, these cost data are questionable because of several factors. First, PAPS funds are budgeted for use at a specified rate for each aircraft support year. The implications of this are the source of several problems. The fact that there is a certain level of money annually available for field support would tend to encourage managers within Northrop to spend that budgeted money, regardless of field support requirements.

Second, if Northrop wishes to justify a larger total PAPS pool, Northrop is encouraged to indicate both an inflated PAPS expenditure rate and project a higher rate of support utilization. The reasons Northrop may wish to justify a larger PAPS pool are due to the uncertainty of postdelivery field support requirements and/or the uncertainty of the life of the aircraft. Also, Northrop may feel that a larger pool is necessary to improve field support and thus the foreign military sales image of Northrop. This in turn would create a better atmosphere for marketing efforts of other Northrop programs such as the F-18 aircraft. While this study has not produced any indication such abuses are occurring, the possibility for such abuses to occur was pointed out by several U.S. government sources. Since the only way to increase the PAPS pool is to justify increased charges to future F-5 contracts, Northrop may be encouraged to overstate the actual PAPS usage rate so that funds can be obtained before production terminates. Obviously, after production termination increases in the PAPS account become almost impossible.

A third problem exists due to the fact that PAPS funds are pooled and are available for all F-5 programs. Specific support efforts are not matched with specific countries. It is possible for a single country or group of countries to request and receive much more support than the support for which they paid. The funds exist as a pool and any country which makes inordinate demands for field support would utilize more than its paid in share. Thus, for PAPS to remain a viable program and discourage inordinate demands, the availability of this account must retain a low profile. Abuses by individual nations create a higher utilization rate and increase the costs of future sales (23).

Northrop Control of PAPS

Within the Northrop Company another problem concerning PAPS was discovered during this study. There was a tendency by some individual department managers to view the PAPS account as an unspecified pool to which any F-5 tasks not otherwise covered in other contracts could be charged. If such a practice were to prevail, the PAPS account could become a meaningless account, which could be utilized to fund various Northrop F-5 projects which were not specifically identified in any contract.

To prevent other departments from abusing PAPS, Northrop has established a full time PAPS account manager who coordinates all PAPS activities with the IFSP0. Because of the close liaison between the Contracts Division at the IFSP0 and the Northrop PAPS manager, conflicts concerning the utilization of PAPS funds are minimized and control of the expenditures

are maximized. Nevertheless, managers from other departments routinely attempt to utilize PAPS funds whenever other costs pools or contractual arrangements prove to be inadequate.

Participation in PAPS Funding

In order for PAPS to succeed, the program cannot be provided as an optional expense. Nonparticipation in PAPS funding by any country receiving benefits from field support would severely limit the ability of Northrop to provide expected levels of support. The concept of PAPS presumes 100 percent participation of all benefiting countries (8).

Since much of the field support involves aircraft safety, it is difficult to imagine the U.S. government not providing the results of such support to nonparticipating governments. Also, the Freedom of Information Act (dated 4 July 1966) would allow U.S. attorneys employed by nonparticipating countries to access the nonclassified findings of field support studies and related efforts and pass this information along to the foreign governments. Thus, if a country knew it could receive the benefits of the support without having to pay for the support, it is reasonable to assume that many countries would elect not to pay their PAPS share.

Another point to remember is that the benefits of product support are not all future benefits. Many benefits of prior product support efforts are incorporated in current production aircraft and benefit all current and future customers. Thus, the prorata share approach under PAPS attempts to distribute all PAPS support costs equitably among all F-5 customers.

Summary

A number of problems related to the postdelivery field support issue for the F-5 are presented and discussed in this chapter. The major problem identified is the policy vacuum which exists regarding postdelivery field support. This vacuum is evident throughout the U.S. government managerial structure as well as the manufacturing managerial structure. It is the contention of the author that most of the existing problems related to postdelivery field support are due to the policy vacuum.

Nevertheless several related problems are identified. First, a problem exists in matching field support benefits with the benefiting country. As a result, some countries will receive more benefits than others.

Second, there is no commonly accepted techniques for relating support benefits with support task. Third, the allocating of support costs was found to be a complex problem which is not easily solved. Many factors such as estimation errors, timing of purchase, levels of support required and operational life of the aircraft influenced the costs allocated to the customer, especially when costs are allocated as is done with the PAPS approach.

For non-PAPS support, the problem of funding from year to year exists. Also, the impact of charging field support costs for delivered aircraft to newly sold aircraft dramatically increases the aircraft costs. However, as significant as these problems are, the central problem is the assigning of managerial responsibility for postdelivery field support.

VII. POSTDELIVERY FIELD SUPPORT ALTERNATIVES

Background

In the first three chapters of this study, the theoretical framework for this study along with the required terminology are developed so that product support can be analyzed. In Chapter IV the F-5 International Fighter Systems Program Office (IFSP0) is introduced. That chapter provides the introductory background material of an actual foreign military sales unique program. With this background established, Chapter V utilized the terminologies and concepts developed in earlier chapters to examine and study the product support as it exists within the F-5 program. Utilizing the data produced by the study in Chapter V, Chapter VI identifies selected programs which are related to F-5 postdelivery field support. Not all of the problems raised in Chapter VI can be solved on an individual basis. That is, finding the solution to one major problem area such as the policy vacuum discussed in Chapter VI may form the necessary basis for solving other problems such as determining support levels, establishing lines of responsibility and so forth. It should be noted, however, that the application of the concepts developed earlier in this study and the identification of specific problems can be viewed as the first essential step in establishing the necessary dialogue for the understanding of postdelivery field support and the eventual resolution of support problems.

The central problem found throughout all of the problems identified in Chapter VI is the policy vacuum for postdelivery field support. This

vacuum can be traced to the highest levels of government. Although the full implications of the political, economical, and military aspects should be studied before an overall policy is developed, the U.S. Air Force is required to respond to the support situation as it exists and is expected to exist. Thus, while the higher level policies are being developed, the Air Force must depend upon either existing plans and policies or develop alternative plans and policies to resolve and minimize conflicts.

Scope and Purpose

The purpose of this chapter is to examine the assignment of responsibility within the U.S. Air Force for managing foreign military sales postdelivery field support. This chapter concentrates upon two specific considerations for the assignment of postdelivery field support responsibility. The first consideration is based upon the requirements for new or future foreign military sales programs. The second consideration is based upon the requirements of an older, ongoing program, specifically the F-5.

Alternations for the Assignment of Postdelivery Field Support Management Responsibility for New or Future Foreign Military Sales Programs

It is the contention of the author that a clearly delineated assignment of authority and responsibility for foreign military sales field support management would be the most significant action which would help solve postdelivery field support problems. That is, the terminology and concepts developed earlier in this chapter, or any other terminology and

concepts developed by others will be of little value if no management responsibility is designated. It is also the contention of the author that once the responsibility for management of postdelivery field support is established, then the responsible manager can do much to resolve the policy vacuum within the Air Force and develop approaches to solve most of the other support problems identified in Chapter VI.

The decision to assign postdelivery field support management responsibility should be a policy decision made at the highest possible government level. In addition to being charged with the management of postdelivery field support, whatever organization(s) assigned this responsibility should also be charged with identifying, categorizing and tracking postdelivery field support. It must be recognized that as long as postdelivery field support is allowed to be an indistinguishable part of product support, which in turn is often an indistinguishable part of the production effort, no organization can effectively manage postdelivery field support.

Postdelivery field support may be purchased at the time of initial acquisition, however, it is the contention of the author that this support should be clearly identified, categorized and understood by the U.S. government, the manufacturing concern and the concerned foreign government. The basic underlying concept in all of the following discussions in this chapter is that postdelivery field support is, indeed, a distinguishable entity which can be identified, understood and managed.

Maintaining Postdelivery Field Support as Part of the Acquisition Process

If all field support is to continue to remain a function of the acquisition process, then the command responsible for the acquisition effort (Air Force Systems Command) should logically be assigned the responsibility for postdelivery field support. This assignment would make it possible for one command to manage the overall acquisition effort.

However, since AFSC is normally oriented toward research, development and acquisition of systems and not toward acquiring and managing field support, an absence of personnel having the necessary expertise exists. If a cadre of field support expertise is to be developed within AFSC, and AFSC manpower is not increased, then other Department of Defense programs would be required to operate at a proportionately lower manpower level. This lack of qualified personnel could be overcome by increasing manning levels and an extensive training program. However, such changes are costly. The advisability of adding already scarce U.S. Air Force personnel and resources to support foreign military sales requirements should be considered as questionable, especially if the expertise can be found in other organizations.

Since AFSC is responsible for the acquisition efforts and another command (AFLC) is responsible for the follow-on logistics support, assigning postdelivery field support to AFSC creates another problem. Both AFSC and AFLC would be assigned the responsibility to monitor support contracts simultaneously. That is, AFSC would be managing postdelivery field support requirements throughout the operational life of the system, while AFLC would also be managing the traditional logistics support.

Thus, a duplication of effort and possible conflicts of support scope would result.

If the postdelivery field support efforts managed by AFSC were to be transitioned to AFLC when AFLC begins providing logistics support, the problems of duplication of effort would be resolved. However, a potential problem would still exist. Air Force Logistics Command would be charged with managing a support contract created by another command which has different policies and objectives. Thus, the postdelivery field support efforts may not be in accordance with AFLC policies and resources.

Assigning Responsibilities for Postdelivery Field Support Management to
the Logistics Process

The purpose of AFLC is to provide logistics support and the management of logistics support in accordance with the mission of the U.S. Air Force. Since postdelivery field support is very similar to the traditional logistics support and is performed over the same period of time for the same customers as this logistics support, it is logical to assume that AFLC would be the appropriate command to manage this field support. This would, however, involve some major changes in the acquisition, logistics and foreign military sales processes.

The acquisition, logistics and foreign military sales processes would have to be modified so that closer liaison between AFSC and AFLC could be maintained. Air Force Systems Command would have to include AFLC in the contractual negotiations and arrangements between the U.S. government and the contractors as well as those contractual negotiations and arrangements between the U.S. government and the foreign governments.

To avoid jurisdictional conflicts, AFLC alone would be charged with managing postdelivery field support. This would logically lead to complete separation of postdelivery field support from the basic production contract. Air Force Logistics Command could purchase the field support from the contractor at the same time AFSC is purchasing the weapon system, however, the support would be on a separate contract. The foreign military sales customer would still receive only one bill for the total cost of the system as is now done. However, postdelivery field support would now be explicitly defined and delineated.

Under such an arrangement as discussed above, AFLC would be in a position to establish and monitor support policies, control support levels and develop contingency support plans to compensate for estimating errors and/or a prolonged operational life.

An additional benefit would result from the fact that AFLC would now be in a position to coordinate both traditional logistics support and postdelivery field support. Air Force Logistics Command would be able to insure that these two support efforts interface in a complimentary manner, avoiding duplication of efforts and misapplication of resources. Thus, a single support policy within the U.S. Air Force would provide a single viewpoint to both the contractor and the foreign military sales customer. This should improve the existing situation where support is fragmented between logistics support managed by AFLC and field support which is purchased by AFSC.

Assigning the responsibility to manage postdelivery field support to AFLC is not, however, without problems. To assume an increased responsibility and a greater workload, AFLC would require increased manpower and

resources. Again, as with AFSC, these increased manpower levels would mean diverting personnel from other Department of Defense efforts. Thus, personnel who would normally be supporting U.S. requirements would be utilized to support foreign requirements. It is this fact which helps explain the resistance observed during this study for any U.S. Air Force organization to dedicate more resources to foreign military sales unique problems.

The Sharing of Responsibility for Postdelivery Field Support Management with Air Force Systems Command and Air Force Logistics Command

An extension of the first two alternatives discussed is the alternative whereby the responsibilities for postdelivery field support management would be shared by both AFSC and AFLC. Under such an arrangement, mutual cooperation of the two commands would be utilized to attempt to resolve support problems. However, since neither command has the authority to impose policy or resolve conflicts involving both commands, such an alternative would not produce a single source of authority to manage field support. The end results might well be policies and efforts which both AFSC and AFLC would find objectionable. If a single source for management responsibility is selected from only one of the commands and both commands are charged with developing postdelivery field support, the situation would exist whereby personnel would be forced to try to satisfy two command policies: the policies of the command designated to have the management authority as well as the policies of the assisting command.

Recommended Alternative

While all of the alternatives discussed above have some merit, the author recommends the selection of AFLC to be totally responsible for postdelivery field support. While this choice has some problems as discussed earlier in this chapter, the total benefits derived from such a choice appear to be much greater than the problems it would create. This recommendation is based upon the results of this exploratory study and should be subjected to further analysis before any decisions are made.

Postdelivery Field Support Alternatives for the F-5 Program

Background

The F-5 has been under production for a number of years and has had an ongoing foreign military sales program that has extended over a decade. The production rate of the F-5 is beginning to decline as are the foreign military sales efforts (9). Thus, the postdelivery field support problems which face the F-5 cannot be solved by determining the command that should have been assigned field support management responsibility years ago. This discussion thus focuses on what should be done, both in the near future and thereafter, to solve the field support problems of the F-5. As pointed out in Chapters V and VI, field support has been part of the acquisition process. The acquisition process is managed by the IFSP0. Field support has been described as a concept whereby operational aircraft could be kept operational and customers as well as

prospective customers could receive technical advice, updated tactics information, and the benefits of numerous studies. Since this support has been provided over the years without additional costs beyond the original purchase price of the F-5 system, it is reasonable to assume that both prior and prospective customers expect this support to be continued. In fact, postdelivery field support requirements exist throughout the operational life of the aircraft.

The PAPS approach attempts to solve part of the problem of support cost allocation. Additionally, the PAPS approach does establish a pool of funds whereby a small level of postdelivery field support can be provided beyond the production life of the aircraft. However, once the PAPS account is depleted and production terminated, there will be no funds available for postdelivery field support efforts.

Most of the postdelivery field support is not provided by PAPS. The largest portion of field support is purchased on a factored basis and made part of the annual production costs. This has tended to significantly increase the unit price of each aircraft. This increased cost is due to the fact that the base (aircraft produced) is declining and postdelivery field support costs are increasing. The support costs are increasing because of several factors. For example, there are more aircraft in the field, customers appear to expect greater support (36:47), and Northrop policy is to provide whatever support required to satisfy the increasing support requests made by customers, the U.S. State Department, and other U.S. government agencies.

In addition to increasing the unit cost of each aircraft and possibly reducing the level of aircraft sales, purchasing postdelivery field support on an annual basis presents another problem. Once sales are terminated there will be no new sales to fund the support. Thus, the support requirements will continue, but the support program will not be able to respond.

Recommendations

The following approaches will not alleviate all of the postdelivery support problems. Such problems as matching benefits and cost will remain. However, at this point in time, it may not be possible to solve all of the postdelivery field support problems. Perhaps, the best situation for which the F-5 program can seek is the situation which minimizes major repercussions while providing some time to consider alternative approaches. In view of the urgency of the F-5 postdelivery field support problem, the following discussed approach should be considered. The prospect of moving postdelivery field support from the area of crisis management to the area of anticipatory management may be the best possible approach.

Separating Postdelivery Field Support From Production Costs. The Air Force should initiate a study to determine what, if any, field support the U.S. government intends to provide. Assuming that U.S. government policy will not permit postdelivery field support to be abruptly terminated, the IFSP0 should consider what alternatives are possible to minimize support problems. The first action the IFSP0 should consider is to require all F-5 postdelivery field support provided by Northrop to be concisely defined and identified. Second, postdelivery field support

should be purchased on the basis of a clearly worded statement of work, so that support levels can be controlled and the support efforts more easily identified. By separating postdelivery field support costs from the production costs, the costs of actual support requirements can be determined. Once postdelivery field support is made more controllable and the actual requirements determined, the basis will be established whereby the long term support requirements can be determined. Since the F-5 will be in production at least through calendar year 1979, the interim period should be utilized to explore alternative sources of funds and/or alternative support programs for all postdelivery field support.

Since much of the postdelivery field support is an "implicit" type of support, it is not possible for the author to assess existing agreements. It is highly probable that political exigencies rather than legal agreements will dictate what support is to be provided. However, since foreign military sales efforts are to be at no cost to the U.S. government, the U.S. Air Force cannot legally provide postdelivery field support once all funds have been depleted.

Interim Action. Until alternative support arrangements can be developed, one specific interim action should be considered. Postdelivery field support should be contracted for separately, and not be included in the production contract. During the acquisition process, a separate contract for postdelivery field support should be negotiated. This would give the IFSP0 some control over the support program.

Providing Adequate Time for Planning Alternatives. If the above recommendations are implemented as soon as possible, the U.S. government and Northrop could advise both prior customers and prospective customers of how much field support they could expect and for how long. This early identification of the levels and duration of postdelivery field support would provide some lead time so that concerned foreign governments, the U.S. government and Northrop could develop additional support plans. For example, if it is determined that existing funds and anticipated funds for future product support contracts from new customers could provide no more than five years of postdelivery field support, then the IFSP0 would have adequate lead time to develop and implement other support arrangements. All of the countries would be forewarned that at some future date new arrangements for postdelivery field support would be required. Countries that are not able to afford purchasing support after the five year point would have adequate time to request aid from the U.S. government or to make other arrangements with the U.S. government for the continuation of the support.

Reducing the Funding Requirements for Postdelivery Field Support.

By contracting for postdelivery field support for a specified level and time, Northrop could maintain a cadre of support personnel even after production termination. With such an arrangement, the F-5A/B non-ECP support could be combined with the field support efforts for the F-5E/F. This action should reduce duplication of efforts and streamline the field support effort. This, in turn, could lead to reduced funding requirements and increased support capabilities.

Summary

The central problem related to postdelivery field support is the absence of a central authority responsible for the support management. The selecting and assigning of a responsible manager is the first step in solving the other related problems. Careful consideration should be given before the selection is made.

Based upon this initial study, the author favors assigning the responsibility for managing postdelivery field support to AFLC when the program is in the early stages. Air Force Logistics Command has the support expertise and could coordinate existing AFLC support programs to avoid duplication of effort and increased costs. However, the impact that this decision would have on the manpower and resources of AFLC should not be ignored.

For the older programs such as the F-5, a statement of work should be utilized in purchasing the field support. This would require that support efforts be concisely identified and categorized. Also, post-delivery field support should be contracted for separately from the basic production contract. This would place all postdelivery field support under contract and give the IFSP0 some time to develop alternative plans.

VIII. SUMMARY AND CONCLUSIONS

Introduction

This study has been an exploratory investigation of the support which is included with a weapons system as a result of the acquisition process. Most of the emphasis of this study was directed at that type of support which is logistically oriented.

The concept of product support is present in virtually all major weapon systems contracts. Although the scope of this study focuses on the area of postdelivery field support for the F-5 program, most of the terminology developed and concepts employed in this study can be extended to other foreign military sales programs and possibly some Department of Defense programs. However, such an extension is beyond the scope of this study.

Terminology and Definitions

One of the findings of this study was that there are no commonly accepted definitions or adequate terminology from which a study of product support could be developed. As a result of this finding, the author developed terminology and definitions to form the framework of the analysis.

Product Support

The basic support term from which all other support terms in this study are a subset is product support. Product support is defined as

that support which is provided a system (product) and included with that system as a result of the initial acquisition process. This support may be in the form of studies, engineering drawings, update of documentation, training for customers, data collection, technical advice, operational advice and service, systems demonstration and so forth.

Product support can be viewed as a single element, the cost of which the manufacturer has included with the production costs in the initial purchase of the weapon system. Even if the support is not separately identified, a part of the weapon system unit cost is for product support. So that this support could be further identified and understood, the author developed in Chapter II four ways of classifying the support.

Predelivery/Postdelivery Support

The first classification is based on chronological criteria. The dividing point of this classification is the delivery of the system to the customer. Thus, predelivery support as defined in Chapter II is considered to be all product support provided to the production process, customers awaiting aircraft delivery and potential customers. Postdelivery support is defined as that product support which is provided to delivered aircraft to keep the aircraft operational, to customers of delivered aircraft so that the aircraft capabilities can be fully utilized, and quality control type efforts on delivered aircraft so that data from operational systems can be utilized to improve the production process.

Production/Field Support

The second approach classifies product support according to the purpose (function) of the support. Thus, production support is defined as that support which is intended to improve the production process and keep the production process technologically current. This support element is future oriented, with the focus on the production process. The second element, field support, is defined as that support which is provided to customers and potential customers. This support need not be performed in the "field" to be so classified. Rather, the function of the support, customer assistance, determines the classification. While this element of support may be future oriented, it is often a reactive type of support provided to solve existing problems. However, the focus of field support is the customer.

Predelivery/Postdelivery Field Support and Predelivery/Postdelivery
Production Support

The third approach to classifying product support is a combination of the predelivery/postdelivery concepts with the production/field support concepts. The result is four well defined product support elements. The first element, predelivery field support, is defined as that support provided to potential customers. This support may consist of certain sales efforts, surveys, capability studies and so forth. This support is forward looking in the sense of attempting to sell aircraft and is customer centered.

The second element, predelivery production support, is defined as that support provided the production process so that the process will be technologically up-to-date and the process will be able to produce the desired systems acceptable in quality, quantity, and on schedule.

The third element is postdelivery product support. This support is defined as the follow-up of problems in operational (delivered) systems so that the production process can receive corrective feedback. When a system surpasses design requirements or fails to meet design requirements, the production process utilizes this information to correct itself.

The fourth and largest element of product support is postdelivery field support. This support is defined as those efforts which are directed at operational aircraft with the purpose of keeping those systems operational, improving the system, improving the maintenance of the system or correcting any deficiencies. This support is customer oriented and largely reactive in nature. However, some studies and programs are conducted within this element which are future oriented.

Explicit/Implicit Support

The fourth and final approach for classifying product support utilizes the criteria of the explicitness of the support requirements and support task. An explicit support requirement is defined as that support which has been clearly stated in the sales agreement and accepted by all concerned. Implicit support is that support which is not stated in the sales agreement, but is provided because it is expected or it has been provided in the past or it is accepted policy. Clearly, implicit support means different things to different parties. Because of this last

fact, it was not possible to establish a clear relationship between explicit and implicit support. These concepts of support were found to exist, however, and are the source of many problems.

Findings

Product Support

Cost of Product Support. Product support within the F-5 program is a costly, complex area. In Chapter V the application of the terminology developed in Chapter II helped identify the extensive nature of this support.

Product support was found to be an extremely costly portion of the unit cost of the F-5 aircraft. The method of allocating field support costs on an incremental basis to the acquisition effort was identified as a major source of product support costs increases. This method allocated the field support costs of delivered aircraft to those aircraft being delivered. Over a period of time more systems were placed in the field. The postdelivery field support portion of product support costs increased and the delivery rate decreased. As a result, field support costs were found to be driving the cost of product support to unacceptable heights.

Matching of Field Support Costs With Resulting Benefits. In addition to the increasing field support costs, it was found that a cost allocation problem exists. The foreign military sales market is composed of a number of countries, each purchasing different aircraft configurations. These aircraft are delivered over discreet periods of time to purchasing countries. Because of the complexities of identifying

and tracking support efforts, it has been difficult to match support costs with the respective benefits provided. As a result, product support is purchased utilizing two distinct methods.

The first method of purchasing product support is to purchase the support on an incremental basis. This approach attempts to charge the current production contracts for the field support provided operational aircraft which were sold under earlier contracts. That is, all support costs are pooled and treated as if they were production costs and are included in the basic unit price of currently produced aircraft. Those aircraft currently produced will depend upon future aircraft sales to fund their postdelivery field support requirements.

The second method of purchasing product support is to forecast a portion of the total field support requirements and charge each customer for the prorated portion of this support. This approach, presale and postsale support (PAPS), attempts to establish a pool of funds so that selected field support efforts can be provided. This approach also attempts to distribute an equitable share of the support costs among all customers.

Duration of Postdelivery Field Support. The PAPS approach can be used to highlight another finding of this study. Postdelivery field support requirements will exist throughout the operational life of the aircraft. This means that support requirements will exist long after the production effort has closed. As product support is purchased within the existing F-5 program, the only limited capability for providing postdelivery field support once production terminates is through the PAPS account.

Postdelivery Field Support Problems

Postdelivery Field Support Identified. The first postdelivery field support problem was the difficulty of identifying the specific postdelivery field support efforts and determining the actual level of postdelivery field support. This identification was difficult because product support has not previously been adequately defined and subdivided. Support pool data were thus almost meaningless.

Also, since the postdelivery field support efforts are often performed by the same departments or personnel who routinely perform production support, there was a tendency within Northrop to make inaccurate classifications of support.

Postdelivery Field Support Levels. Without accurate classifications of the support effort, it becomes almost impossible to determine the actual field support levels. Product support is thus often viewed as one large resource pool from which all nonrecurring support problems can be solved on a recurring basis. In this environment, there is little motivation upon the manufacturer's part to accurately categorize the support efforts and establish definitized support levels. The postdelivery field support level thus becomes a function of other support requirements and company policy.

Support Cost Allocation. When all product support is included in a single pool, the support costs are in essence treated like indirect production costs. This means that customers are being charged with postdelivery field support for which others are benefiting. Product support unit costs are calculated by dividing the total support costs for the period by the number of aircraft delivered in that period. Thus, as the

postdelivery field support costs increase, the total number of operational aircraft in the field increase, or the production levels begin to decrease due to the decline in annual sales, it can be seen that the postdelivery field support costs will increase, reaching a point where those costs will begin to drive product support costs and, in turn, the unit price of the aircraft to unacceptable levels.

Control of Product Support. Even though the foreign military sales program is conducted on a government-to-government level, by "policy default" Northrop has had to assume the major responsibility for the management and control of product support. Jurisdictional disputes between AFSC and AFLC along with communication problems have hampered the resolution of product support problems. When product support disputes arise, there exists no means of adequately resolving them. Thus, Northrop has established its own policy regarding product support. The actual breakdown of support efforts, the nature of these efforts and even the level of the support provided is mainly controlled by Northrop policy.

As a result of Northrop policy, product support is provided to almost all official and quasi-official sources. These support requests do not flow through any single channel. Instead, support requests are routed through AFSC, AFLC, the State Department, Congress, Northrop employees, government officials, direct contact with the foreign government and so forth.

Conclusions

This study has developed a terminology and methodology whereby product support can be more accurately classified and defined. The application of this methodology would help remedy the problem of product support identification and categorization. However, the problem of allocating support costs and the control of the support effort remain. Moreover, as discussed in Chapter VII, the central problem which must be resolved prior to addressing the other problems is the assignment of postdelivery field support managerial responsibility. Once this is done, the assigned manager can address the other problem areas such as matching support benefits with costs, allocating the costs, tracking and controlling the support, funding the support and so forth.

In Chapter VII a number of alternative approaches for the assigning of management responsibilities for postdelivery field support were presented. Before selecting any single approach, each alternative and possibly other alternatives should be examined more rigorously. Based upon the results of this study, two preferred postdelivery managerial approaches have been selected. One is for new foreign military sales programs and the other is for the F-5 program. The criteria utilized for the selection of these approaches was based upon the observed data collected during the course of this study and as perceived by the author.

As was stated in Chapter III, a primary purpose of this study was to develop the terminology, definitions, and concepts for further study of foreign military sales product support. Although some analysis of existing and potential product support problems was done, the scope of

this effort was of necessity limited. Thus, the recommendations which follow should be considered as possible suggestions which warrant additional research.

Recommendations for New Foreign Military Sales Programs

Management Responsibility for Postdelivery Field Support. Programs anticipating entering the foreign military sales market on any major scale should consider assigning the responsibilities for postdelivery field support to the AFLC. Air Force Logistics Command is designed to meet logistics requirements and has the expertise to incorporate post-delivery field support efforts into existing or predicted logistics programs.

Under this arrangement postdelivery field support would be negotiated as separate contracts between the manufacturer and the customers. However, this support could still be purchased at the time of aircraft purchase so that the foreign government would receive only one billing.

Assigning AFLC management responsibility for postdelivery field support would require the inclusion of AFLC in the acquisition phase of the contract. Field support should be made an explicit type of support and clearly delineated. All parties would thus understand the type, level and duration of the support which has been purchased.

One adverse situation created by such a change would be upon the AFLC and Air Force manpower requirements. Since the Air Force is not provided increased manpower for supporting foreign programs, the transfer of manpower to support such non-DOD programs might be detrimental to the overall Air Force mission. Thus, such a decision requires further study by the highest possible DOD officials.

Recommendations for the F-5 Program

The fact that there are not enough funds to provide postdelivery field support indefinitely for the F-5 program is inescapable. The implications this may have in the political and international arena are significant. Once foreign governments realize that a mismatching of support benefits and costs with various customers has occurred, additional international reactions may result. The following suggestions will not alleviate this situation. However, these suggestions will help the IFSPD manage the remaining postdelivery field support efforts for the F-5 program. This improved management may result in lower support costs and reduced support requirements. Additionally, the following suggestions should help the postdelivery field support managers to anticipate and plan for some of the inescapable problems discussed above.

If a policy decision is not made to terminate postdelivery product support, then three recommendations would apply to the F-5 program. First, postdelivery field support should be excluded from the basic F-5 purchase from Northrop on all future F-5 sales. Second, postdelivery field support for the F-5 should henceforth be purchased on a statement of work rather than a level of effort. A clearly worded statement of work would establish the specific support tasks, support levels and support duration. Third, the postdelivery field support should be clearly delineated in the sales agreement between the U.S. government and the foreign government. This would clearly define both what is promised by the U.S. government and what the foreign government expects. The U.S. government is not committed to open ended support if that

support is not funded by the foreign government. Foreign military sales efforts are prohibited from causing the U.S. to incur a loss.

For those countries that have purchased F-5 aircraft under prior contracts, this approach would give both the IFSP0 and Northrop the ability to determine how long this support can be continued without additional funding and at what level. Such countries would be placed on notice that additional contracts would be required at some specified future date. Thus, countries unable to afford future support contracts would have adequate lead time to seek credit from the U.S. government or to apply for assistance.

Additionally, such an approach would make it possible for managers to identify and fund a specific level of support. Thus, Northrop could maintain a cadre of expertise dedicated to F-5 field support problems and not be required to either absorb some support costs as is done with the F-5A/B call contract or bury the costs in the production contract as is done with F-5E/F.

The above discussed approach will not necessarily solve all of the F-5 support problems. However, this approach would help solve the support cost allocation problems, improve the management of the funding of field support and establish definite controls on field support. Such improvements could form the basis for a well developed approach for handling the postdelivery field support problems identified in this study.

Selected Bibliography

1. Department of the Air Force. Retrofit Configuration Changes. United States Air Force Regulation 57-4. Washington, D.C. 26 January 1972.
2. Department of the Air Force. A Guide for Program Management. United States Air Force Systems Command Pamphlet 800-3. Washington, D.C. 9 April 1976.
3. Department of the Air Force. Foreign Military Sales. United States Air Force Manual 400-3. Washington, D.C. 7 May 1974.
4. Northrop Corporation and the F-5 International Fighter Program Office, Aeronautical Systems Division of the United States Air Force Systems Command. Hawthorne, California. Interview, 8 April 1976.
5. Northrop Corporation. "Indirect Product Support." A Northrop prepared briefing package. Hawthorne, California, 1974. (Mimeograph.)
6. United States Department of Defense. Proposed changes to the Armed Services Procurement Regulations, 6-1304.3, Washington, D.C. 12 January 1976. (Mimeograph.)
7. F-5A/B Program Personnel. Aeronautical Systems Division of the United States Air Force Systems Command. Wright-Patterson Air Force Base, Ohio, Interview, 27 April 1976.
8. Northrop Corporation. "Pre- and Postsale Support Activities (PAPS)." A Northrop prepared briefing package presented to the government of Switzerland. Hawthorne, California, 1976. (Mimeograph.)
9. F-5A/B and F-5 E/F Program Personnel. Aeronautical Systems Division of the United States Air Force Systems Command. Wright-Patterson Air Force Base, Ohio, Interview, 28 April 1976.
10. F-5A/B and RF-5A Historical Document. "Configuration Accounting Report." Aeronautical Systems Division of the United States Air Force Systems Command. Wright-Patterson Air Force Base, Ohio. 10 June 1975. (Mimeograph.)
11. F-5A/B and RF-5A Historical Document. "Country Status Report." Aeronautical Systems Division of the United States Air Force Systems Command. Wright-Patterson Air Force Base, Ohio, 3 June 1975. (Mimeograph.)
12. F-5A/B and RF-5A Historical Document. "Summary Cost Report." Aeronautical Systems Division of the United States Air Force Systems Command. Wright-Patterson Air Force Base, Ohio, November 1975. (Mimeograph.)

13. F-5E/F Historical Document. "F-5E/F Program Overview Summary." Aeronautical Systems Division of the United States Air Force Systems Command. Wright-Patterson Air Force Base, Ohio, 26 July 1976. (Mimeograph.)
14. F-5E/F Historical Document. "F-5E/F Summary Data." Aeronautical Systems Division of the United States Air Force Systems Command. Wright-Patterson Air Force Base, Ohio, 27 July 1976. (Mimeograph.)
15. F-5E/F Briefing Package. "F-5E/F Summary of MASF/USAF/SAP-GA/FMS." Briefing package prepared by the F-5 International Fighter Program Office, Aeronautical Systems Division of the United States Air Force Systems Command. Wright-Patterson Air Force Base, Ohio, 26 July 1976. (Mimeograph.)
16. United States Department of Defense. Armed Services Procurement Regulations. Washington, D.C., 1 October 1975.
17. Moberly, Michael W. Northrop Air Division Deputy for the Capabilities and Pricing Analysis Team Interface. Contracts Division, Northrop Corporation. Hawthorne, California. Interview, 12 April 1976.
18. Northrop Corporation Documentation. FY76 F-5E/F Aircraft Program CY 1978 Deliveries. Unpublished Northrop documentation prepared for the United States Air Force F-5 International Fighter Program Office. Hawthorne, California. (Mimeograph.)
19. Northrop Corporation. "Support of Northrop Aircraft by Utilization of Sustaining Engineering." A Northrop prepared briefing package. Hawthorne, California, 1975. (Mimeograph.)
20. Engineering Conference. Attended by representatives from the F-5 International Fighter Program Office; the Northrop Air Force Plant Representative Office, and Northrop Air Division. A conference which discussed aspects of F-5 engineering. Hawthorne, California, 6 April 1975.
21. F-5 Program Personnel (names withheld by request). Hawthorne Division, Northrop Corporation, Hawthorne, California. Interview. 15 April 1976.
22. F-5 Field Support Cost Study. A letter with an attached study, performed by the F-5 International Fighter Program Office. Aeronautical Systems Division of the United States Air Force Systems Command. Wright-Patterson Air Force Base, Ohio, August 1973. (Mimeograph.)
23. Cost and Pricing Analysis Team Conferences. A series of conferences which included representatives from the United States Air Force F-5 International Fighter Program Office, the Northrop Air Force Plant Office, and Northrop Corporation. Hawthorne, California, 7-15 April 1976.

24. "Advance Agreement for 'Pre- and Postsale Support Activity' ASPR 6-705.3." Letter of agreement concerning the F-5, signed by representatives of Northrop Corporation and the F-5 International Fighter Program Office, Wright-Patterson Air Force Base, Ohio, 1 May 1975. (Typewritten.)
25. Tapper, Thomas. Northrop manager of the Presale and Postsale Support Activity. Hawthorne Division of the Northrop Corporation. Hawthorne, California. Interviews 7-15 April 1976.
26. Northrop Corporation. "Pre- and Post Sale Support." A Northrop prepared briefing package. Hawthorne, California, 1975. (Mimeograph.)
27. Northrop Corporation. F-5 Operational and Support Program Status Report. An unpublished report prepared by the Northrop Corporation for the F-5 Support Program Management. Hawthorne, California, March 1976. (Mimeograph.)
28. Cogburn, Dennis K. Assistant Chief, Procurement and Production Division, F-5 International Fighter Program Office. "Procurement of Special and Sustaining Support for Mixed USAF/FMS Aircraft Buys." An unpublished position paper. Wright-Patterson Air Force Base, Ohio. (Mimeograph.)
29. F-5 Program Personnel (names withheld by request). F-5 International Fighter Program Office, Aeronautical Systems Division of the United States Air Force Systems Command. Wright-Patterson Air Force Base, Ohio. Interviews, July 1976.
30. United States Air Force/LG to CINCUSAFE, et. al. Letter discussing sustaining engineering for Foreign Military Sales. Washington, D.C., 5 November 1973. (Mimeograph.)
31. Sustaining Engineering Conference. Attended by representatives from the United States Air Force F-5 International Fighter Program Office, the Northrop Air Force Plant Representative Office, and Northrop Engineering Departments. A conference which discussed F-5 sustaining engineering. Hawthorne, California, 8 April 1975.
32. Mueller, Robert M. Northrop Air Force Plant Representative, Aerospace Engineering. "Contractor's Sustaining Engineering AFPRO/EN Evaluation." An unpublished report. Hawthorne, California. 6 May 1976. (Mimeograph.)
33. F-5E/F Historical Document. "Manhour Accounting." A Northrop prepared report for internal management. Hawthorne Division of Northrop Corporation. Hawthorne, California, March 1976. (Mimeograph.)

34. Cost and Pricing Analysis Team Conference. Attended by representatives of the United States Air Force F-5 International Fighter Program and Northrop Air Force Plant Representative. F-5E/F support was discussed. Hawthorne, California, 7 April 1976.
35. F-5 Historical Document. "Northrop Sustaining Activity, Quarterly Report." A Northrop prepared report provided to the F-5 International Fighter Program Office. Hawthorne, California, March 1975. (Mimeograph.)
36. "New Perils in Arms Sales to Mideast." U.S. News and World Report. Volume LXXXI Number 7. 16 August 1976. p. 47.

APPENDIX A

DEFINITIONS

APPENDIX A

Definitions

1. Explicit Support. That product support which has been clearly stated in the sales agreement and accepted by all concerned.
2. Field Support. That product support which is provided to customers and potential customers. The function of such support is customer assistance.
3. Foreign Military Sales. The selling of U.S. produced military equipment and services to friendly foreign governments and international organizations under the authority of the Foreign Military Sales Act of 1968. The sales are conducted on a government-to-government level.
4. Implicit Support. That product support which is not stated in any sales agreement, but is provided because it is expected or it has been provided in the past or it is accepted policy.
5. Postdelivery Field Support. Those support efforts which are directed at operational aircraft with the purpose of keeping those systems operational, improving those systems, improving the maintenance on those systems, correcting any deficiencies in those systems, or providing customer assistance.
6. Postdelivery Production Support. The follow-up of problems in operational (delivered) systems so that the production process can receive corrective feedback.
7. Postdelivery Support. That product support which is provided to delivered aircraft to keep the aircraft operational and customers of delivered aircraft so that the aircraft capabilities can be fully utilized. This support is also defined to be those quality control type efforts on delivered aircraft which are performed so that the production effort can be monitored.
8. Presale and Postsale Support (PAPS). An approach utilized by the F-5 International Fighter System Program Office for purchasing and funding a small level of field support for the F-5 aircraft.
9. Predelivery Field Support. Those sales efforts, surveys capability studies and other types of product support which are provided to potential customers.
10. Predelivery Production Support. That product support provided the production process so that the process will be technologically up to date and able to produce the desired systems acceptable in quality and quantity, and on schedule.

11. Preelivery Support. That product support which is provided to the production process, customers awaiting aircraft delivery and potential customers.
12. Product Support. That support which is provided a system (product) and included with that system as a result of the initial acquisition process. This support may be in the form of studies, engineering drawings, tests, training, technical advice, operational advice, and second systems demonstrations.
13. Production Support. That product support which is intended to improve the production process and keep the production process technologically current.
14. Sustaining Engineering. That engineering effort necessary to maintain and improve the production process. Sustaining engineering is further defined as that engineering effort necessary for the support of customers, prospective customers and operational aircraft.
15. Weapons System Life Profile. A conceptualization of the preproduction, full scale production and postproduction stages of a weapons system.

APPENDIX B

ACRONYMS

APPENDIX B

Acronyms

ADC	Aerospace Defense Command
AFCS	Air Force Communications Service
AFLC	Air Force Logistics Command
AFM	Air Force Manual
AFPRO	Air Force Plant Representative Office
AFR	Air Force Regulation
AFSC	Air Force Systems Command
AFSCP	Air Force Systems Command Pamphlet
ASD	Aeronautical Systems Division
ASD/ISA	Assistant Secretary of Defense for International Security Affairs
ASPR	Armed Services Procurement Regulation
ATC	Air Training Command
CAPAT	Cost and Price Analysis Team
CECP	Configuration Engineering Change Proposal
CY	Calendar Year
DCAA	Defense Contract Audit Agency
DOD	Department of Defense
ECP	Engineering Change Proposal
FMS	Foreign Military Sales
GFE	Government Furnished Equipment
IFSP0	International Fighter Systems Program Office
MAAG	Military Assistance Advisory Group
MAP	Military Assistance Programs
MASF	Military Assistance Service Funded
PAPS	Presale and Postsale Support
SAP	Security Assistance Programs
TAC	Tactical Air Command
TCTO	Time Compliance Technical Order
TR	Trouble Reprot
UR	Unsatisfactory Report
WBS	Work Breakdown Structure


VITA

James Paul Dutcher, Jr. was born on [REDACTED] Oklahoma. On 2 January 1962, nine months after graduation from Armijo High School in Fairfield, California, he enlisted in the Air Force. Throughout his Air Force career he has served in a variety of assignments, some of which included duty as a missile guidance systems technician, a flight controls specialist and instructor duty for an advanced course in missile guidance systems. In 1967 he was selected for commissioning and sent to Colorado State University in Fort Collins, Colorado. In 1970 he received a Bachelor of Science Degree in Mathematics with an emphasis in Computer Science. He was commissioned a second lieutenant in the United States Air Force shortly thereafter. His last military assignment prior to attending the graduate degree program at the Air Force Institute of Technology was as an airborne electronics specialist aboard EC-135 aircraft assigned to the Air Force Eastern Test Range, Patrick Air Force Base, Florida. He provided telemetry support to such programs as Project Apollo, Skylab, several deep space probes, various Air Force programs, the Trident Program and several other Department of Defense programs.

[REDACTED]

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER GSM/SM/76S-5	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) FOREIGN MILITARY SALES PRODUCT SUPPORT: AN EXPLORATORY STUDY OF THE SUPPORT PURCHASED AS PART OF THE INITIAL ACQUISITION EFFORT FOR THE F-5 WEAPON SYSTEM		5. TYPE OF REPORT & PERIOD COVERED MS Thesis
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) James P. Dutcher, Jr. Captain USAF		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Air Force Institute of Technology (EN) Wright-Patterson AFB, Ohio 45433		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Air Force Institute of Technology (EN) Wright-Patterson AFB, OH 45433		12. REPORT DATE September 1976
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		13. NUMBER OF PAGES 162
		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES Approved for public release; IAW AFR 190-17  JERRAL F. GUESS, Captain, USAF Director of Information		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Foreign Military Sales Postdelivery Field Support International Fighter Program Implicit Support Field Support Explicit Support Product Support Predelivery Field Support		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The United States Government is deeply involved in foreign military sales programs. In recent years, the foreign military sales programs have become increasingly complex and more difficult to manage. One of the reasons for this increasing complexity and resulting difficulties is due to support which is purchased as part of the initial acquisition effort (product support). That is, the U.S. government sells more than hardware to the foreign governments. The United States Government and its vast technological resources stand behind each		

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

item sold under a foreign military sales arrangement. Included in the acquisition price of each item are costs for providing such support.

The F-5 program, which is synonymous with foreign military sales, provides valuable insight into how this support is purchased, managed and funded. The implications of the support problems identified in this study is readily applicable to other foreign military sales programs.

The objective of this thesis is to present a detailed study of the support which is included in the acquisition process of foreign military sales programs. Thus, a set of definitions and concepts are developed in this study whereby this support can be identified, problems identified and suggested solutions developed. These concepts are then applied to the F-5 program in general as well as specific support efforts within this program so that support tasks can be categorized in a meaningful manner. Additionally, selected problems such as support cost allocation problems, the matching of support benefits with costs and problems associated with the funding of the support efforts are presented.

This thesis is an initial study of this support topic. It is intended to provide insight into the obscure area of product support and establish a framework of terminology and concepts whereby program managers can understand and better manage such support.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)