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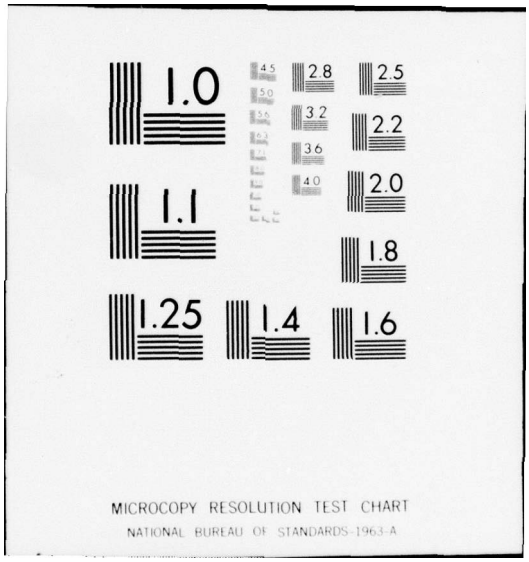
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DEFENSE SYSTEMS MANAGEMENT COLLEGE

PROGRAM MANAGEMENT COURSE
INDIVIDUAL STUDY PROGRAM

RETURNING RDT&E ASSETS (AIRCRAFT)
TO OPERATIONAL USAGE

STUDY PROJECT REPORT
PMC 76-2

David M. Sjuggerud
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FORT BELVOIR, VIRGINIA 22060

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DEFENSE SYSTEMS MANAGEMENT COLLEGE

STUDY TITLE:

RETURNING RDT&E ASSETS (AIRCRAFT) TO OPERATIONAL USAGE

STUDY PROJECT GOALS:

To examine techniques and results of RDT&E aircraft management which have been evident in past aircraft programs and to present a discussion of factors and alternatives which exist in program management of RDT&E assets.

STUDY REPORT ABSTRACT:

The purpose of this study report is to review past aircraft programs to gain insight as to what aircraft utilization and program management techniques can be considered in the recovery and continued service utilization of RDT&E aircraft after reconfiguration.

The research for the project consisted principally of interviews with Navy, fixed-wing aircraft, program managers, correspondence with contractor personnel, and review of the test plans of ten programs dating back to 1960. A study of a contract amendment of the F-14 program, known as "Trade Fair", is included due to its unique method of firding funding to support reconfiguration costs.

Review of past programs indicates that the numbers of aircraft needed to accomplish the required testing has increased in the past decade. The rate of successful reconfiguration and return to continued service usage of the test aircraft varied from 0% to 88% in the programs examined. Program management options in recovery of assets ranges from full-system compatability with production aircraft to limited utilization usage in either operational roles or dedicated as a test-bed platform for future projects. Program management must plan early on for disposition and identify funding requirements. Operational requirements and the desire to place existing funds in forward directed programs, vice recovery of test assets, appears to be a major furd allocation decision affecting reconfiguration.

SUBJECT DESCRIPTORS:

RDT&E Testing
Reconfiguration

NAME, RANK, SERVICE	CLASS	DATE
David M. Sjuggerud LCDR USN	PMC 76-2	November 1976

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RETURNING RDT&E ASSETS (AIRCRAFT) TO OPERATIONAL USAGE

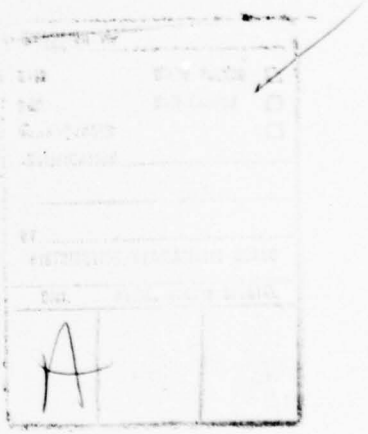
Study Project Report

Individual Study Program

Defense Systems Management College

Program Management Course

Class 76-2



by

David M. Sjuggerud
Lcdr USN

November 1976

Study Project Advisor
Mr. Fred Kelley

EXECUTIVE SUMMARY

The purpose of the study project was to review past aircraft programs to gain insight into management techniques and options which restored test aircraft to continued service usage after initial testing was completed.

Review of test plans of nine test programs dating back to 1960 revealed a trend toward increasing test assets needed to accomplish current test requirements. The record of restoration/reconfiguration of test aircraft after testing varied from 0% to 88% in programs examined. Eight cases are reviewed for the specific utilization of assets. The Amendment to the Contract for the purchase of F-14 aircraft, known as "TRADE FAIR", is examined due its unique method of finding funding to support reconfiguration costs.

It is concluded that success in reconfiguration of test aircraft is a problem which is entirely manageable within the program office. The desire to apply program funds to forward directed applications, such as additional production changes or additional of capability to operational aircraft, vice restoring early assets to some limited capability, is probably the principal factor in management consideration.

ACKNOWLEDGEMENT

To the professionals of the Naval Air Systems Command and to private industry, I express grateful appreciation. In the course of research for an interesting topic and in the decision and research for the particular topic selected, every request for an interview was granted, every telephone call returned, and every letter answered, although much of the time devoted to my ideas and project required distraction from their prime duties, or was conducted after normal working hours of their commands. The interest of everyone contacted and their willingness to contribute however they might was impressive and indicative of their dedication to their careers and the field of systems acquisition.

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SECTION I

INTRODUCTION

Purpose of the Study Project

Within the lifespan of any major acquisition of an aircraft, a question will arise from either the Program Manager (PM), his deputy, or his test and evaluation coordinator, "What are we going to do with our test and evaluation aircraft?" Every program office (PMO) will then proceed to lay-out a test and evaluation master plan (TEMP) or its equivalent which includes development testing, operational testing, and production acceptance testing appropriately time-phased into the acquisition cycle as delineated in current Department of Defense (DoD) directives. With the TEMP completed and approved, the program will proceed without reconsidering all of the original question, "What are we going to do with our test and evaluation aircraft, after we've completed the test and evaluation required?"

There are no DoD directives nor explicit Service instructions providing guidance to the PM regarding either recovery of the aircraft and resumption of useful service lives after the completion of the test program or disposition including relegation to mothballs in some Service boneyard of expired aircraft. The lack of direction regarding disposition of the test aircraft

is ironic in that in terms of capital investment, none of the individual production aircraft will approach the costs of the individual test aircraft. With increasing costs of aircraft and the resulting tendency to affect economies by reducing the total number of aircraft bought, the importance of full utilization of the original test aircraft becomes magnified.

The purpose of this paper is to review past programs to gain insight as to what has been done, and to relate some alternative solutions observed in various programs.

Scope of the Report

Although one of the original project goals in pursuing this subject for a report was to develop a course of action which could be applied directly to future projects involving test aircraft, it became apparent development of such a checklist would be beyond the scope of this report. In order to fully understand the reasons why particular programs choose particular courses of actions in handling the reconfiguration of test aircraft, it would be necessary to live with the program and understand all of the factors, socio-politico and economic, which played upon program decision-making at the time of the actual program prosecution. Obviously, such an experience was not possible, nor was the next best solution, that is, to find and interview someone who did. In many cases,

military managers who were directly involved had moved on to new assignments. Most of the current PMO's have moved beyond the testing phase as their programs have matured, and the details of specific decisions, beyond historical test plans, is not retained in the program office. An extremely good source of historical data was discovered in the flight test divisions of aircraft manufacturers. The essentials of good business require long-term corporate memory in the handling of past projects as it can affect future profitability. Some of this information is exploited in this report. Unfortunately the wealth of such sources and the realization of the willingness of the manufacturers to share such experience was discovered late in the research phase. Time precluded a broad canvassing of industry, although it is now clear that this method of research would bear the most fruit on this particular subject.

The scope of this report was thus limited to the review of as many test plans as possible with regard to differences in testing and the ultimate disposition of the test aircraft. Interviews were conducted with many current PMO's to discuss current approaches, past programs inasmuch as information existed, and to discuss the subject philosophically in the real-world of program management. The extent to which this report became more informative, vice instructive, in nature is reflected in reduced access to meaningful data, compared to what was thought to be available at the outset of research.

DISCUSSION

The Nature of the Problem

"Test and evaluation shall be commenced as early as possible and conducted throughout the system acquisition process...." (DoDD 5000.3). Arising from the mandate for early testing has been the concept of "fly-before-buy", "try-before-buy" and other iterations of the same theme. Within the scope of this paper, it is assumed that all of the purposes of such policies are met, i.e. risk minimization, technical performance determined, operational effectiveness and suitability verified etc. Attention is then directed at the "residue" of the testing which falls into several categories. Pure technology or research aircraft, such as the X-4 or the X-15 find little use after their intended research objectives have been achieved. Test beds used to develop subsystems (such as radar and/or engines) can resume useful lives after the test program is completed. Prototype aircraft of an intended production program can and frequently do have long and productive lives. Preproduction or the initial production runs of aircraft, usually 10-15 aircraft should be programmed for update to production configuration but in some cases are not. Because of the number involved and the amount of updating required, the latter category of aircraft represent the potential for the achievement of greatest

savings which can be directly controlled through sound management practices within the program office.

The essence of the problem is that in all cases, the test aircraft are different from the ultimate production aircraft due to unique test instrumentation installation and due to the fact that deficiencies in design discovered in the test aircraft will be corrected somewhere in the production run. The issue is the extent to which the test aircraft can be updated and/or de-instrumented to match the production configuration.

A quick review of two recent programs clearly demonstrates failure to recover assets through foresighted planning. According to information provided from industry, a poor example lies in the F-15 program, where twelve aircraft are presently mothballed at Edwards Air Force Base. The aircraft are so badly butchered up from the test program purposes, reportedly, that they were uneconomical to restore to a tactical configuration. They were too costly to operate for chase purposes or for other test support and represent approximately $200,000,000 of wasting assets.[1] The F-14 program found itself in the position of having eleven aircraft uniquely configured for early test purposes without plans or funds for reconfiguration. Providentially, due to factors almost unrelated to the purpose of reconfiguration of test airplanes, a method was discovered and implemented which resulted in eleven aircraft being updated

1. Mr. Hugo Pink, Northrop Corp, 7 Oct 1976

to a current configuration. At a nominally quoted cost of $12,000,000 per production aircraft, the potential loss of assets represented an understated value of $132,000,000, though the true cost of the original test aircraft was probably higher.

Both programs highlight the large sums of money/investment involved. The fact that there is no guidance for the PM in the disposition of the aircraft or that such a large investment is officially overlooked and left solely to the discretion of the PM seems a cavalier treatment of hardfought allocations on the part of DoD policy.

Historical Overview

Accomplishment of the necessary testing requires dedicated assets. Some aircraft must necessarily be designed and built to meet specific test requirements. Structural integrity testing, stability and control testing, and performance testing are areas which require special instrumentation and may result in destructive testing of the individual aircraft. The following list, compiled from flight test plans and interviews shows the historical needs for test aircraft in some programs of the past two decades.

Year	Program	Flight Test Requirements
1956	T-38A	8
1960	F-5A	12
mid-60's	A-7A	10-12
1968	A-7E	9
	A-7D	9

1971	S-3A	14 (includes 4 OT&E)
	F-5E	9
1973	F-14A	20 (includes 6 OT&E)
	A-9	10 (Northrop Proposal)
	F-15	19-20
1975	F-5F	9
	F-16	6 (USAF Prototype RFP Requirements)
1976	F-17	8 (Northrop Prototype Proposal)
1978	F-18	25 (includes 9 OT&E and 5 FMS)

It appears that the number of aircraft required from the aspect of new starts to complete the necessary testing has increased in the past decade. The investment required to conduct the testing has increased as has the ultimate production costs of individual aircraft as functions of inflation and increased complexity. In Navy programs, the early introduction of OT&E and Board of Inspection and Survey (BIS) Trials has necessitated augmenting the flight test needs with early production models to accomplish the required testing. Examination of programs for which data was available showing continued utilization of flight test aircraft beyond initial test and evaluation purposes revealed the following information.

Program	Flt. Test Rqmts.	Returned to Serv. Use
T-38	8	6
F-5A	12	10
A-7A	10-12	0
A-7E	9	1
A-7D	9	2
S-3A	14	10
F-14A	20	16
F-5E	9	8
F-15	19-20	7-8

The record of the number of assets returned to some degree of service use varied from 0% to 88% throughout the range in the tabulation presented. If the early 1970's can be considered the benchmark for both the new testing policies and the truly expensive aircraft, the record of returned assets as a result of foresighted planning is only fair.

Potential Uses of Recovered Assets

To bolster the recommendation of managerial responsibility in full utilization of expensive test assets, examination of some of the uses, both limited and full-systems, which can be derived from reconfigured aircraft is required. The most optimistic and expensive, and therefore probably the least achievable is complete configuration compatibility with production aircraft or with a specific block of production aircraft. The potential uses are unlimited and the total production buy required is thus reduced one-for-one for each aircraft so restored, producing savings both in recovery of heretofore "sunken" costs of RDT&E assets and reduced production procurement costs. A more realistic configuration which derives operational benefit to the Service is restoration to a condition which might be defined as "For Training Purposes Only." Typical of limited utilization assets might be an aircraft which evolved from the test community without a weapons system. In the Navy, such an asset could be useful for pilot familiarization training, carrier landing practice, and chase purposes. On the other

hand, an aircraft with a full weapons system, but non-standard flight controls or assessories would be useful for Naval flight officer training and/or chase purposes. The desirability of this type of limited asset in a stable of training squadron aircraft is a function of the degree of dissimilarity. There is a not-too-clearly defined point at which dissimilarity becomes dysfunctional for the training unit - it becomes more work to support than it is worth. Nevertheless, the potential savings in restoring an aircraft to even a limited training status again recovers some of the "sunk" investment costs and releases one more full-systems aircraft into the operational inventory, accruing savings and economies on both ends of the procurement process.

A potential use of a limited capability aircraft which would fulfil an ongoing Service need and potentially reduce operational requirements thereby exists in continuing test and evaluation. In the Naval Air Systems Command, a flag rank officer heads a division dedicated to test and evaluation. Although fine-line distinctions can be drawn about the de facto and dejure administrative and managerial controls over test aircraft between the T&E division and the PM during the full-scale development and production phases, ultimately total control of the test aircraft will shift to the T&E division. (For example, although T&E has had dejure administrative

control over all F-14 T&E aircraft since the first day of testing, T&E division personnel stated in interviews that even today, nearly four years after first flight, they would not assign an F-14 to another Navy project not specifically F-14 related without the approval of the PM nor would they expect such approval to be forthcoming from the PM for non-F-14 project utilization - defacto managerial control is simply not yet theirs.) Once total control of the particular asset is given to T&E, the aircraft can be utilized as a test bed for any designated project. Radar, avionics, flight controls, ordnance carriage, advanced development testing - any number of uses can be conjured up as an aircraft can be configured and reconfigured to play useful test bed roles. The prime requirement in the reconfiguration of such an aircraft is to achieve commonality in major engine and airframe components such that even as a shell airplane, it can be supported through the normal supply channels. The desirability of such a testbed is predicated on two factors; economy of operation, and flexibility in potential uses. An example of such an aircraft is the F-4, twenty-seven of which presently exist in the T&E inventory although the aircraft is out of production in the Navy and no longer has a PM in charge. It can serve in the fighter or attack roles, is twin-engined, and is proven reliable and maintainable.

Once such an aircraft is totally turned over to T&E control it is supported by money from the R&D major force program and its service equivalent for its operations and maintenance (O&M) costs, whereas fleet aircraft O&M funding comes from general purpose and operational forces. This impacts the program manager in several ways. First, he should be prescient enough to recognize that today's new airplane will be the test bed for tomorrow's projects. Sources for those future test bed aircraft exist solely in the projects T&E aircraft inventory or in part of the production run. Political and managerial factors such as overruns or reduced funding can further reduce the planned buy and increase the operational value of production aircraft. Prolonged armed conflicts with attendent attrition of forces can strip any program of anticipated test beds. (For example, during the early 1970's, Navy T&E agencies were left with a total of about 4-5 F-4's with which to conduct all fighter testing programs.) The PM should take steps to ensure that as many airplanes as possible are reconfigured and he must then track their location and current use along with T&E coordinators. Although this sounds simple enough, an example of the type of problem is evident in the handling of ECP's. Although the PM tracks and approves all engineering change proposals (ECP's) the ECP for the test aircraft may require a special ECP (SECP) to overcome slight configuration dissimilarities from the

production aircraft. The extra funds for the SECP are probably not programmed in the PMO budgeting nor may there be sufficient funds in the T&E R&D funding to support such a change. Even larger difficulties exist in the major rework of the test airplanes. Major overhauls are planned and funded within the O&M budget of the operational forces. The overhaul depots are set-up and scheduled to accomplish overhaul of production aircraft. The problem which may arise is that the first aircraft (probably) to reach sufficient hours to require a major overhaul will be a test airplane. It will also probably be unfunded, unscheduled, non-standard, and generally unwanted. It is doubtful that even if T&E could get the rework approved and scheduled, it could afford by itself such an unscheduled expense from its own funding.

Studies of Past Programs

T-38A

In the T-38 development program, which began in 1956 with contract award, two YT-38 aircraft and six production aircraft were specified for Northrop and Air Force testing. The YT-38's were equipped with non-afterburning engines and were limited to subsonic testing. After the production aircraft started flying, the YT-38's saw limited action except for a very extensive and highly successful spin program. After the development tests were completed, the two YT-38's, which were aerodynamically identical to the production aircraft, were used for display purposes and USAF recruitment programs, finally ending up in

museums. Two instrumented T-38A aircraft were transferred to the USAF test pilots school and are still active in daily use. All the remaining aircraft were restored and delivered as fully representative production aircraft and are still in service use, however, several T-38's that had reached their structural life had been recently transferred for conversion to drones, and it is possible that the first aircraft may have been included.

N-156F, The F-5 Prototypes

In the same time frame, Northrop was awarded a contract to develop the N-156F which was a lightweight low cost fighter designed around the basic T-38 airframe and propulsion system. Three N-156F test aircraft were constructed and two of them were in flight status when the program was terminated by the USAF. The program was later reactivated and the airplane designated the F-5A. The airframe was essentially the same as the N-156F, armament and avionics were different, and a more powerful J85-13 engine was utilized. The three N-156F test aircraft were used extensively in the F-5A and F-5B test programs, the F-5B being a two-place trainer fighter with the same equipment except the 20mm cannon was deleted. Two of the N-156F aircraft were modified to be representative of the F-5A in certain areas and accomplished significant elements of a very extensive development program. Plans were made from the beginning to remove all common T-38A and F-5A components from the prototypes and to

use them as spare parts at the completion of the test program. The third N-156F was used very successfully as a functional mock-up for production and cockpit mock-up for equipment location and lighting evaluations. This same aircraft has been used as a mock-up for the Norwegian F-5, the Canadian F-5, the Netherlands NF-5, and is still being used today in various versions of the F-5E that are being sold.

F-5A

There is one F-5A still in test status that has been retained to clear new weapons as required and to solve field problems when they come up. A new version of the AIM-9 missile will soon be cleared by this aircraft. In addition to its use as an F-5A test aircraft, it was used on two separate occasions as a radar test bed. Funds were provided in each case to restore the aircraft back to its original test configuration. Cost estimates were made to restore the aircraft to be fully representative of the F-5A and to deliver it to a user country. The estimate came out slightly less than 10,000 manhours, after 12 years as a test airplane. In addition, during this period NASA conducted two research programs using the aircraft and the USAF conducted several. One very interesting program was to measure the structural flight loads during simulated air combat maneuvers against similar and dissimilar aircraft. The flight loads data surprised many people as to the frequency, abruptness, and magnitude of the loads. These data were used in defining

the F-5E fatigue loads spectrum and also will be used in the F-18 Cobra structural design.

F-5E and F-5F

Two test bed aircraft were used, one to develop the radar and the other, an F-5B, was used to develop the J85-21 engine. The radar test bed, the F-5A, will be restored to a fully tactical configuration. The F-5B engine test bed is in storage and is not economical to restore. This aircraft will make an excellent chase aircraft. All other F-5E test aircraft either have or will be restored and delivered. Two of the test aircraft will remain in test status at least through the production program, probably in 1981 or later. In addition to the basic F-5E program, numerous other programs have been conducted for additional equipment, armament, and improvements. One of these programs added a great deal of avionic capabilities, plus in-flight refueling capability, and a broad external store matrix. This follow-on program was larger than the basic F-5E program. The F-5F is the latest in the F-5 series of aircraft to be developed. Both of the F-5F fighter trainer test aircraft will be restored and delivered to Williams AFB for use in FMS pilot training programs. Funds to restore the aircraft were provided in the original contract.

A-9 Prototypes

The two YA-9 prototypes were delivered to NASA Flight

Research Center, Edwards AFB. They are currently in storage. The cost of overhauling the one-of-a-kind engines is very high and may prevent the use of the aircraft for any extensive research.

F-17 Validation Prototypes

Two YF-17 prototypes were built in the competitive validation testing for the Air Force/Navy lightweight combat fighters. The F-18 emerged as the Navy version of the YF-17 variant of the lightweight fighter built to replace the F-4 and A-7 aircraft. The F-18L Cobra, a land based version of the F-18A will soon follow. These aircraft were all derived from the YF-17 prototype design. Extensive use of the prototypes was considered and proposed in the F-18 program, but has been dropped out due to front-end loading of funding problems. Both aircraft have been leased to Northrop. One NASA Flight Agility research program was recently completed, some design data for the F-18 was obtained at the same time. A very successful demonstration program was just completed at Farnborough England and at NATC Patuxent River Maryland. The present plan is to overhaul two engines and continue updating the aircraft systems, getting the aircraft in flight ready status for marketing purposes and any developmental data requirements which may arise. McDonnell-Douglas test pilots will probably be provided familiarization flights in the Northrop aircraft. In addition, a vectored

thrust nozzle research program is being considered. The YF-17's will be around for some time to come.

S-3A

Of the current day "big" programs, the S-3A program appears to have the best record of returning test assets to continued service use. Of fourteen aircraft used during DT/OT&E and BIS trials, four were fully configured and returned to unlimited operational usage. Four were designated as "For Training Only Aircraft" (FTOA) and returned to restricted use. Of the others: one was dedicated to static structural testing until failure; one was dedicated to destructive accelerated testing through three service lives; one was stricken from the the Navy rolls after flying qualities and performance tests, carrier suitability tests, BIS trials, and barricade engagement testing; the fourth of the "spent" aircraft crashed during testing - a nonprogrammed loss to the project. Of the two remaining aircraft, one was bailed to the contractor for continued development work and the other is presently part of the T&E inventory used for follow-on testing. Even including the unfortunate loss of one aircraft during the test phase, 71% (10 of 14) of aircraft used in testing were returned for continued service use. It is doubtful that any major program could be completed with fewer aircraft sacrificed to programs needs requiring destructive testing. The planning and foresight which produced such remarkable results is evident in a Master Schedule dated December 1973 which

delineated specific disposition of the test aircraft as was ultimately carried out. The program conducted extensive weapons system testing in a test bed P-3 Orion Patrol Airplane in advance of the building of the S-3 platform. Because the S-3 was not designed for high tactical performance (i.e. normal accelerations, transonic speeds etc.), it may have required less extensive airframe and/or engine testing. Nevertheless, the record indicates foresight and follow-through on the part of the PM. The resulting conservation of assets speaks for itself.

F-14A

The F-14A program represents a most interesting case in the recovery of assets because of innovation and resourcefulness on the part of the PMO once the problem was perceived. In the interests of freeing-up later produced aircraft for squadron use and deployment without reducing the F-14 aircraft available for training purposes, the F-14 PMO was directed to review the possibility of reconfiguring some of the F-14 aircraft assigned to testing and demonstration to a carrier-based, combat-capable configuration for use in a training squadron or deployment if necessary. Although the PMO's directions were to review the program, the purpose of the review was to fill a real need which then existed to free-up production aircraft.

Under the "Trials and Acceptance" clauses of the F-14

contract, the government had the right to direct the contractor to reconfigure the test aircraft, at his plant, to such a configuration subject to an equitable increase in the contract price for removal of instrumentation and incorporation of changes not previously required with respect to such aircraft. Sufficient funds were not available at the time of the request (Spring 1975) to cover the expected increase in contract price and such funds could only be obtained in October 1976 through inclusion in the FY-77 budget. On the other hand, the contract terms also entitled the government to a reduction in contract price where the government elected not to have aircraft defects or deficiencies corrected. With respect to the F-14 aircraft delivered under contract, there were a number of deficiencies falling into this category. Accordingly, the government had withheld disbursement of certain funds for each aircraft thus delivered (for the eleven test aircraft involved alone, the withholds totaled approximately $250,000 in themselves). The PM initiated a review of the planned disposition of T&E aircraft as well as those outstanding uncorrected deficiencies with the view of determining whether the equitable contract price reduction for such deficiencies, if obtained, would provide the funds sufficient for the equitable increase in contract price in the event the reconfiguration of the T&E aircraft was so directed.

The question of trading contract rights for value had been under review and discussion for over a year without an agreement. The revision of contract requirements in return for reconfiguration of aircraft was finally concluded to be an appropriate means of meeting requirements within funds available. This quid pro quo contract revision was thus negotiated involving a zero dollar exchange between parties of contract rights for hardware modifications valued roughly in excess of $10,000,000. The counterclaims on the part of the contractor involved dispute of reduced contract price, and the requirement to update the test aircraft. Additionally, the contractor requested release of the withholds for the work previously performed. The contractor also had a facility in operation on the West Coast solely involved in incorporating updated configuration changes into early production aircraft, in addition to its main production facility on the East Coast. It was the desire of the contractor to continue operation of the West Coast site although it was clear that requirements for updating production aircraft was terminating. From the diverse elements involved, an agreement was reached.

The Amendment of Solicitation/Modification of Contract which resulted became known as "Trade Fair." The program incorporated changes in eleven F-14 RDT&E aircraft which will result in the modernization of five aircraft for continued

development work and provide six aircraft to the fleet in a deployable, combat-capable configuration. Advantages to the Navy were seen as:

1. Gains six additional fleet combat capable aircraft assets.

2. Modernization of five RDT&E aircraft.

3. Improved fleet readiness resulting from increased training assets.

4. Makes available for Navy use today previously budgeted/allocated funds which would otherwise lie in escrow until contract settlement and probably revert to the General Treasury fund.

5. Avoids legal conflicts which could not contribute to fleet readiness regardless of outcome, and which have been traditionally resolved in favor of the contractor after protracted high level government involvement.

6. Settlement today via TRADE FAIR results in an increase of $10.3M worth of buying power for the F14 program now, rather than receiving possible depreciated future dollars in later years.

7. Retains U.S. Navy direction and control over contractor obligations regarding newly revised specifications which result from TRADE FAIR.

8. Assures productive use of modernized flight test assets beyond the test and evaluation phase in support of fleet and operational readiness requirements.

9. Provides resolution of performance specification problems.

10. Avoids long term inflationary costs and losses in fleet readiness which would result if an effort of this type were undertaken through Scheduled Depot Level Maintenance (SDLM) or overhaul.

11. Makes available SDLM slots for other aircraft programs.

Advantages to the contractor were seen as:

1. Improves current cash flow.
2. Eliminates withholdings.
3. Removes the requirement to perform to the more stringent original specification, some parts of which are beyond the state of the art and/or time-consuming and highly expensive
4. Re-defines the specification in terms of actual aircraft performance rather than unattainable goals.
5. Avoids future costly and time-consuming legal expenses at the time of contract settlement.
6. Guarantees that price reductions will not be imposed for future disputed withholdings for Lots I and II.
7. Assures continued employment and continuity in levels of expertise, with related effects on supportability, productivity, and engineering support.
8. Reduces extent of contractor's necessity to borrow funds (at interest) to meet current cash flow/payroll requirements.
9. Resolves a potentially thorny contractor/government source of irritation.
10. Early settlement enhances contractor image and promotes foreign and domestic sales potential.

The ensuing modifications to the test aircraft will enable the contractor to continue operation of its West Coast site until the Fall of 1977. An interesting company-related view of the transaction appeared as part of an article in an F-14 newsmagazine published by the contractor public relations. "The assignment of the TRADE FAIR/Up(date) III program to (the West Coast site) is evidence of the Navy's recognition of

the proven capability of that team to produce a quality product on schedule and within austere budget limitations."

SUMMARY

Conclusions

Although this review and analysis of options available for the continued use of test aircraft beyond the early testing stage is not all inclusive, several features stand out as worthy of consideration.

From the information obtained, the utilization and disposition of test aircraft appears to be a subject which presents itself as entirely manageable by foresighted planning and disciplined follow-through on program prosecution. The potential pay-offs can be considerable. The F-14 case represents an example where a $10,000,000 investment returned approximately $100,000,000 in assets to continued use. Typical of problems facing the PM when planning the program are testing uncertainties. Clarity as to the termination date of required testing does not exist from the outset nor does explicit requirements for follow-on testing. Nevertheless, some need for reconfiguration must be anticipated and planned for.

Similarly, early reconfiguration costs cannot accurately be established with real credibility because of possible factors such as specification violation and subsequent waiver of requirements etc. Additionally, the scope of the reconfiguration

program cannot be certainly perceived. However, it should be incumbent upon every PM to provide for probable reconfiguration of assets. In the S-3 program, the early planning paid-off with an admirable restoration record. The F-14 contract appeared to consider the possibility, yet when execution was required, the PMO did not have the means to accomplish the reconfiguration without innovative contract negotiations. Relatively simple expedients demonstrating foresight can be conducted between the PMO and the contractor at an early stage. For example, according to its management, it is Northrop's policy to design modifications to test aircraft such that it is economical to restore the aircraft to its original status. In many cases, the engineering analysis and drawings are completed for the demodification at the same time as the modification drawings are completed. The record of restoration of aircraft on programs involving Northrop aircraft is remarkable. Extensive use of test bed aircraft from the existing T&E inventory for weapons system development has accelerated system development and may reduce dedicated test aircraft requirements from the program itself. Costs of such utilization of testbed aircraft from the T&E inventory may be considerably less expensive and may be shared with the R&D force program funding.

The biggest factor and perhaps the major real-world constraint of perfect management of T&E assets is probably costs.

Just as utilization of the YF-17 prototypes in the F-18 full-scale development program was ruled out due to front-end loading funding problems, it is probable that other programs could not afford the design alternatives (designing out instrumentation as it is being installed) suggested earlier. The result may be evidenced in the 12 non-recoverable F-15's reportedly sitting in storage. Yet the record shows that utilization of prototypes as in the case of the N-156F and design foresight can conserve valuable assets.

Program priorities and capability to follow through may preclude execution of even the best of plans. It is alleged that one of the goals of the F-15 program was to completely test the aircraft to an extent never done on an aircraft program before, to avoid apparent pitfalls caused by insufficient testing encountered by other programs, viewed retrospectively. The price to pursue such a philosophy has been quoted earlier, however it is not entirely clear that the product of the extensive testing is markedly "de-bugged" from other comparative programs to justify the considerable cost. The capability of the F-14 PM to follow-through on the reconfiguration intentions expressed in the contract was affected by an acceleration of events beyond his control including inflation of costs and a resulting reduction in total aircraft buy, untimely loss of several aircraft at an early stage of operational deployment accentuating

the need to call upon test assets, an acceleration and expansion of deployment schedules and plans possibly requiring faster utilization of programmed funds, total consumption of any management reserve which could be applied toward resolution of the reconfiguration problem as a result of the preceding factors, and finally all PM operations in the spotlight of intense national scrutiny directed on all financial matters affecting the program.

The final conclusion which can be drawn is that the present handling of reconfiguration costs and priorities is probably a natural result of economic realities. Many of the costs are front-loaded, as mentioned. As the program procedes into production and inevitable inflation and resolution of problems anticipated but unidentified (unknown-unknowns) erodes program reserves, the program will probably be strapped for any and all extra allocations which it can obtain. Regardless of the needs and practicalities of the test program, the most economic application of extra funds perceived by PM's and program sponsors is probably in forward directed programs such as production improvements or increased buys rather than in the reconfiguration of early test articles with less clearly tangible program benefits. Only the best of plans, the most disciplined, and probably the most tenacious (in defense of overall program needs) PM can succeed in the environment of such a situation.

Summary

Department of Defense test and evaluation policies of this decade have required an increase of assets required to conduct the testing of new aircraft acquisitions. Coupled with inflation of costs and the increased complexity of today's aircraft, the total investment of costs to the nation and the program for testing purposes only are becoming increasingly larger and more significant. Good management practice on the part of the Services and the program manager requires conservation and economy of these expensive assets to the maximum extent possible, including extensive utilization beyond early test and evaluation requirements. Based on a brief review of several past programs, several uses for the reconfigured test aircraft are evident. Successful reclamation and also loss of assets are apparent in many recent cases. Factors affecting the PM in consideration of reconfiguration are diverse and include relatively simplistic approaches to instrumentation design and test bed utilization. Success or failure to recover test assets is probably a direct function of the perception of the need and the resolution of cost priorities which may include both the PM and higher authority.

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