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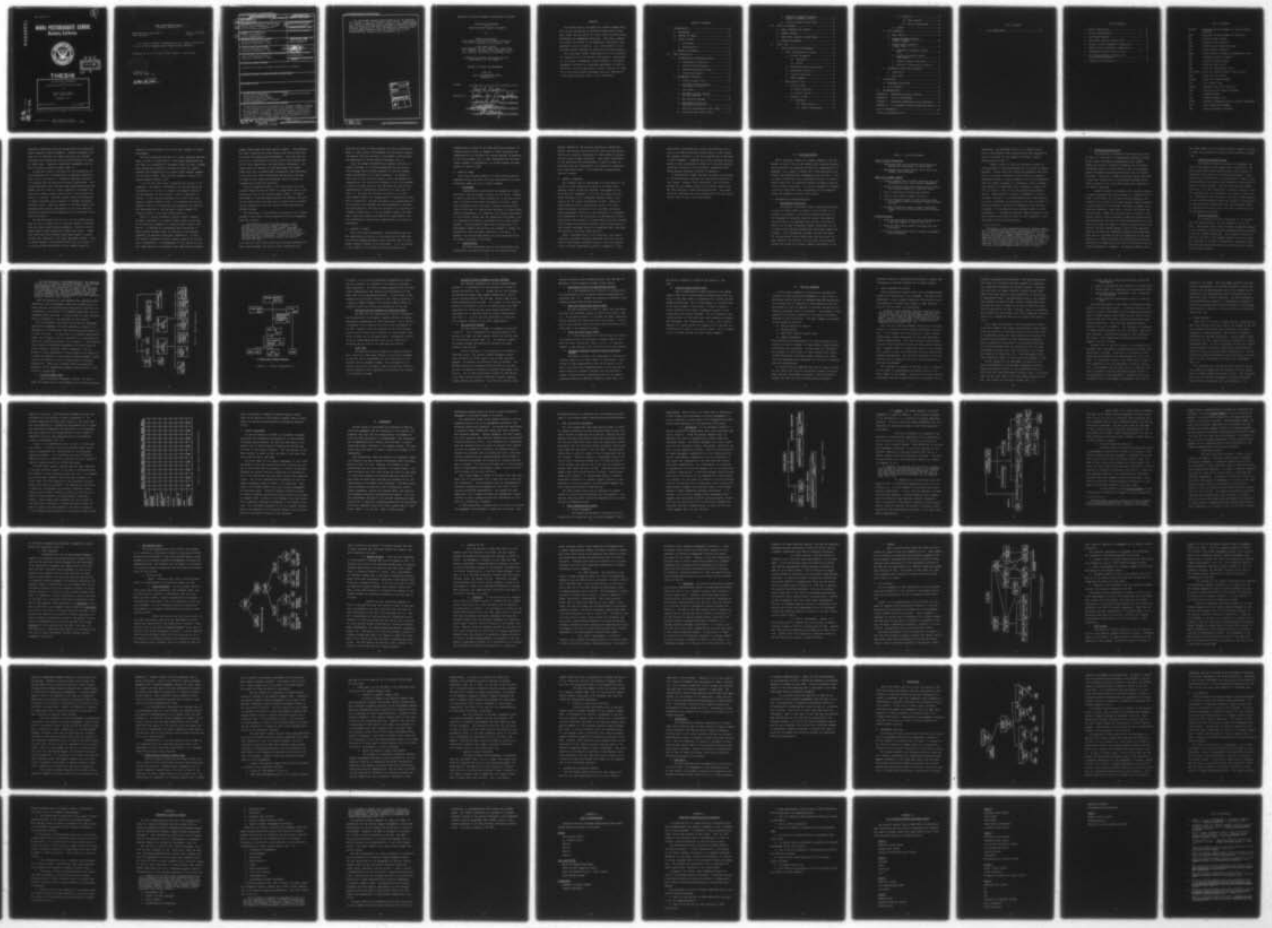

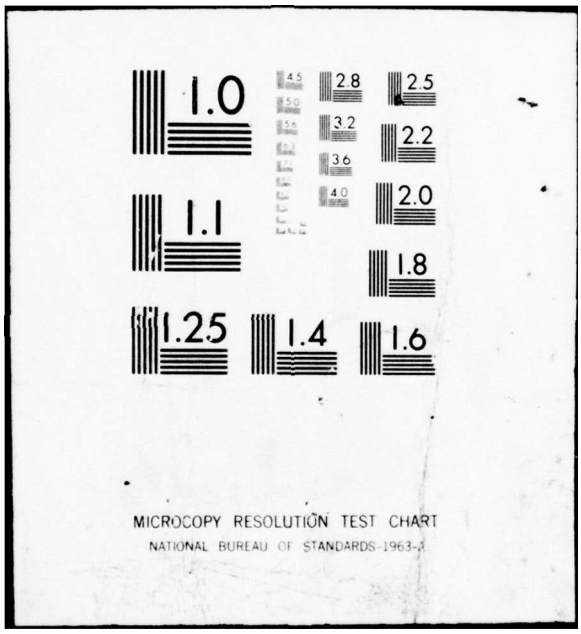
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ACQUISITION MANAGEMENT
OF
PECULIAR GROUND SUPPORT EQUIPMENT

by

Rodney Donald Beran
Paul Roger Decker

December 1977

Thesis Advisors: J. W. Creighton
J. B. Hall

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China Lake, California 93555

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The methods used by the Naval Air Systems Command (NAVAIR) in the acquisition of Peculiar Ground Support Equipment (PGSE) was the object of a study which reviewed policy, procedures and management techniques. Particular emphasis was placed on a review of the managerial innovations being employed by the F-18 project, e.g., funds control by the Assistant Project Manager for Logistics and phased support

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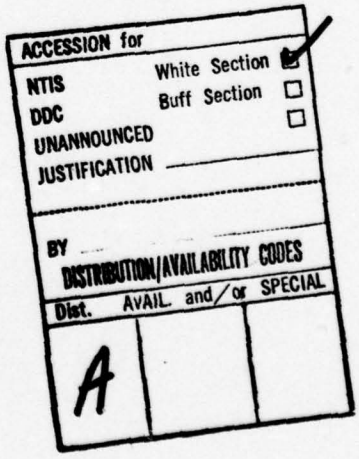

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Acquisition Management of Peculiar Ground Support Equipment

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ABSTRACT

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The study made several observations as to the potential for success of the F-18 project's new methods. Additionally, the authors recommended several changes to the NAVAIR management structure for long-term improvement in PGSE acquisition, the most significant of which involves the transfer of the Ground Support Equipment Division (NAVAIR-534) to the Logistics/Fleet Support Group (NAVAIR-04).

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LIST OF ACRONYMS

APM-GSE	- Assistant Project Manager for Ground Support Equipment
APML	- Assistant Project Manager for Logistics
ASO	- Aviation Supply Office
ATE	- Automatic Test Equipment
CGSE	- Common Ground Support Equipment
GSE	- Ground Support Equipment
GSERD	- Ground Support Equipment Recommendation Data
ILS	- Integrated Logistic Support
LEM	- Logistic Element Manager
MSD	- Material Support Date
NAEC	- Naval Air Engineering Center
NARF NORIS	- Naval Air Rework Facility, North Island
NATC	- Naval Air Test Center
NAVAIR	- Naval Air Systems Command
NSD	- Navy Support Date
OPEVAL	- Operation Test and Evaluation
PGSE	- Peculiar Ground Support Equipment
PM	- Program Manager
PMA	- Project Manager, Air
RILSD	- Resident Integrated Logistic Support Detachment
SRA	- Shop Replaceable Assembly
WRA	- Weapon Replaceable Assembly

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I. INTRODUCTION

At the outset it is appropriate to define the general class of equipment treated by this thesis. Broadly defined, Ground Support Equipment (GSE) is that equipment which provides maintenance support directly to an aircraft weapons system or an uninstalled aircraft component undergoing test or repair. GSE is, for purposes of acquisition management, divided into two broad categories; Common Ground Support Equipment (CGSE) and Peculiar Ground Support Equipment (PGSE). As the name implies, CGSE is that GSE which is used with more than one aircraft type or system and, similarly, PGSE has specific application to only one such weapon system. Classifying a piece of equipment as PGSE does not mean that it is necessarily unique to a given aircraft, but rather that it is unique to a particular system which may be employed on several aircraft types.

It should also be noted that, with today's emphasis in avionics support on Automatic Test Equipment (ATE), a PGSE requirement is not necessarily for just hardware but can also include software. For the purposes of this thesis, the terms "support equipment", GSE and PGSE refer to both hardware and software.

A. BACKGROUND

Until the late 1950's, the sophistication of aircraft and their weapons systems was such that even the support of

electronic subsystems could be accomplished with relatively simple standard support equipment. Airborne equipment that could not be repaired with simple test gear and standard techniques was replaced at sea and either repaired on shore or thrown away. Therefore, spare parts management was the key to effective logistic support [Ref. 1].

In the early 1960's, the Fleet saw the introduction of the forerunners of a new generation in aircraft sophistication, the A-6 and the E-2. Increased complexity resulted in a greater need for specialized repair capabilities. With system complexity came decreased Mean-Times-Between-Failures (MTBFs) and the lack of a repair capability overloaded the spare parts supply system, particularly in the limited confines of a carrier. Moreover, repair became cost-effective at deeper subsystem levels because of increased equipment/component costs. These new demands on the Navy support system paralleled similar developments in the other services. Therefore, sophisticated equipment had to be repaired at sea and in the field.

The DOD-wide impact was felt not only by support equipment but also in areas such as training, manuals, technical data and other support-related elements. Efforts in all of these support areas became more complex and costly. Longer lead times were also required which made support of weapon systems very difficult in the early deployment phases. Thus, it became apparent that greater efforts had to be taken in all major system acquisitions to give support/logistics

planning a more prominent role in the early phases of system development.

The Navy recognized the need for a more organized approach when, in 1963, it issued WR-30. This Weapon Requirement was the first in a succession of documents which for over a decade have refined and clarified a process in which all support elements are integrated into a visible total support program for any major system. This official scheme is called Integrated Logistic Support (ILS).

It is not the intent here to describe ILS and all it encompasses. The reader is referred to an ILS overview given in Appendix A or to any of a number of documents listed in the Bibliography for that purpose. What is important to realize, is that GSE was considered to be one of the nine logistic support elements which, in accordance with the ILS approach, were to be coordinated and integrated in planning and implementation by the Assistant Project Manager for Logistics (APML) on any major NAVAIR project.

PGSE is a unique Integrated Logistic Support element. Although classified as a support element under the purview of the Assistant Commander for Logistic/Fleet Support (NAVAIR-04), it includes the development and acquisition of sophisticated hardware under the purview of the Assistant Commander for Material Acquisition (NAVAIR-05). In turn, this support equipment requires logistic support by the NAVAIR-04 organization. The management of this process is further complicated by the necessary time lags between aircraft

design, PGSE design and PGSE logistic support. The pressures for fleet introduction become intense when the aircraft weapon system has demonstrated performance. The time lags result in an interim period in which the aircraft systems cannot be fully supported in the operational environment. Adverse publicity, because of high Maintenance Man Hours/ Flight Hour and low operational availability, has historically occurred upon fleet introduction and has given the Navy an image as poor acquisition managers and has resulted in Congressional review and direction.

GSE is a significant part of the Life Cycle Cost of an Aircraft Weapon System and PGSE is a significant part of the acquisition cost of an aircraft weapon system. In today's environment of limiting appropriations for defense, the Navy can no longer afford the high cost of support and low operational availability that are typical of existing aircraft weapons systems.

The relevance of this problem is pointed out in a recent message to the Chief of Naval Operations from the Commander, Naval Air Pacific.

> Sophisticated avionics systems require equally advanced State-of-the-Art support equipment. The methods in which Peculiar Ground Support Equipment is developed, procured and supported is unsatisfactory. New aircraft historically arrive in the fleet well in advance of approved PGSE and are supported by contractor, work-arounds or by retrograde. As much as five years has been required to develop, produce, and deliver avionics GSE [Ref. 2]

As a result of this input, which also includes references to many other problems, the Chief of Naval Operations has

directed the Chief of Naval Material to form a professional group to study overall GSE problems with the goal of improving present policies relative to procurement, provisioning, and maintenance of Ground Support Equipment [Ref. 3].

Given the budget constraints and command visibility of support problems, it is being recognized that an acquisition strategy which focuses primarily on aircraft weapons system performance is no longer practical. An example of this trend is the F-18/A-18 project, which was mandated by Congress when Life Cycle Cost estimates of the F-14 exceeded 20 million dollars while at the same time the aircraft was experiencing an operational availability of less than 40% [Ref. 4]. The Navy was directed to procure a low cost, light-weight fighter with design goals of commonality, multi-mission capability, and high reliability and maintainability. This pressure from Congress and acknowledgement of acquisition deficiences by the Navy has resulted in an aircraft procurement program that, in the development phases, has made real trade-offs between performance and supportability and has contractually incentivized supportability as heavily as performance.

B. PURPOSE OF THESIS

With a few notable exceptions, the procedures used and the organizations involved in the acquisition of PGSE have evolved and changed gradually since the early days of Integrated Logistic Support in the mid-1960s. It is the purpose of this thesis to (1) define the basic procedures and

organizations involved in the PGSE acquisition process, (2) identify recent trends in changes to these procedures and organizations, (3) evaluate the current approach as embodied in the F-18 program, and (4) make recommendations for additional changes, if appropriate, to further enhance aircraft support in terms of PGSE.

C. SCOPE OF STUDY

This study focused primarily on those PGSE acquisition responsibilities and tasks which are encountered in the predeployment phases of a new aircraft program.

1. Procedures

Organizational relationships and managerial responsibilities were the primary subjects of this study. However, in order to provide a proper perspective, it was also necessary to review the more basic procedures involved. These basic procedures were those used to ensure that particular items of PGSE are: (1) appropriate responses to defined maintenance requirements, (2) compatible with design requirements of the aircraft systems and the operational environment, and (3) scheduled and funded in accordance with a total support program. These procedures begin with the definition of a maintenance concept and end with the transfer of support responsibility from the prime contractor to the Navy. In general, the step-by-step details of these procedures were not within the scope of the study.

2. Organizations

The above procedures involve the participation and coordination of several divisions in the Logistics/Fleet

Support (NAVAIR-04) and Material Acquisition (NAVAIR-05) Groups, certain Navy field activities which provide administrative and technical assistance to those NAVAIR divisions, and the prime airframe contractor. This study concentrated on the particular Navy participants in terms of their responsibilities and interactions, but treated the contractor as a single participant. The contractor's organizations were not studied.

D. METHOD OF RESEARCH

This research had its beginnings with term papers by the authors in three consecutive courses at the Naval Postgraduate School; Technology Transfer, Procurement Policy and Production Management. The first two papers provided broad overviews of the Integrated Logistic Support (ILS) process and the second concentrated on PGSE. Efforts on these papers provided a preliminary review of the more readily-available literature on ILS and PGSE acquisition. These preliminary efforts were then expanded to a comprehensive examination of the guidelines and implementing instructions which have resulted in current PGSE acquisition methods. Also reviewed were several technical reports describing aircraft support problems related to inadequate PGSE, including two reports of the Naval Audit Service.

After a thorough study of the literature, the authors conducted a series of personal interviews with Navy and contractor participants, primarily those in the F-18 program. A list of those interviewed is given in Appendix B. Each

participant interviewed had a fairly well defined role to play in the PGSE acquisition process which, in most cases, was somewhat different in the F-18 program than it had been on prior programs. A general set of key questions was presented to each interviewee in addition to the more specific questions relating to the individuals' responsibilities. These general questions are given in Appendix C.

A conscientious attempt was made to ensure the accuracy of the descriptions, analyses and conclusions presented in this thesis. However, time constraints, data collection methods and the dynamic nature of the subject under study may have resulted in some misinterpretations. Any errors should be considered the sole responsibility of the authors and not that of any of the interviewees.

II. PGSE ACQUISITION

GSE is certainly unique as a support element in the ILS scheme, in that it is the one element which produces products which often must be supported by their own comprehensive ILS programs. As a result, a unique set of GSE acquisition procedures and organizational arrangements have evolved. A list of today's traditional Navy participants is given in Table I. These players will be addressed further following a description of current procedures. The review procedure is intended to provide little more than a background for the organizational and managerial reviews which follow.

A. PROCEDURES AND RESPONSIBILITIES

1. Requirements Definition

Long before a contractor begins submitting proposals to build the PGSE needed to support a new aircraft, he is supposed to undertake a fairly well-defined analytical effort designed to determine logistic support requirements. His first step is an agreement with the Navy (the PMA and AIR-411) as to what the general support philosophy will be in terms of the aircraft systems and traditional support approaches. This "Maintenance Concept" provides the guide for the analytical efforts which must then take place for each system on the aircraft, as individual system designs become firm enough for logistic support requirements to be

TABLE I. Navy Participants

Chief of Naval Operations

1. Operational Test and Evaluation Force--evaluate operational suitability of new systems.

2. Replacement Air Groups--Fleets' first use of new system; Fleet training.

Naval Air Systems Command

1. Project Manager (PMA)--Primary authority and sole responsibility for total project management.

2. AIR-410--Provides each major project with an Assistant Project Manager for Logistics (APML).

3. AIR-411--Maintenance Engineering Division.

4. AIR-417--GSE Logistic Support Division.

5. AIR-534--Program Manager for GSE; provides each major project with an Assistant Project Manager for GSE.

6. Resident Integrated Logistic Support Detachment (RILSD)--On-site contractor/Navy ILS coordination.

Field Activities

1. Naval Air Engineering Center (NAEC)--managerial and technical support of AIR-534 and 417.

2. Naval Air Test Center (NATC)--technical test and evaluation.

3. Aviation Supply Office (ASO)--inventory management and procurement.

identified. By NAVAIRINST 4790.4A, it is NAVAIR policy that the Maintenance Plans resulting from these analyses be used as the bases for the respective systems' logistic planning efforts [Ref. 5].

Among a variety of Navy and contractor inputs to the generation of each Maintenance Plan is a Level of Repair Analysis. Unless there are conflicting arguments from technical, facilities, training or other areas, this analysis determines whether a repair capability and the corresponding need for support equipment is economically sound by comparing estimates of replacement cost, frequency of repair and cost of repair at each of the three standard maintenance levels: Organizational (O-level), Intermediate (I-level) and Depot (D-level).[1] Each Maintenance Plan, when approved by AIR-411, provides the justification for the contractor to plan and propose a specific ILS program for that specific equipment. If the approved plan indicates there is a GSE requirement, it identifies available common equipment in the Navy inventory and opens the door for the contractor to propose PGSE to fill any existing gap.

---

[1]Typically, O-level maintenance involves actions analogous to changing the headlights, windshield wipers or battery on a car and is performed by squadron personnel. I-level actions are similar to engine tune-ups and it is the more highly trained and equipped Aviation Intermediate Maintenance Department (AIMD) on any carrier which handles this level of work. D-level actions, which are accomplished on shore, get into the kind of major repair and modification work that would not be cost-effective at sea or would tie up aircraft too long, like crash damage repair and major overhaul.

2. Proposal/Review/Approval

The contractor's proposal for any particular item of PGSE is in the form of a standardized document entitled Ground Support Equipment Recommendation Data (GSERD). GSERDs are typically submitted throughout the full-scale development phase of a major project, with the mechanical support equipment being proposed earlier than the avionic test gear. Typically, a GSERD can provide little more than a functional description of the proposed equipment since there is usually very little PGSE design work completed at the time of submittal.

Logistic support requirements for a specific article of support equipment are also supposed to be defined in its GSERD. Particularly for the more complex equipment, participation is required by the same logistic support elements as were required in the aircraft development program; e.g., technical documents, spare parts, training, facilities and even more GSE. GSERDs are typically sent via NAVAIR to the various logistic support planners, technical support groups when appropriate, and even the NAVAIR representatives in the Fleet for review and comment. Approval authority rests with AIR-534, the GSE Program Manager, unless it has been delegated to the Naval Air Engineering Center's GSE Department, where most of the GSERD review is accomplished in any case. Approval of a GSERD authorizes the Administrative Contracting Officer to negotiate a price with the contractor and request development to commence. The approved GSERD is also

the "green light" for all logistic support elements involved to begin their respective efforts for the particular support item.

3. Design/Development Testing

The program required to produce an acceptable end-item of GSE depends on the support gear's complexity. The more sophisticated items require efforts quite similar to those which take place for the airborne equipment. These efforts at the contractor's or subcontractor's plant include airborne/GSE design liaison, Navy technical monitoring and a series of design reviews. When the PGSE end-item becomes available, it is then subjected to technical testing by both the contractor and, if appropriate, the Naval Air Test Center. Depending on when the gear is available, PGSE suitability may also be addressed during the aircraft's maintainability demonstrations, Operational Test and Evaluation, Board of Inspection and Survey trials and Fleet introduction with the Replacement Air Groups.

4. Delivery/Deployment

It is during the initial deployment of the aircraft that the effectiveness of the ILS program is put to the test. During this period there is always "augmented" support by the contractor where lead-time requirements have prevented a full Navy support capability. This transition period is difficult for most of the support elements since the transition schedule is, in part, constrained by requirement dates and quantities specified back in the GSERD process, possibly several years earlier.

PGSE's major transition takes place when the Aviation Supply Office (ASO) assumes responsibility for acquisition and delivery not only for spare parts, but GSE itself. It is then that the Fleet and other users must rely on ASO's Aircraft Maintenance and Material Readiness List (AMMRL) program for non-programmable support equipment and on the Tailored Outfitting List (TOL) program maintained by NAEC for Automatic Test Equipment [Ref. 6].

B. MANAGEMENT STRUCTURE

Concurrent with the increasing sophistication of Navy aircraft in the late 1950s/early 1960s, was an increasing awareness that the Navy's logistic support capability was becoming a critical factor in determining Fleet readiness. The other services were experiencing similar problems. As stated earlier, this led to the institution of Integrated Logistic Support throughout the Department of Defense. It later became clear to the Navy, however, that GSE problems were not solvable by the ILS approach alone.

In spite of a policy to rely on multi-purpose GSE rather than PGSE whenever possible, the Navy was experiencing a proliferation of numbers and types of GSE required by the Fleet. In concert with a NAVAIR policy emphasizing the use of multipurpose equipment, there was a multimillion dollar major project to develop an automatic test set with an unprecedented capability to service many different kinds of avionic systems on several different types of aircraft. The resultant Versatile Avionics Shop Test (VAST) has been

operational for several years and recent aircraft programs have been directed to influence aircraft systems design by emphasizing VAST compatibility.

Clearly, GSE was assuming a role of major importance in the material acquisition world and, in 1967, NAVAIR recognized this importance by designating the director of the GSE Division (AIR-534) as the GSE Program Manager, less than one year after the division's establishment [Ref. 7,8-p.61]. Until 1976 when Armament, Avionics and Propulsion Program Managers were established, the GSE Program Manager held the unique position in NAVAIR of being its only Program Manager. According to the implementing instruction, the GSE Program Manager was responsible for "over-all GSE policy and direction," resolution of "GSE interface problems between projects" and ensuring "that all GSE management and functional responsibilities are carried out in a timely manner." In short, he was to be the ultimate authority for all NAVAIR GSE issues. Additionally, he was tasked with designating an Assistant Project Manager for Ground Support Equipment (APM-GSE) for each major NAVAIR project [Ref. 9].

The prominance of GSE was further enhanced several more times by the establishment of additional organizations, giving the GSE program an all-encompassing, semi-autonomous character normally reserved for weapon system projects. These further developments were summarized in a 1973 report on GSE management conducted by the Naval Audit Service.

The GSE Department of NAVAIRENGCEN[NAEC] was organized in June 1967 to provide centralized support. The GSE Test and Evaluation Branch at the Naval Air Test Center (NAVAIRTESTCEN) was established in August 1968 to ensure that comprehensive testing was conducted on all GSE prior to fleet introduction. The need to consolidate the previously fragmented GSE logistics management support was satisfied in March 1970 by chartering of the GSE Logistics Division (AIR-417) [Ref. 8-p.61].

With the exception of the organizational approach being employed by the F-18 program, which will be described in a later section, the participating organizations and their relationships to one another have remained essentially as implemented seven years ago. A brief review of these relationships is presented in the remainder of this section.

With the somewhat traditional matrix project management approach to management structure employed by NAVAIR, it is appropriate to describe the PGSE acquisition participants in at least two ways: (1) positions in a standard organization chart, as in Figure 1, and (2) positions in a responsibility chart for a particular project, as in Figure 2. This description focuses on the NAVAIR organization in which there are groups headed by Assistant NAVAIR Commanders. The two groups of direct importance to PGSE acquisition are NAVAIR-04, in which the majority of the Logistic Element Managers (LEMs) reside, and NAVAIR-05, which is responsible for material acquisition. Simply put, although there are exceptions, NAVAIR-05 is the engineering community and NAVAIR-04 is comprised of logisticians.

1. Project Manager (PMA)

Under the project management concept, the PMA is under the supervision of the Commander and the administration

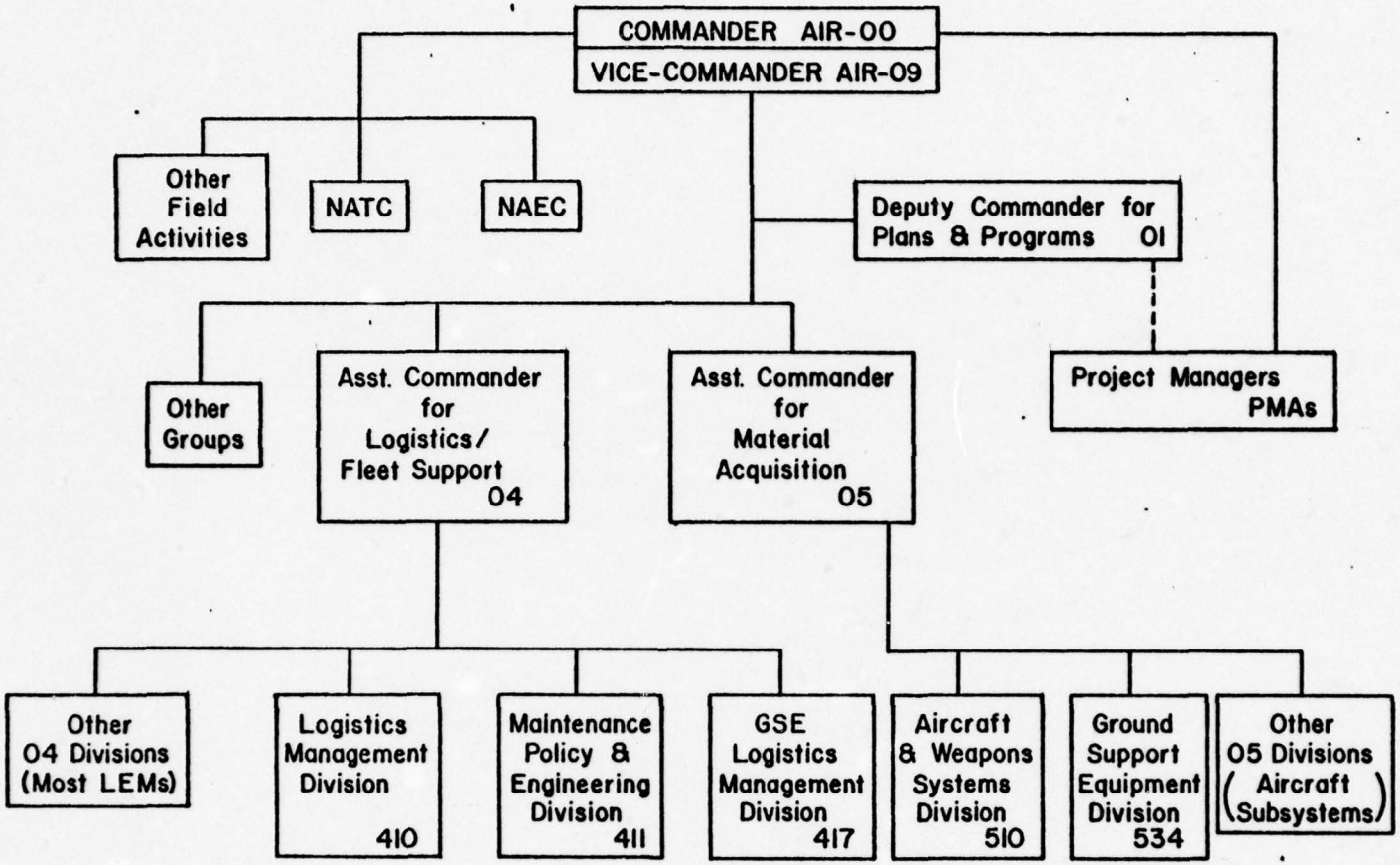

Figure 1. NAVAIR Organization

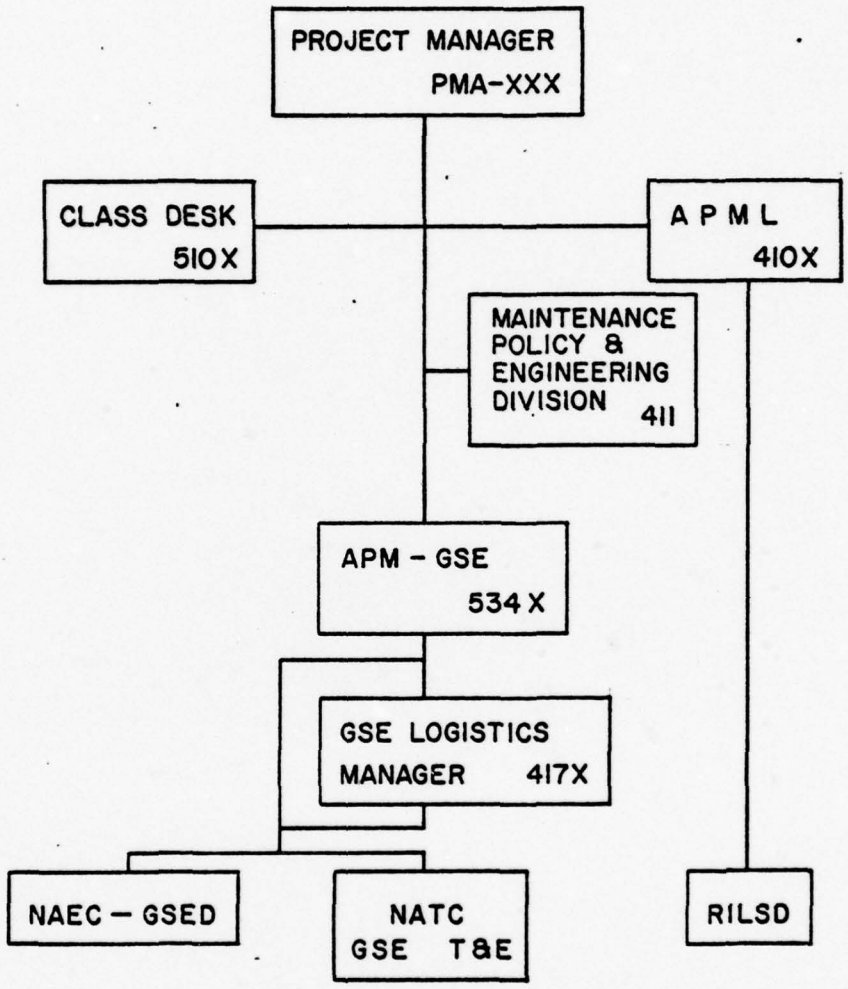

Figure 2. Project Responsibility

of AIR-01. He is the one individual responsible for ensuring the success of all aspects of the project, including PGSE acquisition. He receives budget requests from the functional organizations and controls the distribution of the major part of the appropriated funds. A minor share of the budgeted dollars become "fenced" in that they go directly to a Logistic Element Manager, the Aviation Supply Office for example, without any further accountability to the PMA.

2. Assistant Project Manager for Logistics (APML)

The APML has the responsibility for the coordination and integration of the logistic support efforts, including maintenance engineering and PGSE acquisition. He is typically assigned to his position by AIR-410 with concurrence of the PMA. However, with the exception of the F-18 project, he has never had any direct authority or funds control with which to carry out his assigned tasks. Furthermore, AIR-410 is at the same organizational level as the other AIR-04 divisions and not even in the same group as AIR-534.

3. Class Desk

The assistant project manager for material acquisition, called the Class Desk Officer, is the AIR-05 analogue of the APML and is responsible for the acquisition of the aircraft and its weapons systems. He is assigned to his position by AIR-510 and does not get involved with AIR-534's efforts because of his orientation and workload with respect to the airborne systems.

4. Assistant Project Manager for GSE (APM-GSE)

The APM-GSE, designated by the GSE Program Manager (AIR-534), is responsible for the acquisition of PGSE to support the project [Ref. 7]. Except for the F-18 Program, the APM-GSE has always made budget submissions to and received funding directly from the PMA. Being a LEM, he receives direction from the APML. In a sense, he also receives direction from AIR-411 since it is NAVAIR policy that PGSE acquisition be initiated only after being identified as a requirement in an approved airborne system's Maintenance Plan [Ref. 5]. He also has the distinction of being the only "support" element in the AIR-05 organization.

5. GSE Logistics Manager

The GSE Logistics Manager is assigned his position by AIR-417. He is responsible for coordinating and integrating for PGSE, the same support efforts as the APML does for the airborne systems [Ref. 10]. He typically submits his budget through the APM-GSE and receives his funds directly from the PMA.

At this juncture, it is appropriate to restate an important point. The Logistic Element Managers receive their direction for PGSE support from the GSE Logistics Manager. He receives his direction from the APM-GSE. The APM-GSE receives his direction from the PMA via the APML. He also is supposed to receive a validated requirement from AIR-411. All of these individuals, except the APM-GSE and a few LEMs, reside in AIR-04 divisions of equal organizational stature and authority. All involved, however, have

typically received their funding directly from the PMA, regardless of their respective budget review chains.

6. Maintenance Policy and Engineering Division

It is the responsibility of AIR-411 to provide overall maintenance policy and perform project maintenance engineering [Ref. 11]. Budgets are typically submitted to and funding received from the PMA directly.

7. Naval Air Engineering Center (NAEC)

The GSE Department of NAEC is tasked with the administrative and technical support of AIR-534 and AIR-417 [Ref. 11]. On any major project, it provides the major contractor/NAVAIR interface for PGSE acquisition and support. It budgets to and receives funds from both AIR-534 and AIR-417 for work tasks in the respective areas.

8. Naval Air Test Center (NATC)

It is the responsibility of the GSE Test and Evaluation Branch of NATC to technically evaluate items of GSE prior to Fleet introduction [Refs. 10, 11]. It typically budgets to and receives funds from AIR-534 for this purpose.

9. Resident Integrated Logistic Support Detachment (RILSD)

The RILSD, located at the contractor's facility, is typically made up of a small number of individuals. From a variety of home organizations, they are on detail to the Navy or Air Force Plant Representative, as the case may be. Their relatively informal interface with the contractor serves a multi-function, time-saving role in the support planning, design and submission/approval areas [Ref. 12].

The RILSD is headed by a director who reports to the APML.

10. Aviation Supply Office (ASO)

ASO is responsible for PGSE acquisition and spares support after the so-called Material Support Date [Ref. 10]. Prior to that date, NAEC is responsible for the GSE and GSE spares provisioning. ASO, to some degree, is involved even in the early stages of the project in order to ensure a smooth transition from NAEC's "augmented" support to the operational Navy support programs. The one exception, mentioned earlier, is that NAEC never does transition Automatic Test Equipment (ATE) responsibility to ASO. ASO's initial support for a major project is budgeted for by the PMA, but the funds do not come to the project office. ASO is located in and is funded through the Naval Supply Command.

III. THE F-18 APPROACH

At this point, emphasis is shifted from a general description of PGSE acquisition management to look at how a particular current project is accomplishing PGSE acquisition. In outlining the F-18 approach to PGSE acquisition the larger context of the F-18 approach to aircraft acquisition becomes the principal topic of discussion. The changes in PGSE acquisition are really embodied in the overall acquisition strategy of the F-18 project. The major changes in approach can be grouped as follows:

1) Early planning for support
2) Phased Support
3) NARF NORIS Logistic Support Team
4) Support management

The definition and implementation of these concepts will be covered in terms of changes in organizations, organizational interactions and procedures. In most cases the discussion will attempt to limit itself to areas having direct impact on PGSE acquisition, although related elements will necessarily be addressed where essential for the sake of completeness and understanding.

It should also be recognized that some of these concepts are not really new; they are incremental changes from prior major aircraft procurement procedures. These incremental changes can take the form of establishing a desirable

procedure earlier in the acquisition process or simply acknowledging an existing informal way of doing business.

A. EARLY PLANNING FOR SUPPORT

Early planning for support seems like a straightforward concept that would occur on all programs. The depth of the commitment to early support planning in the project office was apparently a second order concern on many projects. A quote by the F-18 APML is enlightening.

> It seems in past programs logistics received little PMA attention until fleet introduction. The major area of PMA concern was the design and performance of the aircraft. This trend has been reversed in the F-18 program. PMA-265 is keenly aware of the importance of detailed planning and integration of logistics from the beginning of the program [Ref. 13].

The F-18 Full Scale Development Contract has 29 million dollars of incentives divided between performance and support. In the support area the incentive is split between predeployment support demonstrations and post-deployment support demonstrations. The final incentive award depends on actual fleet experience during the first year of deployment. Adequate PGSE is a significant factor in the contractor's ability to meet the contractual cost and support performance requirements. For the first time part of the contractors fee will depend on how well the PGSE performs in the fleet environment.

The commitment to support on the Navy side is evidenced by the number of organizations and people active in the early stages of the program. The F-18 is the first aircraft procurement that has a specification in the contract for an

Aircraft Maintenance Plan Analysis. The resulting Maintenance Plans for individual aircraft systems are considered the integrating documents for aircraft support. Personnel from the Naval Air Rework Facility at North Island (NARF NORIS) have been tasked to assist NAVAIR-411 in the review of Maintenance Plans. The Maintenance Plan is the document that defines the need for GSE. Without a Maintenance Plan defining that need, a GSERD for an item of PGSE will probably be rejected by the APML. However, there is a mechanism for submittal of early GSERD's for GSE in response to obvious needs (e.g., mechanical PGSE such as slings, jack stands, etc.).

Also, based on Reliability and Maintainability predictions which emanate from weapon system design, those systems which are expected to constitute the bulk of the work load at Intermediate level have been assigned first priority for analysis and development of fleet maintenance capability. This is basically a philosophy of concentrating resources on the hard problems first and making sure that the small percentage of systems that cause the majority of problems are supported in depth [Ref. 14]. This philosophy should have significant impact on the selection and design of PGSE.

Another example of the commitment to support is the early establishment of the Resident Integrated Logistics Support Detachment (RILSD), at the contractors plant, 30 days after Full Scale Development contract award. This RILSD had, for the first time, a full-time member responsible for GSE. The charter of the RILSD includes [Ref. 12]:

1. Ensure that all system specifications include GSE requirements.
2. Assist in determining the existence of suitable GSE.
3. Review GSERDs for compliance with Maintenance Plans.
4. Monitor GSE design, development, test, evaluation, and production.
5. Monitor contractor performance related to GSE support.

The RILSD GSE expert is from NAEC, the NAVAIR-534 field activity for technical support. In addition NAEC has been tasked to supply a GSE member from the appropriate specialty area to attend weapon system design reviews, monitor first article PGSE tests and attend Contractor Maintenance Engineering Inspections. NAEC has been delegated approval authority on all F-18 GSERD's. This delegation is expected to reduce GSERD processing time by a few weeks. NAEC will also implement a computerized program to allow tracking of GSE status. This program was developed during the late stages of the F-14 project.

Another first on the F-18 project is a contractual requirement for a Reliability and Maintainability Master Plan specifically for PGSE. Flexibility is included to allow tailoring the Reliability and Maintainability Plan to the PGSE. An evaluation is made of each PGSE item in terms of use, complexity, cost, and importance to mission success. If it is determined that the PGSE item is a high use, complex or expensive item and considered program critical, the Reliability and Maintainability candidate blocks will be marked "yes" on the Summary Requirements List which is

attached to the GSERD. This attachment specifies the quantitative requirements, the testing required to verify compliance with the specifications and a cost estimate for the Reliability and Maintainability Plan as tailored for the particular piece of GSE in question. The PGSE Reliability and Maintainability program is a comprehensive program including the subcontractor level and contains a well-defined data collection, analysis, corrective action, and reporting system [Ref. 15].

B. PHASED SUPPORT

Under the F-18 concept of phased support, contractor support will continue until such time as the designs of the various systems involved have been stabilized, the support equipment is Fleet-configured, and the Navy is capable of performing the required maintenance. Phased support recognizes that full Navy support cannot be attained on a single anticipated date. In the F-18 program the Navy will require that the support system must demonstrate proper operation before the Navy will assume repair responsibility. The contractor will perform maintenance with production test equipment in a fleet environment to fulfill this requirement [Ref. 16].

The contractor will use Factory Test Equipment during his flight test program and will evaluate this test equipment for proper operation and fleet utility. The contractor will also use this test equipment to perform maintenance during Initial Operational Test and Evaluation. The

contractor will deliver Production O-level GSE prior to Board of Inspection and Survey (BIS) trials. During BIS the Navy will perform the necessary O-level maintenance and the contractor will perform I-level and D-level maintenance with most non-avionic I-level maintenance accomplished with Production GSE.

The first operational squadron will have full O-level capability, full non-avionic I-level capability and will be in the process of achieving avionic Weapon Replaceable Assembly (WRA)[2] I-level capability. Avionic System Replaceable Assembly (SRA)[3] I-level capability and D-level capability will phase in over the two years following introduction of the first operational squadron [Ref. 17]. Figure 3 is a diagram of the proposed F-18 Phased Support chronology.

C. NARF NORIS LOGISTIC SUPPORT TEAM

Phased Support, discussed in the preceding section, requires the support system to mature at the same rate, although delayed in time, as the aircraft functional system design. In order to accomplish this it is necessary to manage the support system development by aircraft functional categories. Since there are almost 50 functional systems on the F-18 it would be inefficient to assign a man to manage the logistic

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[2]Weapons Replaceable Assembly (WRA): a system or system component that can be fault-isolated and replaced at the Organizational level of Maintenance.

[3]Shop Replaceable Assembly (SRA): Subsystems or components of a WRA that can be fault-isolated and replaced/repaired at the Intermediate level of Maintenance.

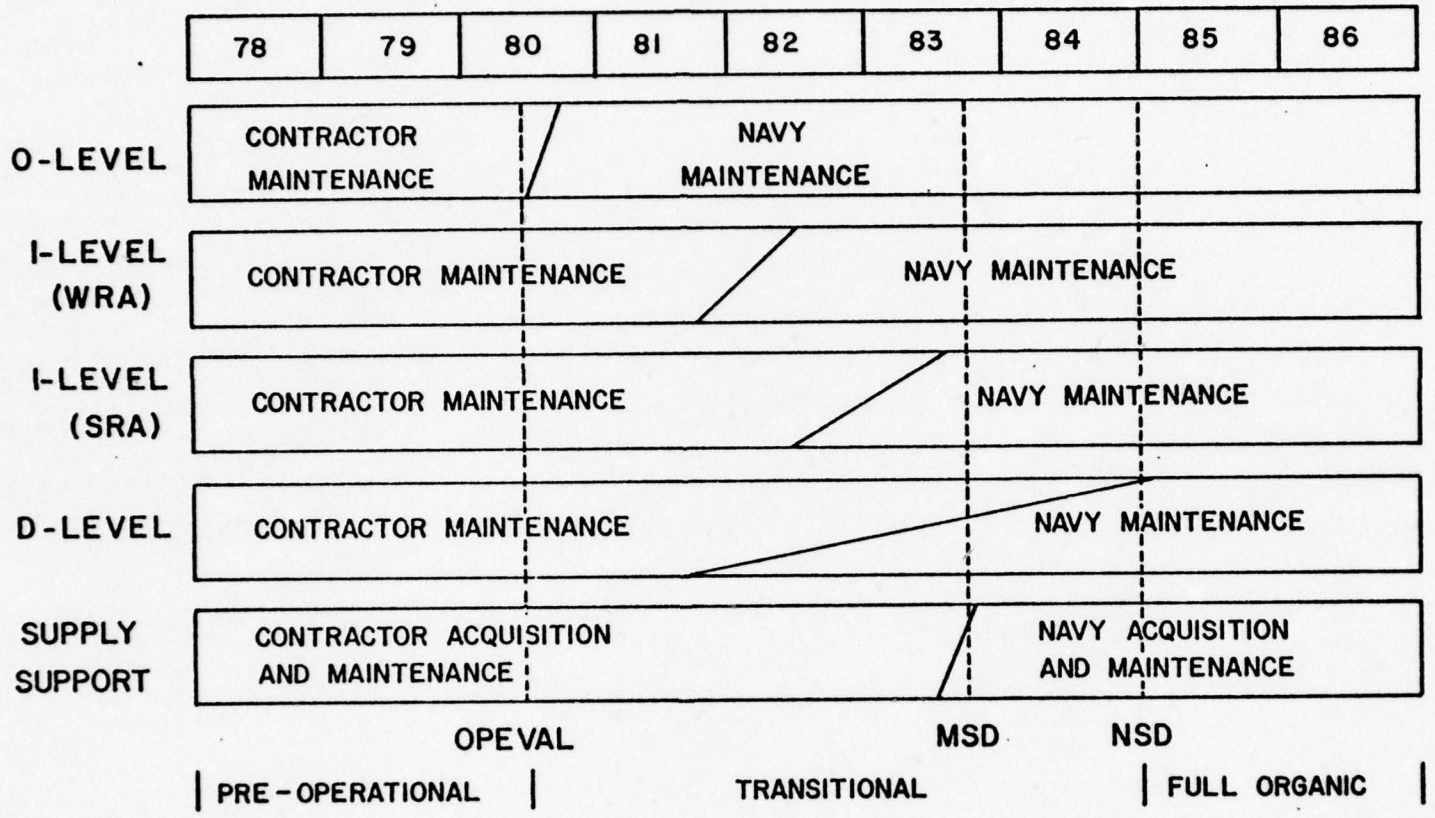

Figure 3. F-18 Phased Support

support of each one. The functional systems have been consolidated into nine groups as shown in Appendix D. The systems comprising each group are similar in the sense that they are compatible in engineering requirements and in necessary educational background and experience of the designers. They also agree with the categorization of work centers in OPNAVINST 4790.2A at the organizational and intermediate levels of maintenance [Ref. 16].

Figure 4 is an abbreviated chart to help in visualizing the concept. In each of the nine functional areas one man would be responsible for coordinating all the applicable logistics elements. As is presently the case, the NAVAIR LEMS would still be technically cognizant of their respective logistic elements across the functional groups.

The NARF NORIS Logistic Support Team has been organized to provide technical support to the APML in coordinating the ILS elements in each functional group [Ref. 18]. For example, the LEM for PGSE (APM-GSE) could have many different delivery dates for PGSE depending on the functional aircraft system each item is to support. The APM-GSE has the ability to make cost, performance and schedule tradeoffs between various items of PGSE. However, he does not have the visibility to make tradeoffs with publications, training or spares. These higher order tradeoffs can only be made by the APML after a problem in a functional group (either design or support) has been brought to the APML's attention by the cognizant group engineer on the Logistic Support Team.

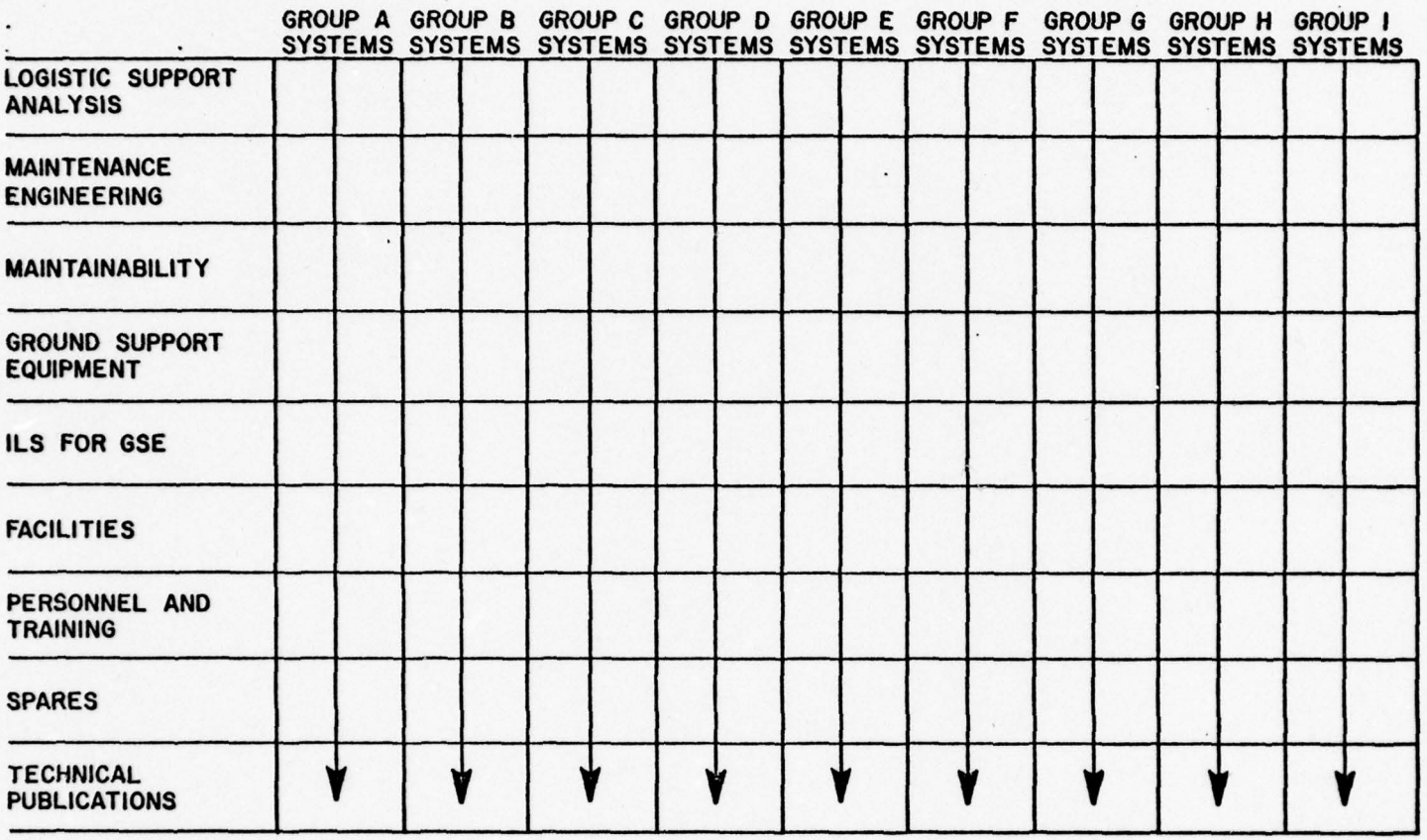

Figure 4. Logistic Support Team Responsibilities

Thus, the ability to manage the Phased Support concept rests on the ability of the Logistic Support Team to accomplish its technical monitoring and coordinating responsibility.

D. SUPPORT MANAGEMENT

On the F-18 project, the APML is considered a manager. Along with the traditional responsibility of coordinating the weapon system support, the APML has been given a much greater role in making support tradeoffs and controlling the funds to the support elements. The F-18 project is the first project in which the APML has been in the funds flow chain from the PMA to the LEMs.

The whole theme of F-18 support management is that plans are going to drive the system rather than allowing the system to evolve and then fix problems in a crisis environment. Managing the process requires recognizing the characteristics of the system and evolving plans around these characteristics. One of the characteristics recognized is that all support equipment cannot be ready on the same date. This leads to the Phased Support Plan which requires management by functional group. Tradeoffs between functional groups or logistic elements requires the data provided by the Logistic Support Team. Control of the funding by the APML allows him to implement necessary adjustments to the support structure. This systematic approach to the F-18 support development is an indication of the greater emphasis and visibility given to the support function on this program.

IV. DISCUSSION

Central issues in discussing the relevance of PGSE acquisition management are the visibility of the subject, the problems that exist and the organizational environment in which the PGSE acquisition is accomplished. Any conclusions and recommendations must address real problems to achieve usefulness beyond interests of an academic nature. The visibility must also exist in order to expect any changes to be implemented.

PGSE acquisition, under the umbrella of Integrated Logistics Support, has had a logical methodology since the promulgation of AR-30 in 1964. However, the promises of this methodology have not been realized to any great extent. Systems introduced into the fleet during the late 60's and early 70's have been plagued with problems that have existed for many years and additional problems have appeared due to the sophistication of Automatic Test Equipment. The PGSE operational problems included poor PGSE configuration control, design inadequacy, useless and unwanted gear, late delivery and inadequate training, publications and spares. Poor support performance resulted in low aircraft operational availability and, in addition, escalating operation and maintenance costs have combined to give this topic a great deal of visibility [Refs. 4, 8, 19, 20]. Many of these support

performance problems were the result of poor acquisition management in the early phases of a project.

The traditional image of the support function in the engineering world is one of an unglamorous profession that attracted second-rate personnel. The design and acquisition of aircraft weapon systems has always been from a performance oriented approach. Project managers, and their superiors, have typically come from the fighter pilot, white-scarf-flying-in-the-wind, school. This orientation is understandable and desirable since obviously an aircraft must perform in order to successfully accomplish the assigned mission. However this attitude led to insufficient early, tough planning for support and any funding problems that occurred in the aircraft development were resolved by cutting some element of support. The typical philosophy was: If the aircraft meets the performance requirements, money to solve the support problems will be made available.

This climate began to change in the early 70's when Congress cut F-14 procurement due to high life cycle costs and low availability. The realization that the performance-at-all-costs orientation has changed has been slowly filtering into the NAVAIR organizations. Any change will meet opposition, but a change elevating the nonglamorous support function to equal tradeoff status with performance is, for want of a better word, traumatic.

In PGSE acquisition, problems exist, the issue is visible and management and procedural changes are occurring. This

discussion section is concerned with the evolution and adequacy of this change toward correcting existing deficiencies.

A. PGSE ACQUISITION MANAGEMENT

The F-18 Program has taken some positive steps to avoid the support problems which have persisted despite prior project's efforts at improving the situation. Because the F-18 approach involved some methods which were distinctly different from the traditional ones, there was significant initial resistance from the functional NAVAIR divisions, particularly those under the direction of the F-18 APML. The resistance within AIR-04, given the logic of the F-18 approach, has all but subsided. There is, however, a substantial area of conflict still in existence between the F-18 APML and AIR-534. On the surface, the issue is one of who has the authority to control PGSE funds from the F-18 PMA. Analysis reveals that deeper, more basic issues are also involved. These issues range from a question of categorizing PGSE as a material acquisition function or a logistic support function to the question of how much authority the GSE Program Manager has over a particular project's PGSE efforts.

The funds control issue will be discussed at greater length in a later section analyzing the F-18 approach. The related, more basic PGSE issues are organizational by nature and will be addressed first.

1. Basic Organizational Issues

a. Project Management

Both NAVAIR and aerospace contractors have developed ways of operating with a project management type of

organization. While there is no intent here to discuss all of the virtues and shortcomings of project management, it will be necessary to review some of the organizational principles before getting into the particular PGSE issues.

(1) Contractor. In the aerospace industry, a typical contractor's organization chart looks something like that in Figure 5. Under the general manager there are basically two kinds of organizations; project teams and functional groups. The project managers are totally responsible for the successful design, development, production and sale of their respective products. They are given authority by higher management commensurate with that responsibility. Project team members, numbering as few as a half-dozen in most cases, are transferred to the team from their parent functional organizations. As a team member, an individual is responsible to the project manager, not to his respective functional organization. A functional manager retains responsibility for the quality of his organization's contribution to a project, but has almost no authority on project matters. In spite of detailed sets of guidelines, active conflict between project managers and functional heads is unavoidable because of their inherently different motivations. J. M. Stewart, in his article "Making Project Management Work," suggests that short-term conflicts [project-specific issues] can often be resolved in favor of the project manager and long-term conflicts [company policy] in favor of the functional manager [Ref. 21, pp. 453-469].

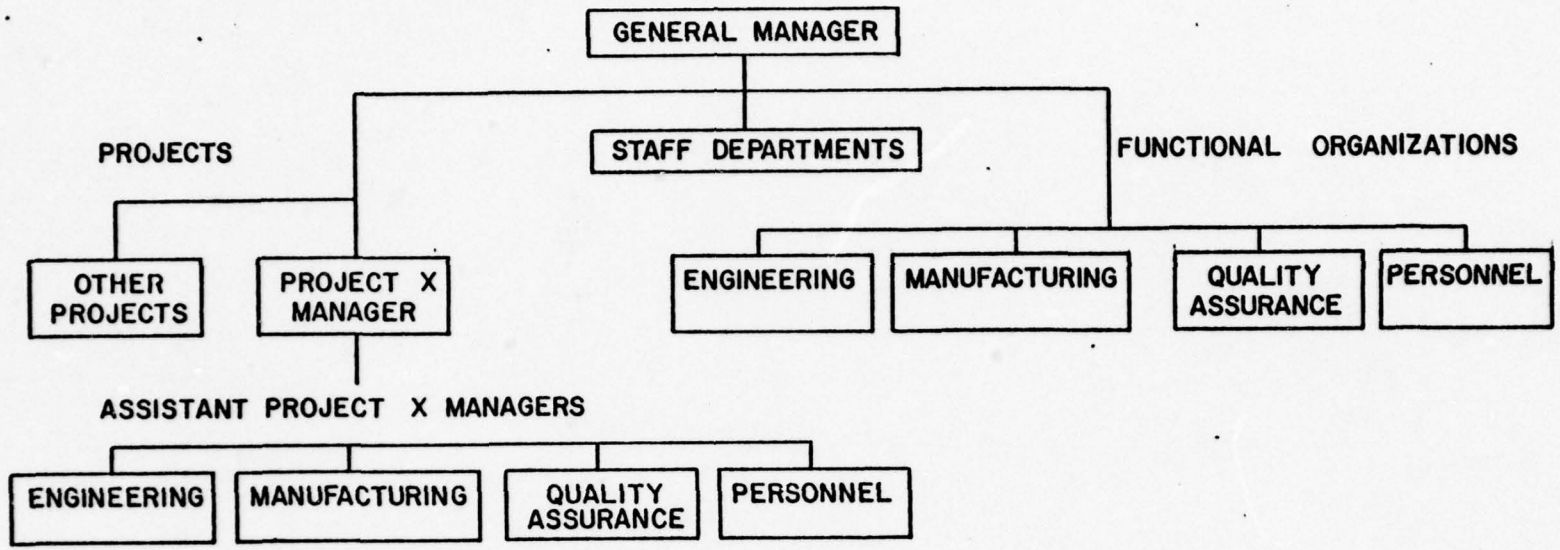

Figure 5. Typical Project Management Organization

(2) NAVAIR. The NAVAIR approach to project management is shown in Figure 6. While basically similar to the contractor's, it is different in several important respects. It will be seen that these differences have the potential for significant impact on the PGSE acquisition environment.

The first difference to recognize is the potential in the military organization for an individual's rank to impact his ability to function as a particular player, e.g. a project manager. When NAVAIR set up its project management structure, it had to be cognizant of the military tradition of equating authority with rank in a simple, rigidly enforced hierarchical structure. This factor was alluded to by the Comptroller General in a report to Congress in 1971:

> "In general, the military services have not deemed it wise to place the project manager high in the organization because of some practical considerations, such as the large number of project managers and the need for them to work directly at lower levels of the organization" [Ref. 22].

By comparison to the industrial case, the heads of NAVAIR's functional organizations wield a lot of authority and are quite capable of influencing individual project's operations. In fact, they are admirals, and PMAs are typically captains. Division heads are also captains while the APML and Class Desk are typically commanders. Also, in contrast to the typical industrial project organization, Figure 6 shows how the project's functional representatives, the Class Desk and the APML, do not leave their parent organizations.

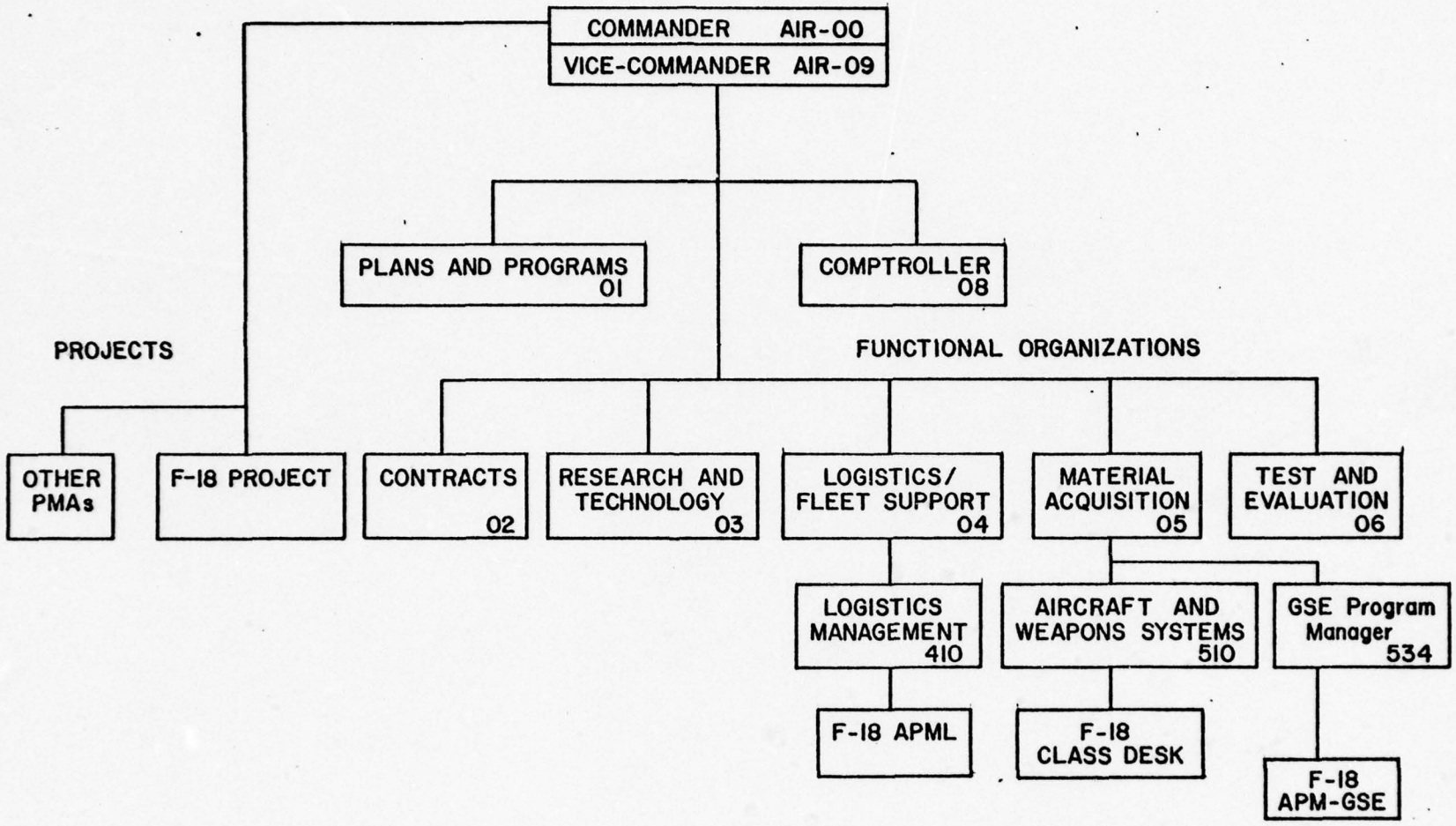

Figure 6. NAVAIR Project Management Organization

Again, there is no intent here to evaluate the logic of the NAVAIR project management structure other than to point out how it is different from industrial project management and how that difference affects the PGSE acquisition environment. The main point that has been made is that a project team's functional representatives, the Class Desk and the APML, remain organizationally in line to their respective functional heads, admirals, rather than to the PMA, usually a captain.

b. Project/Program Proliferation

One major aspect of NAVAIR's business with which the management structure must contend is the number of different systems acquisition programs in existence at any one time, only a few of which have project status[4] [Ref. 22]. Many of these non-project programs are large enough to cut across division lines and are managed by personnel in AIR-510, assisted by logistics coordinators from AIR-410. There are also programs confined to the technologies of individual divisions which are managed by their own personnel. Also, AIR-410 and AIR-510 provide managers/coordinators for programs and functional members for project teams.

In this thesis the term project manager is used consistently to indicate the manager of a major acquisition

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[4]Project status is usually reserved for major programs having an estimated RDT&E cost in excess of $75 million, or an estimated production cost in excess of $300 million.

program that is organizationally outside the functional disciplines. The term program manager is used to indicate the manager of an acquisition program that is organizationally within a functional discipline. Project/program manager conflict with functional organizations is inevitable and the addition of project manager conflict with program managers, who are backed by functional organizations, adds another dimension that can have some serious consequences. The impact of the two types of program management on PGSE acquisition management will be addressed further when alternatives to the present organizational structure are presented.

c. Functional Authority

The term "functional authority" refers to that authority of heads of functional organizations, delegated from upper management, to determine company-wide policies and procedures in their respective areas of expertise and require company-wide adherence. As typical industrial examples, this type of authority is usually given to accounting and personnel departments. According to Koonty and O'Donnell in their book "Principals of Management," the limit of any functional authority must be very carefully and explicitly stated in order to minimize project/functional area conflict [Ref. 21, pp. 476-485]. The reasons for granting functional authority are standardization and continuity of company policy in those areas where these requirements are requisite to effectiveness. Engineering design, prototyping methods, test scheduling, etc., usually do not fit into this category.

Depending in part on the stature of a particular project, conflict between a project and an engineering organization is usually decided in favor of the project. This process works well in an industrial organization where programs are few in number and the company is not required to operate and maintain every product it produces.

In the Navy, however, engineering decisions are often less project-specific. For example, in contrast to the few projects of a typical contractor, NAVAIR has many programs and projects but only one Aviation Intermediate Maintenance Department (AIMD) on a carrier which has to support the end products. Many such examples could be cited in evidence of the greater need for standardization and commonality. In essence, they all boil down to the fact that the Navy manages many different system acquisitions for which it is the end-user. If each program and project were given a free hand in directing the functional participants, chaos in the Fleet would certainly result. Thus, a logical reason exists for having program managers within a functional organization.

There are currently four material acquisition divisions which have the distinction of being headed by chartered program managers: Armament (AIR-532), Avionics (AIR-533), GSE (AIR-534) and Propulsion (AIR-536) [Ref. 9]. These program managers wield a great deal of authority in their respective areas. According to NAVAIRNOTE 5400, dated 21 April 1976, "Program Managers have authority to

short-cut normal chain-of-command lines and to direct efforts of functional groups throughout NAVAIR HQ, as required, for the successful implementation of system efforts." A short history of what led up to this authority being given to the head of AIR-534 was given in an earlier section. Thus, these Program Mangers have "functional authority" in their area of expertise not unlike that of an industrial organization. The interesting aspect of this authority is that it applies the long-term stabilizing influence of functional authority to engineering disciplines which are dynamic and require technological innovation. The destabilizing influence is the short tenure of the military officers heading these divisions which tends to make long term policy change every few years.

d. Conflict Resolution

The management effectiveness of any organization often depends on the ease with which its design allows for conflict resolution. As noted earlier, the hierarchical structure of military rank and the degree to which functional authority is delegated creates a difficult environment for PGSE acquisition. NAVAIR upper management has recognized that, in spite of a preponderance of logical, consistent charters and implementing directives, informal problem resolution will likely be more difficult between program and project managers than between other division heads and project managers. NAVAIRNOTE 5400 directed that, "Should disagreement arise it will be brought promptly to the attention

of the Deputy Commander and Assistant Commanders as appropriate for resolution" [Ref. 9].

e. PGSE Alignment

NAVAIRINST 5400.18, the GSE Program Manager's charter, also created some unique positions within AIR-534; those of the Assistant Project Managers for GSE (APM-GSEs). It is important to recognize the significance of the fact that the term "Assistant Project Manager" is used in the position title rather than any other selection of words. Since, on any project, the Class Desk and the APML are the two assistant project managers, for material acquisition and logistic support, respectively, it would appear that the instruction intended to give the APM-GSE a position of unique stature relative to a project's other Logistic Element Managers. An APM-GSE is a senior individual in AIR-534 and has, in the past, had a relatively free hand in directing a project's PGSE program. While required to be <u>responsive</u> to the PMA, an APM-GSE's title suggests that he need only <u>coordinate</u> his efforts with those of the Class Desk and the APML. This position was echoed to some extent by AIR-534 personnel during the authors' interviews in spite of the general instructions in NAVAIRINST 5400.18 that the APM-GSE "will be <u>responsive</u> to" the Class Desk and the APML. The lack of a clear division of responsibility seems to be substantial and will tend to cause unnecessary conflict between project management and AIR-534.

2. GSE Decision Tree

Given the organizational and political environment, it is instructive to pause and reflect on the nature of PGSE acquisition with respect to the total aircraft/weapon system program and on possible alternative management structure and responsibilities. The decision tree in Figure 7 is provided to illustrate several alternatives and facilitate the discussions in this section.

a. Nature of GSE

Figure 7 indicates that, even at the most basic level of classification, an alternative exists for GSE.

(1) Prime Subsystem. One could argue, particularly since there are substantial CGSE programs today, that all GSE should be regarded no differently than any other major aircraft system. Airborne systems must be designed to interface with one another much in the same way as with support equipment, the real difference being the operational environment, not equipment sophistication nor required engineering efforts.

Under this option, the Class Desk would control PGSE acquisition efforts in the same manner as those efforts are controlled for the other AIR-05 divisions. Note that all four of the AIR-05 "program managers" would then coordinate with and be responsive to AIR-510. ILS for PGSE and CGSE would be provided by AIR-410 in the same way as it is provided for the airborne systems on any program or project. This approach would, perhaps, raise the stature of PGSE such

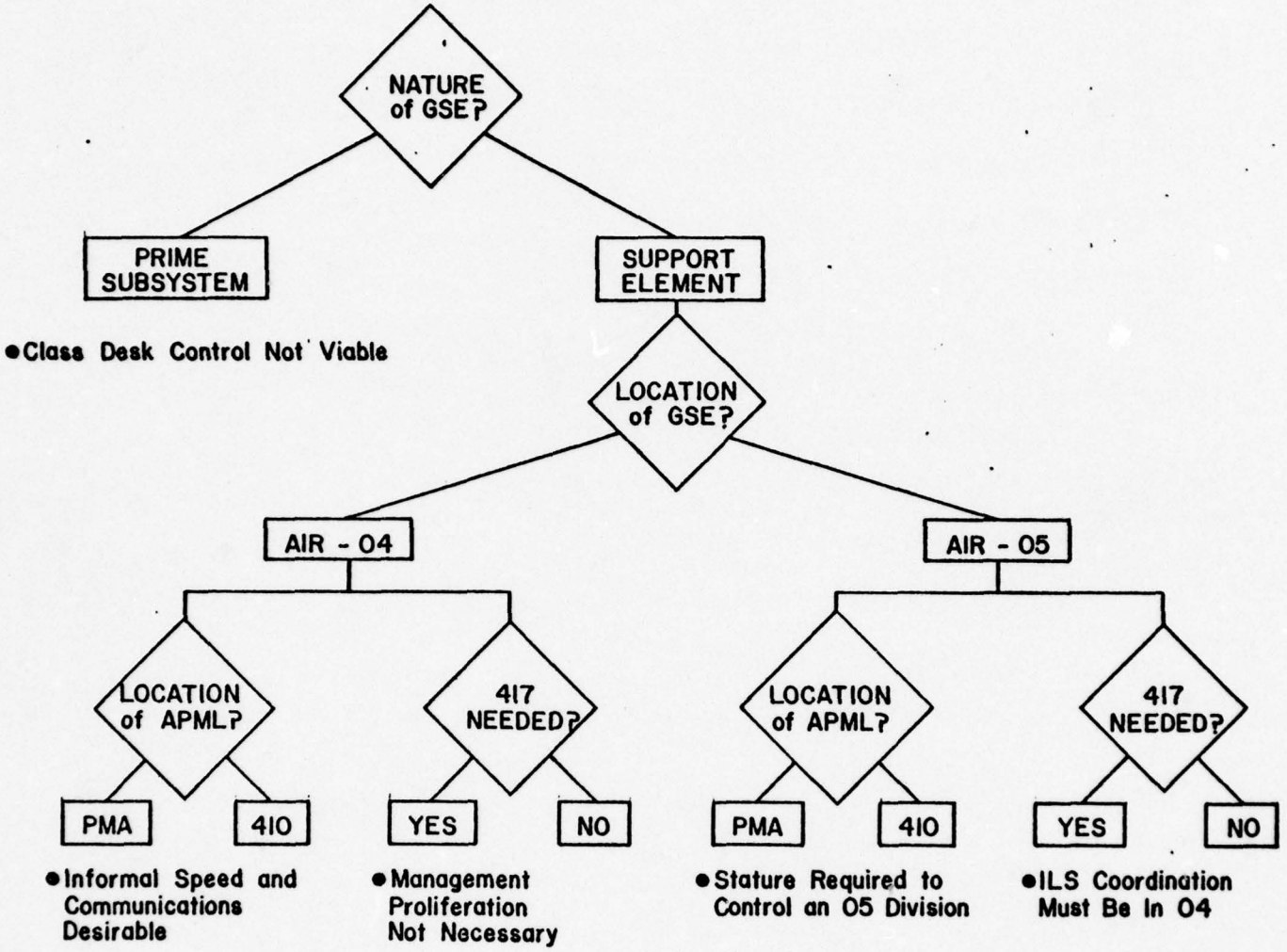

Figure 7. Management Structure Decision Tree

that it would not be subject to funding cutbacks and lack of early planning that have been typical for logistic support elements in the past.

(2) Support Element. There are also arguments for continuing to consider GSE to be an element of ILS. An obvious one is that if the airborne systems were 100 percent reliable there would be no need for most GSE which, therefore, is certainly support by nature. Also, requirements for airborne systems are in response to Operational Requirements, while GSE requirements originate in Maintenance Plans which are a support function. It is also true that the kind of high-level support emphasis that currently exists will make it much more difficult to trade-off the quality of the support program for additional aircraft as has been done in the past.

Perhaps the most convincing argument in favor of leaving PGSE under the control of APML is the practical consideration that the Class Desk does not have the same inclination as the APML to be concerned with it. AIR-510 is responsible for coordinating and integrating the acquisition of airborne systems and must devote full attention to total airborne system considerations: system performance, power requirements, air conditioning requirements, packaging, weight, etc. GSE does not fit into this primary concern for airborne systems and there is no reason to expect the Class Desk to do a better job than the APML of managing GSE acquisition. For this reason, the decision tree in Figure 7 continues to look at GSE only as a support element.

b. Location of GSE

Once the decision is made that PGSE is an ILS element under the direction of an APML, one must decide whether the acquisition responsibility belongs in AIR-04 or AIR-05. The assumption throughout is that PGSE and CGSE would be impossible to organizationally separate, nor would it even be desirable because of the required interfaces and the overall responsibility of the GSE Program Manager. However, it is in the PGSE acquisition process that the organizational issues can become critical. Therefore, although the discussions which follow relate directly to project effectiveness in terms of the PMA/APML/APM-GSE/AIR-417 management structure, any organizational conclusions must apply to the AIR-534 division as a whole.

(1) NAVAIR-04. If the GSE acquisition responsibility were in the AIR-04 group, in concert with its support nature, there would be a more efficient line of authority for resolution of conflict. For problems not solvable at the project/GSE Division level, the next higher level of negotiation would be between the Deputy Commander for Plans and Programs (AIR-01) and the Assistant Commander for Logistics/Fleet Support (AIR-04), which is similar to the present situation. However, conflicts between the APML and the GSE Division could be resolved by AIR-04 and not require negotiation between AIR-04 and AIR-05 or a decision by higher authority. Of course, the GSE Program Manager could appeal to the Commander on appropriate issues, as is authorized by his charter. The potential for conflict and difficulty of resolution,

which currently exists, would certainly not disappear with a simple organizational change, but after a period of adjustment there would likely be an improved, more effective working relationship between the GSE Division and the other 04 divisions. Problems would tend to be worked out at a lower informal level and a more consistent application of support philosophy could be expected.

(a) APML Location. The locations of the Logistic Element Managers (LEMs) is a factor in determining whether or not the APML should be located in the PMA's office with a PMA-XXXX code. With the GSE Division in the AIR-04 Group, then all of the PGSE acquisition participants would be organizationally tied to AIR-04. The advantages of having the APML in AIR-410 would then be in terms of speedier, informal "horizontal" relationships. This very practical matter came to light more than once in the authors' interviews: For tasks as simple and straightforward as processing purchase requests, the NAVAIR functional organizations seem to be more responsive to one of "their own". The APML in AIR-410 would also be closer to his sources of information and could more closely monitor adherence to project guidelines. Informal interaction during planning and budgeting activities, for example, can lead to a much better product and a greater commitment by the participants to meet project goals.

(b) AIR-417 Requirement. A review of Figures 1 and 2 reveals two organizations, of division status in AIR-04, which have similar responsibilities. Both AIR-410

and AIR-417 are "logistics management" divisions. A study of whether there actually are sufficient reasons for this seemingly proliferative management structure was beyond the scope of this thesis. However, if the GSE (acquisition) Division were in AIR-04, there would probably be a greater opportunity for eliminating this additional ILS function. Either the GSE Division could absorb the AIR-417 function by creating a "Logistics Branch" or, with the improved relations between GSE and AIR-410, such a branch could be established in AIR-410.

(2) NAVAIR-05. The previous discussion reviewed the possible organizational impact of recognizing PGSE acquisition for what it is, a support function, and locating the division under AIR-04. However, when traditional bureaucratic politics and professional attitudes are recognized as the powerful considerations that they are, then the question as to the GSE Division's appropriate location becomes very difficult. For some of the same reasons cited in support of improved ILS in the earlier AIR-04 section, the location of the GSE Division in AIR-05 probably better facilitates the required airborne equipment/GSE design interface; i.e., through effective informal interactions. It is also a fact that the AIR-04 and AIR-05 communities do not hold each other in very high professional regard. In particular, it might be difficult for an electronics engineer to consider himself a logistician were a transfer to AIR-04 to take place. Interestingly enough, if a transfer of the GSE Division is not

feasible for these practical reasons, then the two questions addressed earlier concerning the APML and AIR-417 take on a greater significance and lead to opposite conclusions.

(a) APML Location. The GSE Division is certainly one of the more major participants in an ILS program. If the GSE Division cannot be moved out of AIR-05, then serious consideration should be given to moving the APML up to the PMA's office. The F-18 Project has experienced particular difficulty with the present organizational structure. As long as the APML is tasked with controlling the project efforts of organizations which are not within AIR-04, he might need the stature of a PMA code in getting the required functional response. This type of question tends to get down to the level of individual personalities and projects, which cannot really be pursued here. However, it may be generally true that under these circumstances, the loss of informal speed and sources of information cited earlier can be more than compensated for by the increased stature and resulting apparent authority of an APML located in the project office.

(b) AIR-417 Requirement. Again, it is not possible here to consider the pros and cons of establishing a branch in AIR-410 to provide ILS for GSE. However, that function must certainly be provided by an AIR-04 division. There's very little logic to a logistics branch in the GSE Division as long as it remains AIR-534.

c. Summary

GSE, and particularly PGSE, was found to be an element of support within the framework of ILS. There seemed to be a mixture of theoretical and practical arguments both for and against transferring AIR-534 into the AIR-04 Group. Questions were addressed as to the appropriate location of the APML and the requirement for a separate logistics management division for GSE. The answers to the latter two questions depended quite strongly on whether the GSE Division was in AIR-04 or AIR-05.

B. F-18 APPROACH

The F-18 approach to PGSE acquisition will be discussed using the background of the acquisition environment discussion and the description of the F-18 approach from Section III.

Figure 8 is an organizational structure chart that has been put together from relationships defined in F-18 documentation and discussions with almost all of the organizational elements listed on the chart. Such a diagram is necessary to discuss the F-18 approach and a studied attempt has been made, on the basis of available information, to depict the major interactions accurately. However, it is the authors' interpretation and is not an official chart.

The basic philosophy of the F-18 approach to support is that the F-18 project is going to control the support environment rather than support problems controlling the project office. This is the often referred to "pro-active" rather

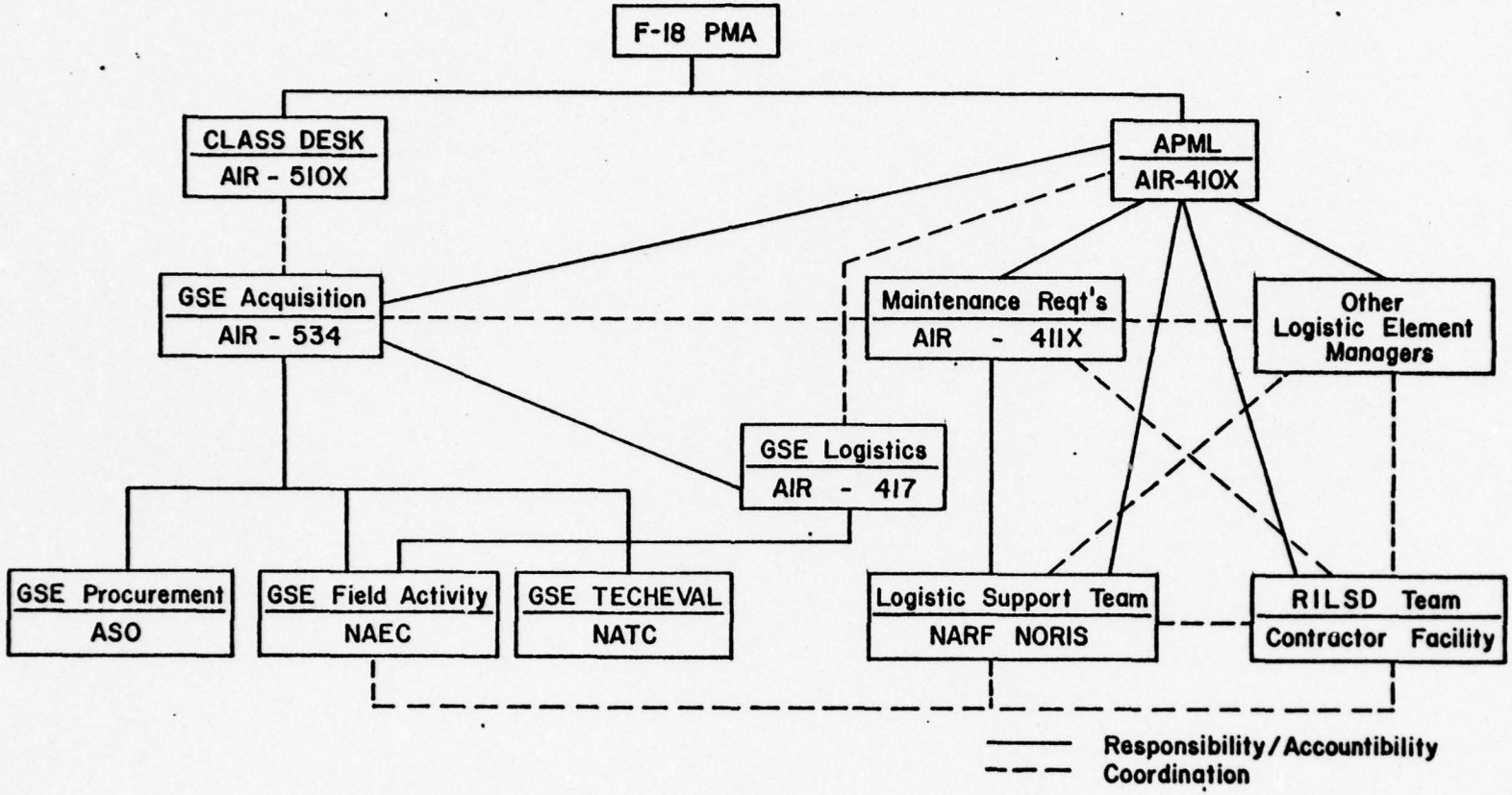

Figure 8. F-18 Organizational Structure for GSE Acquisition/Support

than "reactive" approach to management and is always a worthwhile goal.

The necessary ingredients to implement this philosophy are contained in four goals expressed by the APML:

1. Project office is equally incentivized for cost effective support as well as a cost effective weapons system.

2. APML is recognized as a manager charged with ensuring the support of the weapons system.

3. Recognize there are risks in the support function as well as in the weapon system and plans must be made and contingencies set aside for these risks.

4. Require a firm commitment from the functional organizations to do tasks as assigned by the PMA.

The project office commitment to support as well as aircraft performance is evident from considering the environment that created the F-18 program, the incentives for support performance in the weapon system contract and the strong role assigned to the APML for support management. Given that the first goal has been accomplished, the accomplishment of the remaining three goals can provide a rationale for judging the potential effectiveness of the F-18 approach to PGSE acquisition.

1. APML Control

The stature of the APML position on the F-18 project is one of the greatest changes from prior projects. Comparing Figure 8 with Figure 2 on page 29 gives an indication of the magnitude of this change. Another point about the chart in

Figure 8 is that an Integrated Logistic Support Management Team is not shown. The F-18 Integrated Logistics Support Plan states; "The primary management vehicle of the ILS program is the Integrated Logistics Support Management Team which serves to monitor and control the execution of overall program requirements" [Ref. 17]. The Integrated Logistics Support Management Team still exists on paper but, for all practical purposes, the "monitor" function is now done by the Logistic Support Team and the "control" function is accomplished by the APML.

The increases in the stature of the APML have resulted in corresponding apparent decreases in the stature of the GSE Program Manager and Logistic Element Manager functions. In terms of responsibilities and job content this reduction in stature has not really occurred; it is only relative to the APML position that the change has occurred.

The chief difference from past programs for the GSE Program Manager and other Logistic Element Managers is that the PMA has delegated some of his traditional authority to the APML who occupies a position in NAVAIR-410. Given the other demands on the PMA, it is unrealistic to expect him to be able to deal with functional program managers and Logistic Element Managers in enough detail to ensure that support is really proceeding as he has broadly outlined it in project plans and the maintenance concept. This delegation to the APML brings the AIR-04 side of the house to the same point that the Class Desk function has occupied on the AIR-05 side of the house for some time.

The primary method of implementing this change in stature of the APML has been by giving him funds control. The "Golden Rule"[5] is widely accepted as a primary precept almost without question. Assumption of total reliance on this precept, however, can be misleading.

Changes have occurred in the control and coordination of support elements as a result of giving the APML funds control and charging him with support management but these changes have not been accomplished as easily as the project would desire. This problem of implementing changes has been recognized for some time, as a quote from a book written in 1961 illustrates.

> Personal behavior patterns are frequently encountered which exaggerate the characteristic qualities of bureaucratic organization. Within bureaucracy we often find excessive aloofness, ritualistic attachment to routines and procedures, and resistance to change; and associated with these behavior patterns is a petty insistence upon rights of authority and status. From the standpoint of organizational goal accomplishment, these personal behavior patterns are pathological because they do not advance organizational goals. They reflect the personal needs of individuals [Ref. 21, p. 405].

The logic of the F-18 approach to support management seems consistent with the goals of the F-18 project. However, more attention paid to informal organizational behavior aspects during implementation of the necessary APML control functions would probably have reduced some of the resistance

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[5]The "Golden Rule" stated succinctly is: He who has the gold, makes the rules. Everyone the authors interviewed were familiar with this rule and seemed to accept it explicitly.

to these changes. The end result of this segment of the discussion is that the APML might be viewed as the support manager by his superiors but the same is not generally true of those subject to his control.

2. Program Managers/Logistic Element Managers

As the GSE Program Manager, NAVAIR-534 has occupied a unique position among the Logistic Element Managers on prior projects. Funds were received directly from the PMA and self-approved GSERDS were the documentation for controlling PGSE acquisition. On the F-18 project, funds are received through the APML in NAVAIR-410, and approved Maintenance Plans from NAVAIR-411 are required before any PGSE acquisition can occur.

Two specific issues related to PGSE acquisition have been raised by NAVAIR-534 in questioning these NAVAIR-04 controls. The first issue is that waiting for an approved Maintenance Plan delays GSE acquisition. Timely delivery of GSE is one of the primary concerns of NAVAIR-534. Related to this concern is the fact that NAVAIR-534 has received unexpected funding cutbacks on prior programs and, therefore, believes in obligating funds as soon as possible. The second issue revolves around the implementation of Phased Support. The APML believes the use of Factory Test Equipment for maintenance until the functional aircraft system design has matured is the most cost-effective approach. NAVAIR-534 maintains that fleet configured PGSE should be developed as soon as possible and then modified along with the aircraft

system by Engineering Change Proposals as the aircraft system matures. NAVAIR-534 believes early use of fleet configured PGSE allows an earlier transition to Navy support and Engineering Change Proposals usually have a minor impact on PGSE and are consequently inexpensive. A related Phased Support issue is the NAVAIR-534 view that all identified PGSE should be developed as quickly as possible rather than following the F-18 plan of concentrating on the PGSE for low-reliability systems first. Again, the NAVAIR-534 viewpoint of committing funds as quickly as possible and delivery of GSE as quickly as possible comes through.

From the viewpoint of project management prerogatives, discussed in the section on project management, these issues are of a short-term project nature and are decisions the APML has the authority to make. NAVAIR-534, as the GSE Program Manager, can make a case that the expertise and authority required to make these decisions falls under the control of the functional organization but, as long as the APML controls the GSE funds, he will be able to implement the F-18 project plans. Also, it would appear the APML is in a better position than the GSE Program Manager to protect GSE from arbitrary funding cuts. In the event of a cutback, the APML can make tradeoffs across the support elements and this would allow a systematic curtailment of support functions rather than a cutback only in areas that had funds uncommitted.

The Logistic Element Managers within NAVAIR-04 have generally adapted to the new order with less resistance than

NAVAIR-534. Several reasons for this compliance can be easily postulated. None of the NAVAIR-04 Logistic Element Managers have a program management charter for their logistic element and they are on the same organizational side as the APML in any material acquisition vs. support jurisdictional dispute. Also, conflicts within NAVAIR-04 would tend to be resolved quicker and with less visibility than conflicts across organizational lines.

It is interesting to speculate that perhaps some of the resistance would not have occurred if a slightly different method of implementing the F-18 support plans had been decided on. An Assistant Project Manager for Support in the Project Office, with the same responsibility as the APML, would have the stature of the project office and might have been able to accomplish the formal changes much more easily. The pros and cons of this approach were discussed earlier and will not be repeated here.

Referring back to the four support goals on page 65 it is apparent from the preceding discussion that a firm commitment from the functional organizations to do assigned tasks has not been totally achieved.

3. Phased Support/Logistic Support Team

The F-18 project structured the Phased Support Concept to deal with the deficiencies that have been identified on previous projects. Phased Support recognizes that all support elements, realistically, will not be ready at the same point in time. Phased support is not really new. The terminology of "augmented" or "interim" support are in common

use to indicate the measures undertaken by prior projects when support problems occurred. The question then is not; will Phased Support work, but rather; can Phased Support be planned for from the start of the project?

The key element in a discussion of Phased Support success or failure is the Logistic Support Team. Originally, the Logistic Support Team was designed to be a part of the Resident Integrated Logistic Support Detachment (RILSD) at the contractor's facility. The F-18 project was not allowed to structure the RILSD to include the Logistic Support team because NAVAIR would not provide sufficient billets for a large Navy team at the contractor's plant. This position is understandable in view of the DOD restrictions on billets and the existence of a large Air Force Plant Representative Office at the contractor facility.

The NARF NORIS Logistic Support Team using NARF NORIS billets is the method the APML chose to establish this essential ingredient to the F-18 support program. This is a reasonable choice since NARF NORIS personnel were already involved in reviewing Maintenance Plans for NAVAIR-411 and NARF NORIS is the Prospective Cognizant Field Activity for the F-18 Aircraft. However, there are some obvious drawbacks to this arrangement.

1. Ideally the Logistic Support Team should be physically located at the contractor facility.
2. Choice of team members is limited.
3. NARF NORIS management goals for the Logistic Support

team may not be the same as the F-18 project office goals for this team.

4. Traditional role of the NARF is not consistent with the role of the Logistic Support Team.

a. Location of Logistic Support Team

As shown in Figure 8 the Logistic Support Team should primarily interact with NAVAIR Logistic Element Managers, Resident Integrated Logistic Support Detachment members, Naval Air Engineering Center personnel and contractor personnel in carrying out their responsibilities. Extensive travel would be required of the Logistic Support Team, if they were located at the contractor facility. However, when the base of operations is NARF NORIS in San Diego, the contractor is in the midwest, and other elements are on the East Coast, the situation during the F-18 Full Scale Development Phase appears intolerable. This phase encompasses four years and it is desirable to have the same personnel remain on the team. The ability of this team to retain personnel and do an effective job of coordination is open to question.

b. Choice of Logistic Support Team Members

The strengh of the Resident Integrated Logistic Support Detachment has been in having expertise at the contractor's facility to accomplish day-to-day coordination. Typically these members are rather carefully selected and, coming from various organizations, they are able to provide a broad spectrum of information by personally knowing the type of capabilities and information available in their

organizations. As noted in an article by Lorsch and Lawrence the coordination function requires a balanced orientation [Ref. 21, p. 388]. In the case of the F-18 project a balanced support orientation should include representatives from a variety of support disciplines. The makeup of the Resident Integrated Logistic Support Detachment appears to support this concept since members are specialists in a particular field, retain allegiance to their parent organization, and while on the team will be counterbalanced by specialists from other disciplines.

With the selection of Resident Integrated Logistic Support Detachment members used as the baseline, the selection of Logistic Team Members from NARF NORIS has some obvious drawbacks. The population from which the selection is made is smaller and the same technical specialties do not necessarily exist, to the same competence level, at the NARF. Also, considering the traditional role of the NARF, team members' orientation might lean more toward an overhaul and maintenance viewpoint than toward a balanced orientation more closely suited to the coordination role.

c. Logistic Support Team Goals

The goals of NARF NORIS management in establishing this team might tend to be of a longer term nature than would be desirable for the F-18 Full Scale Development. The advantages for the NARF are, as the Prospective Cognizant Field Activity, that they are training a cadre of people on the Logistic Support Team to manage the F-18 weapon system when it comes under their control. Also, the Logistic

Support Team would set a precedence for the NARF moving out of its traditional Service Life Extension Program (SLEP) role into the acquisition phase of the program life cycle.

The near-term impact on the F-18 project could be a Logistic Support Team, that is a key item for support system success, being made up of personnel that lack the requisite training and experience.

d. Potential Coordination Conflicts

A close working relationship will be required between Logistic Element Managers and the Logistic Support Team. The potential for conflict is apparent in the fact that the Logistic Support Team is taking over a coordination function previously performed by the Logistic Element Managers as members of the Integrated Logistic Support Management Team. A status problem can also be postulated since it could appear, from a superficial look, that the NAVAIR Logistic Element Manager's are working for personnel from a NARF. However, these conflicts would probably exist to the same extent if the Logistic Support Team was based in the Resident Integrated Logistic Support Detachment. This problem must be considered in selection of team members since these conflicts, over the long term, will be worked out on a one-to-one basis and success will depend on the capabilities of the individuals selected.

C. ALTERNATIVE ACQUISITION METHODS

Once the weapon system contract has been signed, the Navy is in a weak negotiating position on any required

additions to that contract. However, it is in this type of sole source environment that procurement of PGSE is carried out. The contractor specifies, costs, designs and develops the PGSE after the original contract is negotiated. The specifications require Navy approval and the costs are negotiated, but the process is not competitive. This fact has led to various alternatives being proposed for PGSE acquisition. The primary alternatives are separate competitive procurement and Navy design and build. Variations of these alternatives are possible but an extensive discussion is not deemed warranted.

1. Competition

The coordination required, especially on a project where design maturity has not been attained, between a weapon system contractor and PGSE contractor appears formidable. The time spent on the source selection process and contract administration would, it appears, further delay PGSE acquisition. From the standpoint of quality of equipment it would seem the Navy cannot improve the acquisition process by adding another interface. Whether cost would be substantially less is open to debate since many other costs incurred by the Navy would need to be included.

2. Navy Build

The Navy certainly has the capability to build most of its own PGSE. The management of the interfaces would, to some extent, be the same as required for competitive procurement although the Navy would not have to spend resources

on contract administration. Again the cost effectiveness of this approach is open to debate and becomes an accounting exercise in adding up true costs. Also the political implications of the Navy competing with a contractor is an issue that might make the discussion academic.

To a certain extent the high cost of PGSE can be attributed to the interface management that the Navy is buying. The complexity of technical coordination should not be overlooked in comparing Navy costs to build vs. contractor cost to build. This is not to imply that PGSE costs are reasonable. What it does imply is that the Navy can probably more effectively use its resources by specifying in the original contract, as much of the PGSE performance requirement as can be defined, and then provide sufficient numbers of technically competent personnel to monitor the PGSE acquisition and demand cost-effective designs and compliance with Navy requirements.

V. CONCLUSIONS

While this thesis does not go into the details of the PGSE acquisition procedures, they were scrutinized by the authors at sufficient length during their background research to determine that they comprised a well-thought-out, comprehensive, logically consistent and potentially effective process. It was found, however, that the NAVAIR political environment and management structure made implementation of these procedures so difficult that it is through innovations in organizations and management technique that the F-18 Project is trying to enforce adherence to stated support policies.

A. MANAGEMENT STRUCTURE

The conclusions which can be drawn from the prior discussion on management structure are summarized in Figure 9. In this figure, the decision tree of Figure 7 is redrawn in the form of a series of hanging scales to illustrate the "balance" of the authors' conclusions at each decision point.

For reasons stated in the discussion section, there can be no serious consideration to making PGSE acquisition management responsive to the Class Desk rather than the APML. The authors believe that whether any project can be given appropriate responsiveness from its APM-GSE is as much a function of the particular individuals involved and the current

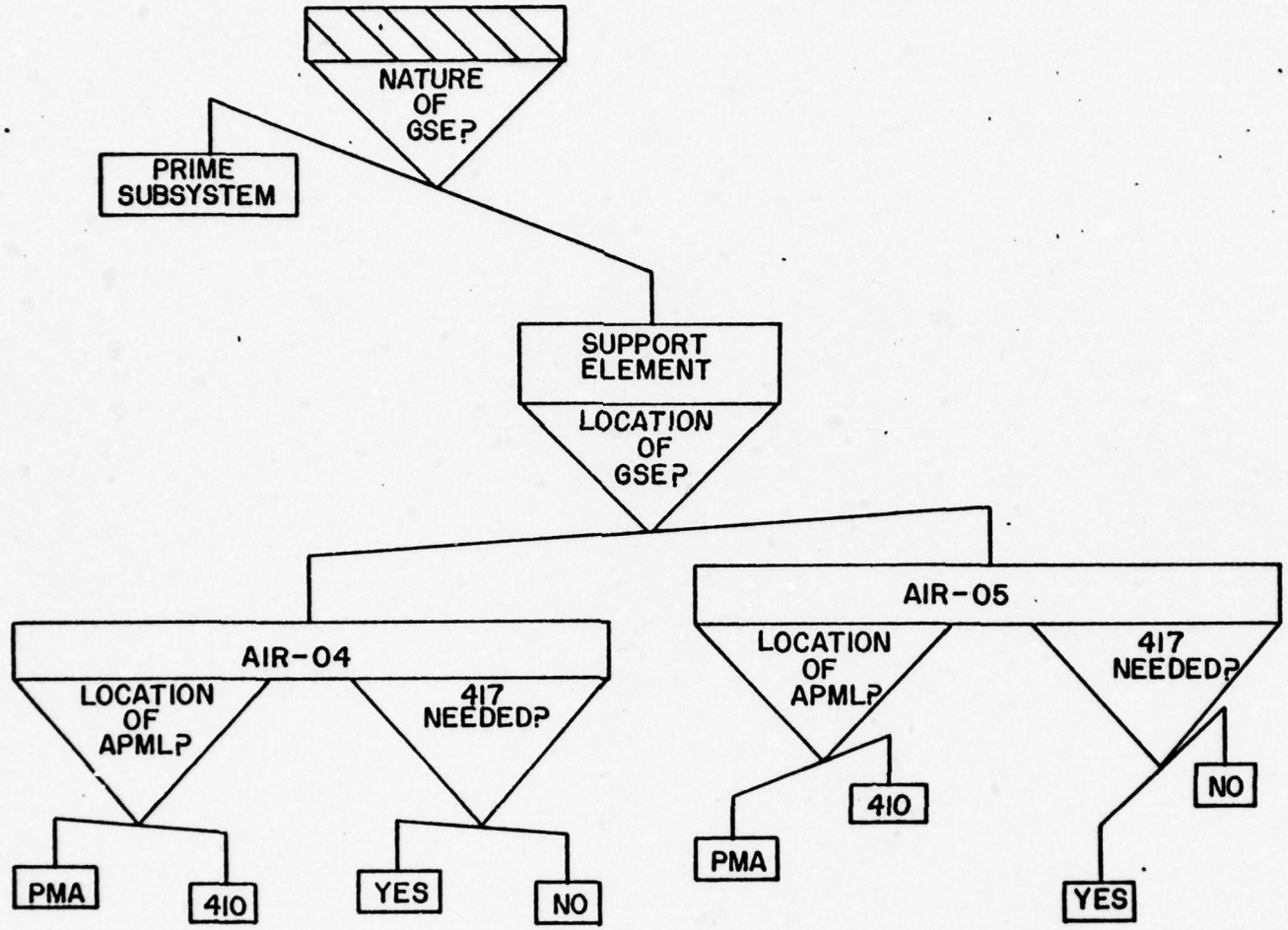

Figure 9. Weighing the Alternatives

political environment as anything else. In order to facilitate the required responsiveness of any APM-GSE to his project's support policies, and hence to his APML, the APM-GSE should be organizationally situated in AIR-04 as are the other LEMs. It is determined that the benefits to be derived by moving AIR-534 into the AIR-04 Group, in terms of increased project responsiveness and integration with other support functions, outweigh any drawbacks in having the GSE Program Manager in AIR-04.

If the GSE Division would move to AIR-04, as the authors think it should, then the APML could probably best manage a project's support program by remaining in AIR-410. Also, NAVAIR could probably eliminate AIR-417 and have AIR-410 or the GSE Division assume the responsibility for GSE logistic support. These latter two conclusions are not as significant, however, as the decision to move AIR-534.

The questions of APML location and the requirement for AIR-417 take on major significance when the GSE Division is in AIR-05, as it currently is. Since there is no reason to believe that AIR-534 could manage logistic support from the AIR-05 side, clearly this responsibility must remain in AIR-04. In lieu of further study, it must be concluded that the present AIR-410/AIR-534 situation calls for the existence of a separate organization for the management of logistic support for GSE, e.g., AIR-417. Another consequence of not moving AIR-534, is the lack of an APML's ability to rely on his position as a functional area assistant project manager to efficiently carry out his tasks in accordance with the project

management approach, although there are probably exceptions to be found, depending on the particular project. Therefore, in the current environment with the political considerations discussed earlier, it would be generally beneficial for the APML to have the status and authority of a PMA-XXXX code.

B. F-18 APPROACH

The F-18 project has elevated support system performance to a co-equal status with weapon system performance. The availability of resources, because of support system visibility, has resulted in detailed early planning. The early planning recognized a single Navy support date was unrealistic and evolved Phased Support as a planned, orderly introduction of fleet support capability. This support concept required dividing the aircraft systems into manageable functional groups. Coordination of logistic elements for each functional group established the need for the Logistic Support Team. Finally the APML needed to control support funds in order to manage the support development and accomplish support system tradeoffs.

The logic of this process is inescapable. As a coordinated whole the F-18 project's acquisition strategy has wide acceptance. Areas of disagreement involving PGSE acquisition revolve around the implementation of specific features of the overall concept. In actuality, these areas of disagreement are more of a political nature than substantive issues. The real issue, inherent in the visible problems, is APML control of support system acquisition. This change threatens

the established routines and results in territorial disputes. The F-18 project appears to be making progress toward overcoming these obstacles in spite of the political and organizational environment.

The responsibilities and coordination duties of the Logistic Support Team were examined in great detail since this team is critical to the success of Phased Support management. The project demands on this team will be substantial and, in the authors' judgement, several factors have impacted the establishment of this team and will limit its effectiveness. The most important of these are the location of the Logistic Support Team on the West Coast and a potential lack of balance in team experience.

Relative success or failure of the F-18 PGSE acquisition strategy will not be known for 6-10 years. In the meantime the F-18 project has a logical, methodical approach to support system development. The execution of that plan requires good management and organizational discipline. The success or failure of the F-18 approach will be judged on how well the project support plan is implemented. The plan itself should stand the test of time.

VI. RECOMMENDATIONS

Specific recommendations have resulted from the work carried out on this thesis. These recommendations have specific impact on PGSE acquisition management. Because PGSE acquisition is a subset of the larger support acquisition category these recommendations necessarily impact this larger topic. Recommendations have only been made that, in the authors' judgement, would also enhance the overall support acquisition function.

In considering these recommendations, it should be recognized that organizational realignments are only one factor in achieving management effectiveness. Continued attention must be directed to aligning organizational goals and individual goals. A formal structure is only the foundation upon which an organization can be developed to achieve this objective.

1. In balancing functional interactions and responsibilities it appears that the NAVAIR-534 GSE Division more appropriately belongs in NAVAIR-04. Related to this move, the function of NAVAIR-417 may be absorbed into existing NAVAIR-04 Divisions to eliminate differences in procedures and duplications of logistic management functions.

2. If a realignment of NAVAIR-534 into NAVAIR-04 cannot be realized, PMA-265 should consider moving the F-18 APML from NAVAIR-410 into the project office. In any case, more project

office influence must be brought to bear in establishing the APML as the F-18 support system manager.

3. The staffing and functioning of the Logistic Support Team are critical to the success of F-18 phased support. Every attempt should be made to establish this team as part of the Resident Integrated Logistic Support Detachment at the contractor facility.

In the process of accomplishing the work on this thesis several areas have been identified where further study could be beneficial. An in-depth study of these topics was not within the scope of this thesis but these topics were recognized as having a potential for improvement that could have an impact on PGSE acquisition. These topics are listed as follows:

4. Test Program Sets used on Automatic Test Equipment are a subset of PGSE. This area has some unique problems and procedures that warrant a separate in-depth study.

5. Innovation in PGSE contracting methods and contractual PGSE performance incentives are an area of great potential payoff. Further in-depth study of possible PGSE contract provisions and alternative methods of procurement is warranted.

6. Further study of the necessity of a separate logistic support division for GSE, NAVAIR-417, would be useful. This study would be beneficial whether NAVAIR-534 remains in NAVAIR-05 or not.

APPENDIX A

INTEGRATED LOGISTIC SUPPORT

In 1963, recognizing the need for a more organized approach to logistics planning, the Navy issued WR-30, a weapon requirement entitled "Integrated Maintenance Management for Aeronautical Weapons, Weapon Systems and Related Equipment." This document was reinforced in the following year by DOD Directive 4100.35, "Development of Integrated Logistic Support for Systems and Equipments" [Ref. 24].

DOD DIR 4100.35 was the first official document to define the main elements of ILS. Since then, there has been much literature addressing this subject with somewhat less than 100% agreement as to what these main elements should be called and into how many categories they should be placed. On May 18, 1971, the Chief of Naval Material (CNM) issued NAVMAT Instruction 4000.20A, "Integrated Logistic Support Planning Policy." This document defines ILS to be [Ref. 25]:

> A composite of all the support considerations necessary to assure the effective and economical support of system/equipments for their life cycle. It is an integral part of system/equipment acquisition and operation and is characterized by harmony and coherence among all the logistic elements. The principal elements (defined in DOD Guide 4100.35G) related to the overall system/equipment life cycles, include:
>
> a. Maintenance Plan
>
> b. Support and Test Equipment
>
> c. Supply Support
>
> d. Transportation and Handling

e. Technical Data

f. Facilities

g. Personnel and Training

h. Logistic Support Resource Funds

i. Logistic Support Management Information

There are, of course, activities and programs within any weapon system acquisition project with which the logistic support process must be compatible and with which a high degree of coordination and cooperation must be attained. According to the Chief of Naval Material, the following are representative of these related matters [Ref. 25]:

a. Configuration Management

b. Data Management

c. Reliability

d. Maintainability

e. Safety

f. Human Engineering

g. Life Cycle Costing

h. Standardization

i. Environmental Impact Statements

The Project Master Plan (PMP) contains a document called the Integrated Logistic Support Plan (ILSP), which combines all of the logistic support documentation. The ILSP, according to DOD, is:

> The Government's detailed ILS management plan for a specific acquisition program. Provides a comprehensive plan for implementing the logistic concepts, techniques and policies necessary to assure the effective economical support of a system/equipment during its life cycle.

It is a dynamic document which continually grows with the increased availability of information, and provides for integration of logistic elements into program planning, development, test and evaluation, production and operational processes [Ref. 26].

The Assistant Project Manager for Logistics (APML) is responsible for the overall design, management, control and effectivenss of the ILS program for the project to which he is assigned. Normally, the APML is assigned to a project out of AIR-410 with concurrence of the PMA. The APML, while usually dedicated to a project and depended upon by the PMA, retains line responsibility to the AIR-04 organization. His funds, however, must come solely through the project office.

The APML accomplishes his tasks, primarily, by coordinating the efforts of the Logistic Element Managers (LEMs), who are responsible for the management of specific support elements such as test and support equipment, spare and repair parts, personnel, and facilities. A LEM is usually a representative of one of the AIR-04 logistic support divisions. Each LEM has the ultimate objective of the effective acquisition, timely deployment and in-service management of specific support items. Although much of the funding available for this support, particularly in the planning phases, must be provided by the project office, all LEMs remain line-responsible to their parent organization, e.g. AIR-04.

The great amount of coordination which must take place, not only between the Navy's participants but also with the

contractor, is accomplished by both formal and informal means. The formal coordination is supposed to be accomplished by means of the periodic meetings of the Integrated Logistic Support Management Team (ILSMT), which is comprised primarily of the LEMs and their contractor counterparts. The team is headed by the APML.

APPENDIX B

LIST OF INTERVIEWEES

Personnel from the following organizations were interviewed during the course of the study:

NAVAIR

F-18 Project Office

A-7 Project Office

AIR-410

AIR-411

AIR-417

AIR-534

FIELD ACTIVITIES

Naval Air Engineering Center

Naval Aviation Logistics Center

Naval Air Rework Facility - North Island

Naval Weapons Center

CONTRACTORS

McDonnell Aircraft Company

Vought Corporation

APPENDIX C

INTERVIEW TECHNIQUE AND KEY QUESTIONS

In conducting over 25 interviews with individuals from seven organizations the authors' attempted to ask a standard set of core questions. In addition to these questions many other topics were explored as they arose. Also, in some cases all the questions were not appropriate, or time constraints limited discussions to only the major topics.

The interviews were not conducted as formal question and answer sessions. A brief introduction of the purpose of the thesis research followed by a few general questions generally set the stage, and most interviewees, as a matter of course, answered many of the questions without any prompting. This process was educational since it indicated the major concerns and viewpoints of the interviewees.

In general, the authors cannot emphasize enough the value of conducting personal interviews. Interviews provide a much more informal and productive method of communication and allows an individualized approach to collecting information.

The following is a list of typical questions used by the authors during interviews.

1. What is your function in PGSE acquisition and where do you fit organizationally?

2. What do you see as the chief problems in PGSE acquisition?

3. What improvements could be made in PGSE acquisition, both procedurally and organizationally?

4. Can the extensive time required for PGSE acquisition be shortened?

5. Why is PGSE so expensive?

6. How do you ensure a contractor will not gold-plate PGSE?

7. Are there any alternative ways to accomplish PGSE acquisition?

8. Is support really considered as important as aircraft performance on the F-18 project?

9. How is the F-18 approach to PGSE acquisition different from past projects?

10. What is your understanding of the F-18 Phased Support Concept?

11. Is Phased Support new?

12. Will there be improvements in the F-18 weapon system as a result of their approach?

APPENDIX D

F-18 AIRCRAFT SYSTEMS FUNCTIONAL GROUPS

The Logistic Support Team at NARF NORIS is comprised of nine individuals who will each be responsible for tracking the logistic support efforts for each system in one of the nine functional groups as categorized below:

GROUP A

Hydraulic Power System

Landing Gear System

Catapult and Arresting Gear System

GROUP B

Fuselage

Wings

Stabilizer

Doors

GROUP C

Bleed Air System

Air Conditioning System

Air System

GROUP D

Oxygen System

Emergency/Survival System

Escape System

GROUP E

Auxiliary Power System

Fuel System

Power Plant

Power Plant Installation

Accessory Drive System

GROUP F

Electrical Power System

Emergency Power System

Ice and Rain Protection System

Fire Protection System

Lighting System

Instruments

Warning/Caution Advisory System

GROUP G

Flight Control System

Flight Reference

Integrated Guidance and Flight Control

GROUP H

Communications System

HF

VHF

UHF

COM-NAV-IFF Integrated Package

Radio Navigation

Radar Navigation

Bombing Navigation

Photographic/Reconnaissance

GROUP I

Weapons Control System

Weapons Delivery

Electronic Counter-measures Displays

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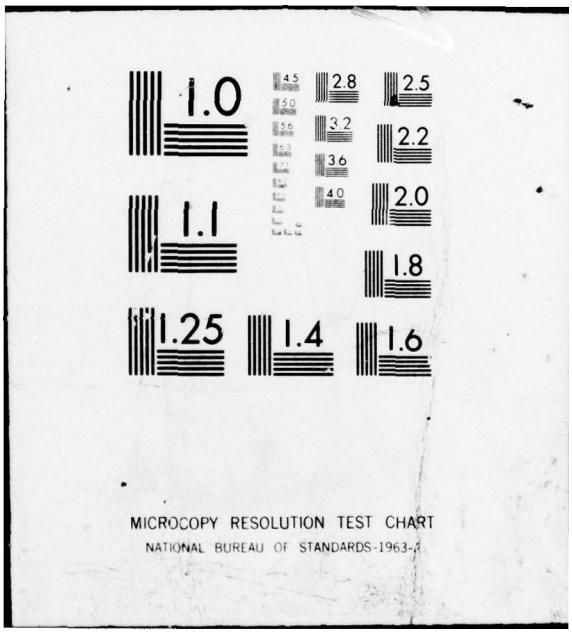
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