5

DEPARTMENT OF THE AIR FORCE

Introduction

This chapter provides a top-level view of how the Air Force initiated, defends and manages modifications and upgrades. It starts by briefly describing the current operating environment and defining some of the frequently used "modification process" terminology. Next, it highlights the key processes involved in starting a modification program; those of requirements generation, resource allocation, and modernization planning. It concludes with a summary of some on-going activities and efforts in the modification community that target improving Air Force business practices.

Environment

To paraphrase a Yogi Berra style witticism, The Air Force environment; it is the same only different from DoD and the other components. It is the same in that, like the DoD and the other components, the Air Force is always searching for a better way to do business, to get more "bang" for the buck. The Air Force recognizes the need to be more effective and efficient with its dwindling resources. Since acquisition personnel are often criticized for poor management and/or waste, acquisition practices are prime targets for reform. Major acquisition reform initiatives in the Air Force focus on producing quality weapon systems more quickly with lower cost. Assistant Secretary of the Air Force (Acquisition), the late Clark Fiester reinforced these points in his briefing to all Air Force acquisition professionals:

- Adopt world class business practices
- Increase the use of commercial state-of-the-art technology
- Integrate commercial and military industrial bases
- Greater use of performance and commercial specifications and standards
- Bottom line—equal or improve combat effectiveness at reduced cost and cycle time.[1]

These challenges are quickly emerging as imperatives vice platitudes because relatively fewer resources are now channeled into modernization than at any time in the recent past. Quoting Norman Augustine, former Chief Executive Office (CEO) of Martin Marietta, "...I calculated recently that we are now on a replacement cycle of

about 54 years, meaning that the average item of equipment provided the Armed Forces has to last 54 years ... in a world where technology has a half-life of from 2 to 10 years...."[2] With no real resources growth projected for new equipment, DoD must strongly emphasize service life extension and improving the capabilities of existing equipment. During the interviews with senior leaders, they speculated that modifications and/or upgrades will be a mainstay of acquisition activities well into the future. The Air Force is like its sister components in its need to cut overhead, facilities and support costs. How does one reduce the cost of owning systems while retaining the ability to carry out a national defense strategy that emphasizes equipping the forces with the most technologically advanced weapon systems in the world? Preserving a strategy based on having the best weapons systems, while DoD budgets decrease by 33 percent and procurement decreases by about 65 percent,[3] forces the Services to optimize every aspect of its operations. Today, sustaining the O&S for major aircraft weapon systems alone requires 25 percent of the Air Force TOA.[4] If the Air Force achieved a 10 percent annual reduction in the O&S costs from just these mainstay systems, it would free up enough resources to double the entire Air Force modification and upgrade budget: an increasingly important avenue for introducing new technology.

Air Force Definitions

Interestingly, the Air Force does not use the same terminology as DoD or other components concerning modifications and upgrades. Air Force personnel do not differentiate in speaking or action between modifications and upgrades. When asked why, most personnel that work with modifications confess they see no value in the distinction. This is probably because the documents used to request funding and notify OSD and Congress of planned modifications and upgrades do not distinguish between the two. Consequently, throughout this chapter, the term modification refers to both "modifications and upgrades." An Air Force definition for modifications is: **Modifications** are changes made to a system, equipment or material (including imbedded software) with the intent of enhancing, improving, changing or adding to the capability or performance of the system, equipment or material being modified. Modifications change the fit or function of a configured item. Modifications are accomplished to fielded systems and are, at least in part, funded with modification procurement appropriations.[5] This definition does not match the DoDI 5000.2 definitions for either modifications or upgrades because it defines changes to "fielded systems" not changes to systems that are in or out of production. Also, this definition does not apply to major modifications programs on the Major Defense Acquisition Programs list. For major modifications use the DoDI 5000.2 definitions in chapter two.

Sustainment Activities

Also, it is important to point out that modifications should not be confused with sustainment actions. In the Air Force, sustainment activities are done to maintain specified or required operational capabilities of the weapon system, equipment, material or product. Sustainment actions are not directed or managed by unique program documentation, rather they are undertaken as part of the overall mission of the Single Manager (SM) to meet the system's required Reliability, Availability and Maintainability (RAM) parameters. Also, while sustainment actions are not intended as a means to improve or enhance operational

capability, this can, and does, occur as a by-product of new production methods, equipment, technology and processes.[6] In some instances when the expected cost and risk are high, sustainment actions can be handled as an acquisition, i.e., managed by its own acquisition documentation.

Modification Types and Classes

In the last couple of years, the Air Force reduced the number of distinct classes of modifications. Previously, there were five classes, now with two classes the major commands (MAJCOMs) job of prioritizing is simplified, speeding progress in the needed modifications. Now, there are two classes: temporary and permanent.

Temporary Modifications

Temporary modifications are used as an interim correction of an operational deficiency, to support or accomplish a special mission, or test proposed changes to a system. Temporary modifications are supposed to be short-lived and accomplished on a limited number of assets; therefore they are not treated as acquisitions. They are:

- Only done on sufficient systems to adequately complete the special mission or test;

- Primarily use existing commercial off-the-shelf or stock listed systems, equipment, spares or material to accomplish the modification;

- Typically accomplished at the unit requesting the change with 3400 Operations & Support Funding (for special missions) and 3600 Research & Development Funding (for testing);

- Not funded with the "modification" procurement appropriations; and

- Removed within 12 months of installation or upon completion of testing or mission accomplishment.

Permanent Modifications

Permanent modifications are used to meet updated operational requirements, correct unsafe conditions or upgrade the sustainability of a system. They are also used to accomplish retrofits to fielded systems previously produced before the approved change was incorporated. The majority of modification resources are spent on permanent modifications. Permanent modifications for safety have a separate set of guidelines for the processing, coordinating, funding and documenting. This is because safety modifications have priority and precedence over all other permanent modifications. Permanent modifications are:

- Done to enhance or improve performance or add a capability;

- Accomplished on finite blocks or series of the system, equipment or material;

- Funded at least in part with modification procurement appropriations; and

- Accomplished by depot maintenance, depot field teams, contractor maintenance, contractor field teams or the gaining unit.

Air Force Organization

The Air Force splits the oversight and management of modification and upgrade programs into two parts. Policy and oversight management for the piece of acquisition concerned with research, development and

procurement reside with the Assistant Secretary of the Air Force for Acquisition (ASAF/AQ) and the support piece resides with the Headquarters Air Force, Deputy Chief of Staff for Logistics (HQ USAF/LG). Air Force policy and oversight flows from these two sources depending on the funding source and whether or not the change is being made for support. The good news is that both groups traditionally coordinate polices and actions with each other.

One level down, the Air Force Materiel Command (AFMC) personnel control the day-to-day execution of most modifications. In 1990, the Air Force merged the Air Force Logistics Command and the Air Force Systems Command into a unified AFMC. The primary goals in this merger were to reduce staff (overhead), cut excess infrastructure (overhead) and change to an Integrated Weapon System Management (IWSM) style of management. An IWSM is defined as, "...a management philosophy for acquiring, evolving and sustaining our products. It empowers a single manager with the authority over the widest range of decisions and resources to satisfy customer requirements throughout the life cycle of the product...."[7]

This restructuring put a premium on knocking down the walls existing between the system developers and the maintainers. In the past, when the developer was "done producing a weapon system," one would transfer management responsibility for the system to the maintainer. This program management responsibility transfer (PMRT) was often a very contentious event or period. Maintainers complained about supportability problems, and the developers complained that supportability problems lacked documentation early or well enough to fix before PMRT. Now, when a system is fielded, the team that managed its production remains fully responsible for its support. The IWSM organization operates with critical processes integrated across the product life cycle. The goal is to have no process seams between organizations, locations and program phases.[8] The core processes are: product management, requirements, systems engineering/configuration management, financial management, contracting, technology master process, logistics, and test and evaluation.[9] This cross-functional interdisciplinary approach to weapon systems management brought with it a need for uniform policies and procedures. Now, one set of policies and procedures applies to the product centers (development), logistics centers (support) and research labs staff. Thus, today most modifications and upgrades are treated just like development programs and use the same management documents and approval processes as non modification acquisition programs.

Another important change required for IWSM, was a shift to an integrated product focused team management philosophy. Consequently, AFMC reorganized around integrated product teams (IPTs). By definition, any modification will have a domino effect: modifications require funds; most possibly new or modified support equipment; spares; software; personnel; etc. Therefore, the modifications' success generally depends on the inputs and participation of many organizations and people including commercial industry. To provide seamless management of a system from Milestone 0 to its eventual disposal, the IPT is headed by a SM who has the day-to-day management responsibility and authority for a given product. The SM could be any one of the following people:

- **System Program Director (SPD)**. The individual responsible and accountable for

decisions and resources in overall program execution of a military system, ...charged with all the cost, schedule, performance and sustainment aspects of a directed program. The SPD's primary customer is the using command.

- **Product Group Manager (PGM).** The individual responsible and accountable for decisions and resources in overall product group management ...charged with all the cost, schedule, performance aspect of a product group and related sustainment activities. The PGM's product is in direct support of one or more SPDs.

- **Materiel Group Manager (MGM).** The individual responsible and accountable for decisions and resources in overall materiel group management ...charged with all the cost, schedule and performance aspect of a materiel group. The MGM's primary customers for daily sustainment products, services and new equipment acquisitions are the using MAJCOMs. However, the MGM's customers for integration of new development and technology transition are the SPDs & PGMs.[10]

This organizational structure provides reasonably clear accountability for most defense products. In the case where a product, such as a subsystem or subassembly of a system, is used in multiple systems, then a consignment agreement between the SPD and the PGM/MGM documents management and support responsibilities. The SM is directed to form a mod-IPT with the appropriate cross-functional representation necessary to plan and execute the proposed modification.[11] The mod-IPT participants develop plans to satisfy each deficiency and recommend technology investments to support these modifications, upgrades and new developments.[12] Formation of mod-IPTs usually occurs upon receipt of a valid need or requirement. However, often mod-IPTs are convened earlier to provide the user with preliminary cost, schedule, performance and risk assessments. The IWSM approach gives the user a single point of contact, the SM, for all issues concerning a specific weapon system's life cycle management.

Air Force Resource Allocation Process

The Air Force resource allocation process links directly to its parent DoD process, PPBS, as DoD Directive 7045.14 describes. At each phase in the DoD process, the Air Force submits it's input to the OSD for review (see Figure 5-1). While this is not new, the undergirding philosophy the Air Force uses to prepare its input is changing. Air Force Instruction (AFI) 16-501, Control and Documentation of Air Force Programs, contains a description of this process. An amended AFI 16-501 is in draft, which includes additional corporate level reviews to ensure, "Air Force at-large interests are considered on key issues."[13] The primary goal of the Air Force PPBS process is to achieve the defense objectives established by the President and SECDEF in the DPG.[14] The POM develops and presents the Air Force's adaptations to program specific changes in investment strategy. The POM represents the balanced, total Air Force program recommendations within the OSD guidance limitations and directions contained within the DPG.[15] While the PPBS process affects all Defense related appropriations, the focus of this chapter is to concentrate on the investment piece, called modernization.

Air Force Modernization Planning Process

In October 1994, the Air Force adopted a new modernization planning process. It is an analytically based process that ties the

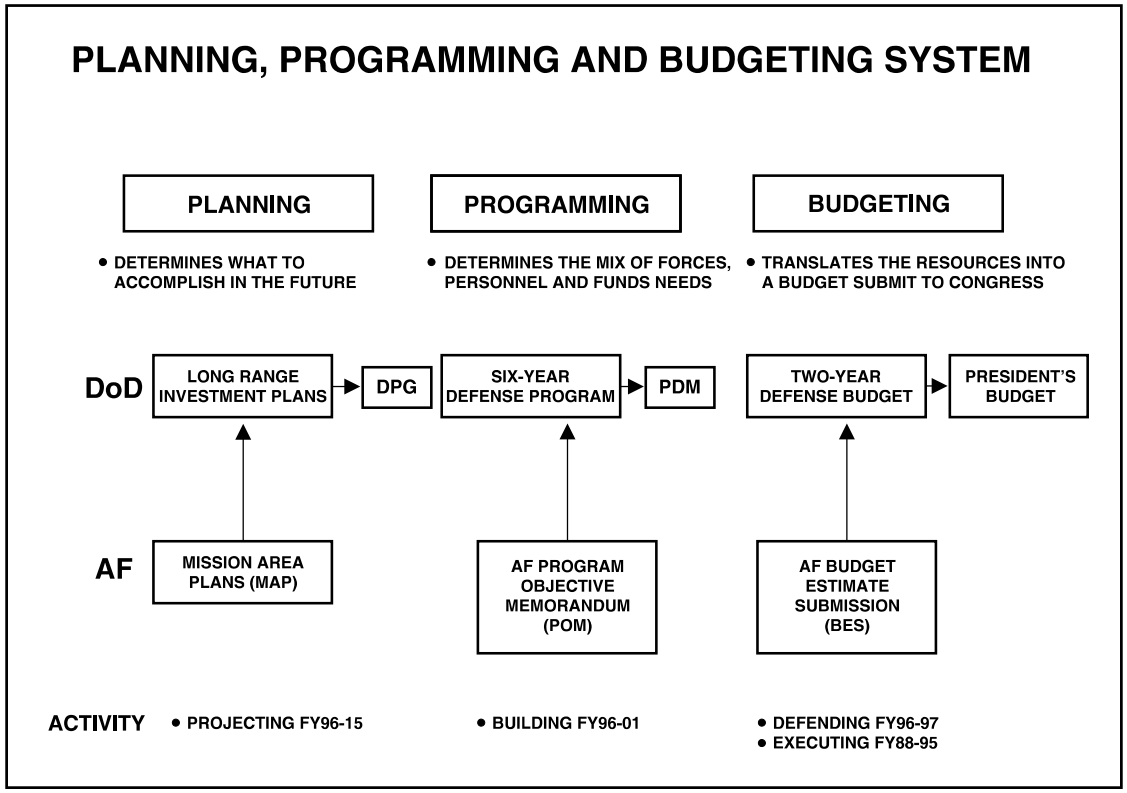

Figure 5-1. Planning, Programming and Budget System

operating commands (users) directly to the developers, maintainers and technologists.[16] The process looks up to 25-years into the future. This long-range planning model is necessary because in the past the Air Forces' planning never adequately addressed future needs beyond the next ten-years: a time frame shorter than the traditional time investment to develop many of its weapon systems.

There are three primary products from this Air Force Modernization Planning process: the Mission Area Plan (MAP), the Development Plan (DP) and the Technology Investment Recommendation Report (TIRR). These products are foundational guides for changing doctrine, tactics, procedures and investing scarce dollars. They guide force modernization by linking critical technologies to mission areas, acquiring new and modified systems, directing national and Air Force laboratory efforts(laboratory technology research), and focusing independent research and development (industry basic research).[17]

Mission Area Assessment (MAA)

The first phase of the process is the MAA. In this phase, National Goals, National Security Strategy and NMS are translated into a list of operational objectives and tasks necessary to achieve those goals and strategies. This phase, like all the phases, is complicated by the fact that both national goals and strategies change. Ideally, by developing alternative futures, i.e., best or worst case (and degrees of each along that spectrum); conducting thorough modeling and simula-

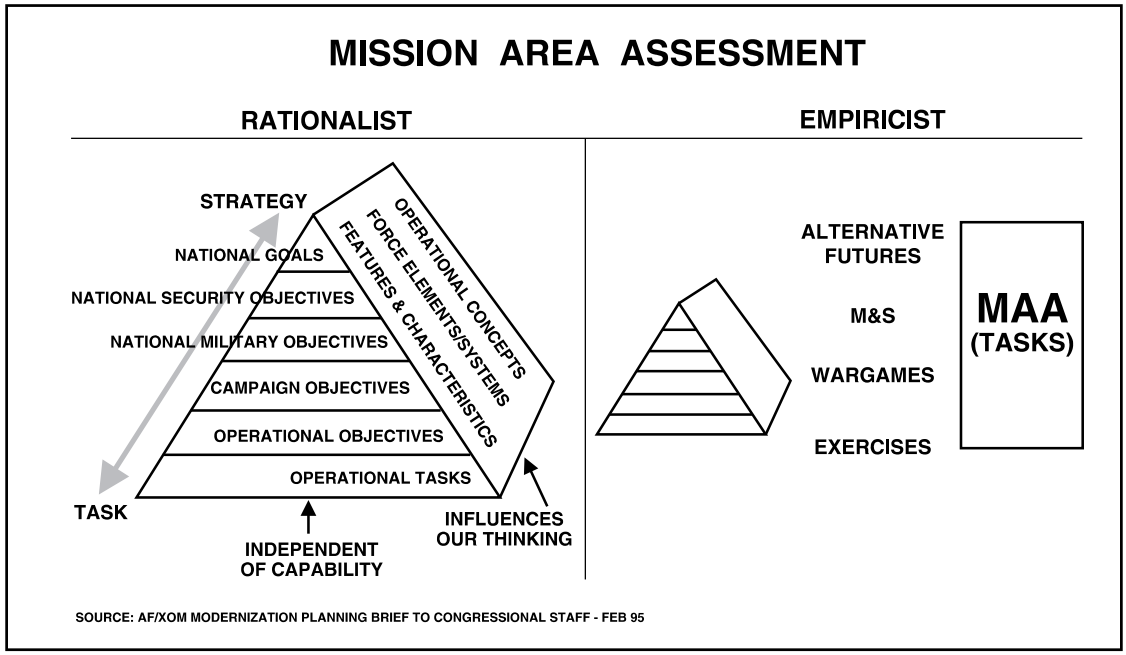

Figure 5-2. Mission Area Assessment

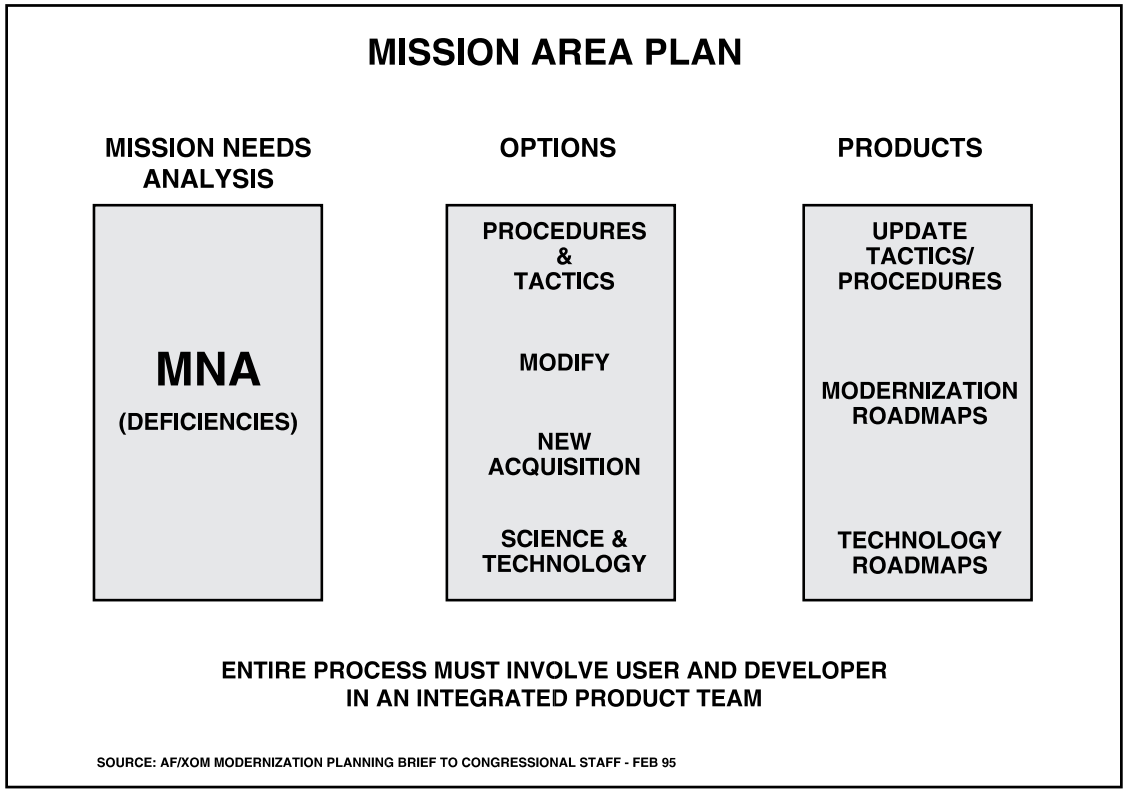

Figure 5-3. Mission Area Plan

tion, wargames or exercises, most likely MAA tasks can be identified.

Mission Need Analysis (MNA)

Deficiencies in the Air Forces' ability to meet the tasks necessary to achieve National Security objectives show up as the product of the second phase called MNA. The MAA and MNA processes provide the users tools to continuously evaluate current and programmed capabilities in the context of changing threats, policy or guidance, military strategy and assigned missions to identify deficiencies.[18] One or more of the Air Forces' thirty-six MAPs categorizes the output of this effort (deficiencies).

MAPs

The Air Force mission areas for the most part are simply a subdivision of the nine JWCA areas. The MAPs provide the overall modernization strategy for a given mission area and specifically address all the deficiencies that can not be met by non-material means.[19] The priority of any given MAP deficiency is based on the concept of "best perceived value." For example, Air Combat Command uses a Quality Functional Deployment model to rate the importance of correcting MAP deficiencies. It charts the cost to fix deficiencies against the estimated increase in combat capability fixing the deficiency provides. In a simplified sense, those deficiencies whose correction provides the most capability for the investment get the highest priority.

DPs

Each DP documents the best concepts or solutions to satisfy the MAP deficiencies. The DP contains a review of the candidate technologies for proposed concepts or solutions and identifies the relative priority of technology needs where the technology is not fully developed. Ideally, the DPs identify concepts or solutions in near-term (POM years), mid-term (post POM to 15 years) and far-term (16-25 years).[20] When the MAPs and DPs are integrated, prioritized and fiscally constrained, the science and technology community, with industry's participation, build the TIRR.

TIRR

The TIRR provides an analysis of technology needs across all mission areas and DPs.[21] It tries to identify the optimum technology investment plan by identifying the high payoff areas that link to the MAPs' prioritized deficiencies. These linked and prioritized deficiencies (requirements) will then show up as newly generated MNSs or ORDs and are the key bridge between planning and requirements.

MNSs and ORDs

Lead commands for the respective mission area prepares MNSs and ORDs and forwards them to HQ USAF for coordination and approval. Headquarters Air Force, Deputy Chief of Staff for Operations personnel staff the MNS or ORDs to the cognizant air staff organizations and to the appropriate Mission Area Director (MAD), who works for the ASAF/AQ. The next step, recently added, is to send these MNSs and ORDs to the Air Force Requirements Oversight Council (AFROC).

AFROC

The AFROC is a board made up of the principal senior officers from each functional area. This board performs the final review of MNSs and ORDs before they are sent to

the Air Force Chief of Staff for approval. Some of the AFROC responsibilities include:

- Oversee the mission need determination and requirements process;
- Develop a corporate position on operational requirements;
- Ensure clear articulation of needs or requirements;
- Review the priority and funding of programs;
- Resolve cross-service issues for joint requirements; and
- Review all warfighting deficiencies that may evolve into acquisition programs and validate that such deficiencies cannot be satisfied by other than materiel solutions.[22]

Modernization Planning Process Summary

Modernization starts with identifying deficiencies. Options for meeting these deficiencies include changing procedures and tactics, modifying existing equipment, new acquisition and/or investments in science and technology.[23] The products of the planning process are tactics or procedures update, modernization roadmaps and technology roadmaps. Throughout each phase, integrated teams composed of users, developers, maintainers, labs and industry provide the expertise and knowledge for the analy-

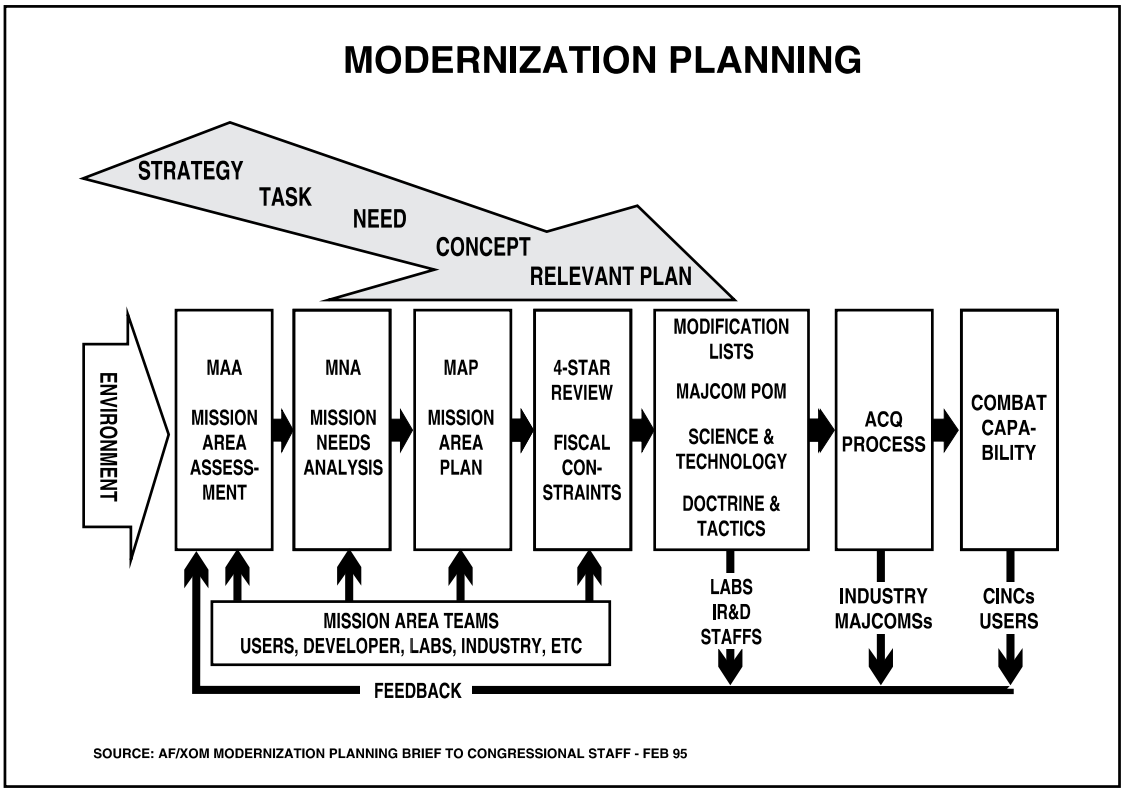

Figure 5-4. Modernization Planning

sis. Application of fiscal constraints to the validated needs, mean each MAJCOM prepares a prioritized POM input covering the mission areas for which they are the designated lead command. Per AFI 16-501, these inputs flow to the HQ USAF Resource Allocation Teams. This process is now influencing the FY97 Budget Estimate Submission and is slated to become the baseline for the FY98 POMinput. This time-phased approach allows all the process participants to know their respective roles in the planning process, investment strategy and future direction of the Air Force.[24]

Weapon System Master Plan (WSMP) and Weapon System Program Assessment Review (WSPAR) (see AFI 63-107)

Two logistically focused tools that dove-tail nicely into the modernization planning process described above, are the WSMP and WSPAR. These tools also identify potential deficiencies. The WSMP is a long-range planning document developed for each weapon system and used by SMs to manage current and future acquisition and support activities. A WSMP can be linked to one or more MAPs. For example, an F-15 fighter aircraft supports taskings and objectives in several mission areas. Thus, support deficiencies in the WSMP show up in several MAPs. The WSMP goal is to assess the operating commands proposed wartime taskings against the logistics capabilities and extrapolate future support needs. As such, the WSMP includes recommendations on candidate solutions for known deficiencies and projects the costs. The WSPAR takes the form of a SM briefing to the Air Force Council, chaired by the Vice Chief of Staff on ones' weapon system. In brief, the SM gets an opportunity to convey concerns about the weapon systems' support posture to senior leadership. It is evident these two tools, while focusing primarily on sus-tainment, provide another important feedback loop for force modernization.

AFMC Resource Management and Allocation Processes

AFMC employs complementary processes to the Air Force Modernization processes described above. It ensures appropriate use of infrastructure and residual procurement funds, not transferred to the operating commands. Explanations of these processes are in Air Force Materiel Command Regulation 500-2, Strategic Planning Process; 500-10, Corporate Management Process; and 500-16, A Model for Acquisition and Sustainment Under IWSM. Instead of looking at mission areas as the Operating Commands do, AFMC looks at five mission elements and functional areas: systems acquisition, sustainment, science and technology, test and evaluation, and base operating support. The goal of these processes is to provide the SM and users the best possible procedures, training and tools to do their job.

Why the Air Force Does Modifications

There are several reasons for doing modifications but most are the fruit of a formally documented deficiency. Senior Air Force leaders cited the following prioritized reasons for embarking on modifications:

- Improve combat capability
- Respond to a changing threat
- Insert (exploit) new technology
- Improve a system's Reliability & Maintainability (R&M) (Most R&M system improvements are sustainment actions)

They also view modifications as a cost effective and relatively low risk method of correcting known deficiencies. This is particularly true of weapon systems with many years of projected service life remaining. Quoting Togo West, Secretary of the Army, "...Improvements to our existing systems are the best way to achieve the greatest return for scarce resources and to leverage technology...."[25] Because many modification programs tend to involve lower risk than new acquisitions, there is strong emphasis on using streamlined acquisition procedures.

Cost and Risk Factors in Modification Management

A draft Air Force policy directs the SM to evaluate both cost and risk before starting a modification program (see Air Force Policy Directive (AFPD) 63-11 and AFI 63-1101. This policy directs the use of a combined cost and risk assessment and for the SM to recommend the appropriate MDA and documentation preparation requirements. This shift from looking only at cost is grounded in the philosophy of lowering management involvement to the appropriate level. It is a shift away from risk avoidance practices to risk management practices. A recent memorandum from the USD(A&T) office echoes this philosophy, "...each MDA is responsible for tailoring the application of DoDI 5000.2 and DoD 5000.2-M (including the references in both documents) based on a program's status, risks, and adequacy of proposed risk management."[26] The idea behind these policies is value. Each increase in the level of oversight, control or documentation results in an increase in the cost, schedule or human resources needed. Therefore, the goal is to eliminate oversight or documentation requirements that are without tangible benefits, e.g., maximize the value from limited amounts of funding and personnel.

Facts about the Scope and Size of the Modification and Upgrade Budget

The size of the modifications portion of the Air Force investment budget has remained relatively constant over the last 17 years. Figure 5-5 shows that historically, modifications have accounted for approximately 3 percent of the Air Force TOA in any given year. In 1994 the actual figure was closer to 2 percent. Breaking down the numbers further, 80 percent of these modification programs require less than 20 percent of the funds. Therefore, the majority of modification programs (80 percent) require only 0.6 percent of the Air Force annual TOA. Figure 5-6 shows the percentage of modifications by program cost.

Additionally, the acquisition workforce available to manage modifications is shrinking. Between 1989 and 2001, AFMC is projected to cut 39 percent of its overall workforce (military and civilian) and lose 47 percent of its product management personnel.[27] Putting these facts into perspective, it is easy to see why the Air Force modification policy is shifting. With reduced resources and a stated goal of being more effective and efficient, it simply does not make sense, nor is it practical, to continue forcing time and resource intensive reviews and documentation preparation for most of these limited liability and lower risk programs.

Future of Modification and Upgrade Budgets

In interviews with Air Force senior leadership, they stated, that they expected to see modifications grow as a proportion of the investment budget. Figure 5-5 shows the growth projection of modifications. One rea-

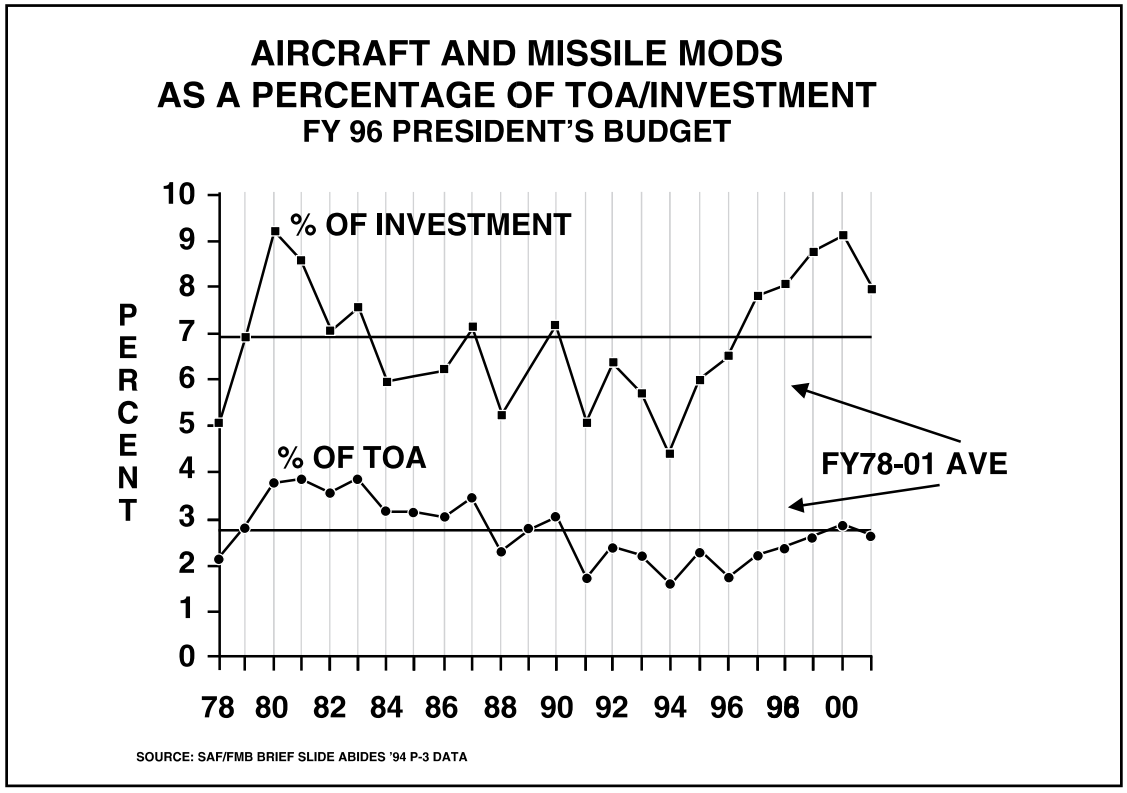

Figure 5-5. Aircraft and Missile MODS as a Percentage of TOA/Investment

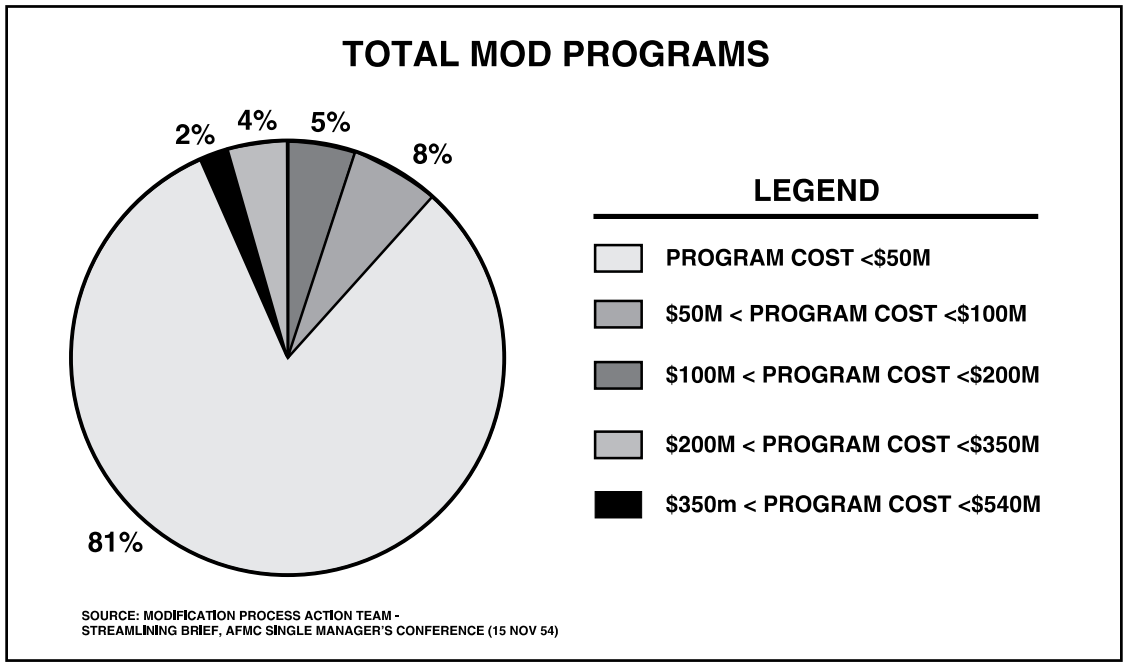

Figure 5-6. Total MOD Programs

son for the anticipated growth is that few (and fewer!) new major weapon systems (ACAT ID or IC programs) are underway (60 ACAT ID programs in 1994 down from 40 in 1992).[28] Thus in the foreseeable future, improvements in combat capability will be realized from TI into existing weapon systems. Senior leadership comments are substantiated by looking at a subset of the aircraft inventory, average aircraft age, and projected aircraft age at retirement date in Figure 5-7. Like in humans, as the hardware ages it requires more medical attention. Hence, even without modifications to improve combat capabilities, modifications become a necessity to replace obsolescing equipment or subsystems.

Non-Material Alternatives to the Modification Process

As the DoDI 5000.2 explains, the first alternative when trying to solve a military deficiency is to assess whether or not a change in tactics or operational procedures could remedy the deficiency. After exhausting these options, material solutions are sought.

Material Alternatives to the Modification Process

While all modifications start in response to formally documented deficiencies, many deficiencies do not require modifications. Resolution of the majority of reported deficiencies or problems occurs by the smart use of preferred spares, buying new items (item

AVERAGE AIRCRAFT AGE
(AS OF 1994)

AIRCRAFT TYPE	NUMBER OF AIRCRAFT	AVERAGE AGE NOW	PROJECTED RETIREMENT	AGE AT RETIREMENT
C/KC-135	638	33	2040	79
B-52	94	34	2030	70
C-5A	77	25	2021	52
C-141	248	29	2010	45
C-130 (20 YRS OR OLDER)	439	30	2030	66
F-15	940	12	2020	38
F-16	1727	7	2020	33

SOURCE: AF SCIENTIFIC ADVISORY BOARD (1994 SUMMER STUDY)

Figure 5-7. Average Aircraft Age (As Of 1994)

replacement), maintenance and repair procedures (technical order) or software-only changes. AFMC has a program titled Improved Item Replacement Program (IIRP) that governs preferred spares and improved items. One advantage of the IIRP is it allows the Air Force avenues to correct deficiencies or introduces, through TI, state-of-the-art components, shop replaceable units and line replaceable units. These then become normal supply items. Procedures levied on IIRP are primarily concerned with the LCC implications of the change. Generally, they are undertaken when the change produces a significant LCC advantage.

Sources of Modification Requirements

Modification requirements can come from several sources. The following non prioritized list represents where most requirements come from:

- Mishap Report
- Quality Deficiency Report (two types I & II)
- AF Form 1000 (suggestion program)
- Unsolicited proposals
- DoD or other agency modification proposal
- High demand rate
- Analytical Condition Inspection
- Aircraft Structural Integrity Program
- Technical Order System Publication Improvement Report
- Product Improvement Program
- Modification Proposal and Management, AF Form 1067
- MNS (MNS)
- Modification Improvement Program

There are many ways to start a need for a modification. Most important is the formalization of modification programs when documenting and researching the deficiency, while using various Air Force processes to validate the need and requirement. AFI 10-601 contains complete instructions on the process and procedures for preparing, validating and approving Air Force mission needs and operational requirements.[29]

Modification Documentation

Documentation and oversight requirements for modifications are typically less structured than are those for major new programs. The guiding principle from the USD(A&T) office and Air Force leadership is to keep documents to the minimum necessary for sufficient oversight and auditing. The premise behind reduced documentation and oversight is the idea that modifications generally involve less risk than major acquisitions. The core documentation requirements for non major modifications are:

- Need approval (see AFI 10-601 for specific documents and limitations)
- Requirements approval (see AFI 10-601 and AFI 10-602)
- Baseline cost, schedule and performance parameters (AF Form 3525, Acquisition Program Baseline or equivalent)

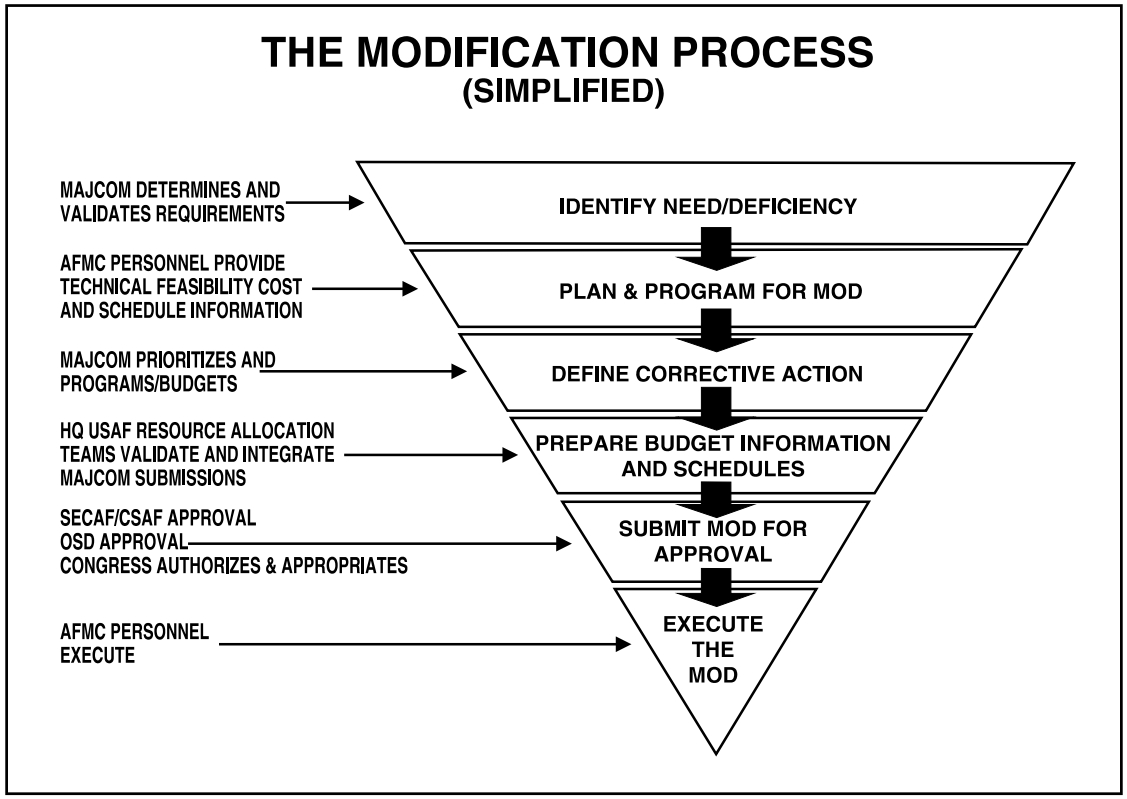

Figure 5-8. The Modification Process (Simplified)

- A management plan that encompasses the key functional areas (AFI 63-107 may be helpful)

Modification Process

In the past, with many ways to establish and fund a requirement, too much time was spent planning modifications that were never accomplished. Modification staff personnel view this as wasting time on planning modifications that are never implemented. Today the user controls the funds for all modifications regardless of requirement origination. Thus, having a commitment to the need is the single most important step in starting a modification program. Currently, the operating commands (users) have the authority to validate requirements below $10M with HQ USAF validating requirements above $10M. If the modification results in an ACAT I or joint interest program then JROC approval may also be required. Ultimately, the user must decide whether to pursue the modification. That signature (validation) signifies a desire by the customer to remedy the deficiency. With a validated need in hand, the SM initiates modification planning. This usually takes the form of a preliminary engineering review. Some of the main steps in this review are as follows:

- Identification of the expected impacts on the Configuration Item (CI)—system—being modified

- Description of the solution, including

replacements, modifications or redesigning to include the magnitude of the change (form and fit)

- Preliminary justification of need

- List of options or tradeoffs including ignoring the deficiency

- Develop a preliminary cost estimate and proposed schedule for the program

- Identify (scope) other issues that might technically or programmatically impact the project.

Modification Planning

In the interviews with working level modification personnel, thorough, up front planning was reiterated at every turn, as a most critical activity. The Air Force "lessons learned" database (Automated Lessons Learned Capture And Retrieval System (ALLCARS)) corroborates that planning is often the Achilles heel activity of less than successful modification programs.[30] It is easy to understand why careful planning is so critical when schedule drives the process. Validating the need and requirement process takes, on average, 6-8 months to complete. The average time to bring a validated requirement to a contract award takes an additional thirty-two months. Thus, if the modification planning documentation and coordination are either incongruent or incomplete it can add an entire year to get funding programmed. Also, because literally hundreds of requirements can show up at each SM's staff for evaluation, it is essential to know which one(s) to work and their relative priority. Another piece of modification planning includes ensuring how to accomplish logistic support. Also, LCCs are a criterion in modification planning and every effort should be made to drive down the O&S cost of ownership.[31]

Operating Command (User) Review and Approval Prior to Milestone 0

For modifications the goal at this preliminary stage is to determine the best value solution based on analysis of a deficiency generated by a new or changing requirement. Once the preliminary engineering and initial planning are complete the SM provides the results to the user. After approval of the project or program it is then submitted to the MDA for a Milestone 0 decision.

Milestone Decision Authority (MDA) Determination

The emerging Air Force policy is to recommend program decision authority to the lowest level MDA commensurate with the proposed program's correlated cost & risk for all but major modifications.[32] See AFMC Pamphlet 63-101, for instructions on developing the specific risk assessment. The intent is to ensure that each program gets the appropriate management focus without non value added burdens. Programs with higher risk generally have more challenges and will require more senior leadership assistance/ oversight. Using the proposed policy, (for non major modifications) the correlated cost or risk assessment results help drive the MDA recommendation. This policy would result in a MDA/ACAT matrix as follows:

- Program Level MDA

- ACAT IV SM

- ACAT III PEO/DAC

As a program moves through the various Milestones the cost and risk assessment may

change. Therefore, the MDA designation remains flexible depending on the needs of the program or when directed by higher authority.

Milestone 0 Concept Exploration and Definition (CE/D)

With the establishment of the need or deficiency and the determination that it can not be satisifed with a non-material alternative, the project moves next to (CE/D). Aggressive tailoring of the documentation, oversight and review is essential because this is a modification of an existing system. The value in this step is to explore the potential alternatives and select the most promising. This in-turn may lead to the alternatives to modifications previously mentioned, i.e., preferred spares, maintenance and repair actions or software-only changes. However, if a hardware and/or software modification is required, then a determination must be made as to whether the end item has sufficient service life (five-years) remaining to justify the modification. This guideline does not apply to safety modifications.

Another guideline to consider is a "best practice" adopted from world-class commercial industries. Their practice is to expect modifications, except those for safety or legal compliance, to result in a reduction in the cost of ownership. Industry expects this because for most types of equipment, new generations of hardware products are cheaper than the previous generation of similar equipment. The key point is that while cost is not the only variable to consider in picking a modification alternative, it should be a heavily weighted variable in the tradeoff analysis to ensure the user gets best value.

Engineering Change Proposal (ECP)

When a most promising solution is found, the most typical vehicle for a material solution is an Engineering Change Proposal (ECP). Explanation of an ECP preparation is in MIL-STD 973, Appendix D. With the recent policy shifts away from MIL SPECs and MIL STDs to performance specifications, MIL-STD 973 is merely a guide. For approval, the ECP must be acceptable in terms of technical fidelity, cost, schedule, logistics factors and agreeable to the system's operational users. In cases where no modification solution is agreeable, then a new start activity may be initiated. Either way, availability of funds is a necessity at this point. Assuming no additional study requirements and approval of the ECP, then the user is responsible for prioritizing resources so as to fully fund the needed modification in the POM. The approved ECP will form the basis for building the CCB package.

Configuration Control Board (CCB)

In the Air Force, the SM CCB is the sole technical committee that recommends approval to the SM to change the configuration of government equipment. Operating commands (users) review and concur or non concur with the proposed engineering change, but cannot grant approval to change the equipment.[33] This is an important point because under the AFMC IWSM management philosophy each system or item's configuration management falls under the responsibility of the SM. Since changing a CI is by definition a modification or upgrade, solid configuration management is crucial to maintaining an effective and efficient modification program.

Configuration Control

During interviews with modification management personnel, configuration control came up over and over as a "critical to success" activity. They cited numerous occasions when the absence of a well-documented configuration "technical data package" or incorrect data on the equipment's configuration resulted in cost, schedule or performance breaches in a modification program. This function is likely to be even more challenging in the future. Changes instituted by the SECDEF last year fundamentally changed how the Air Force controls configurations, "To the extent practicable, the Government should maintain configuration control of functional and performance requirements only, giving contractors responsibility for the detailed design."[34] The SECDEF memo further states, "Performance specifications shall be used when purchasing new systems, major modifications, upgrades in any ACAT."[35] This new paradigm radically changes how the Air Force will control configurations in the future. Essentially, now industry retains configuration authority over the engineering/ configuration baseline commonly referred to as the detailed design. In the past, the Air Force controlled the configuration of the detailed design following a successful Physical Configuration Audit. Now contractors can continually change the detailed design as long as one meets the functional and allocated requirements. Thus, these changes put a premium on carefully managing the interfaces between systems, subsystems or commodities to ensure the appropriate functional, performance and physical characteristics exit at common boundaries.

Interface Control (IC)

An Interface Control Working Group (ICWG) accomplishes IC. The ICWG is the forum used by the participants (government, contractors, or other agencies) to resolve interface problems, maintain clear communication channels and document interface requirements. The ICWG establishes the functional and physical interface characteristics and documents them in Interface Control Documents.

Air Force Modification Management System (MMS)

One of the tools added to improve modification management is MMS. A MMS is an information management system developed to provide an automated capability to collect, maintain and display modification information for the user and AFMC personnel. One of its important outputs is a P-series funding document (the P-3A) that is used to request modification funding. Currently, several other similar systems are in use for keeping track of modifications. A long-term goal is to migrate all users and AFMC organizations to MMS.

Modification Funding

Unfortunately, the rules and policies governing modification funding can be confusing. Still, it is worth mentioning some general rules. First, the type of funds used to develop a modification depend on whether or not the proposed change results in an increased performance envelope for the fielded system. If it does, then RDT&E funds (3600) are used for the activities preceding production/retrofit. If the system is out of production and does not increase performance, then O&M (3400) funds are used for the activities preceding production/retrofit. For systems still in production, the appropriate procurement account (3010, 3020, 3080)is used. In all cases, procurement funds are used to procure the modification kits and install them.

Also, the policy of "full-funding" applies to the use of procurement funds, basically, all the items necessary to complete a major end-item or system must be funded from a single year's appropriation. Another wrinkle on modification funding is the requirement of Congressional approval before initiating any modification requiring >$10M in total funding. If it is a safety modification >$10M then it can be started out of cycle with congressional notification. The reprogramming threshold with the procurement account is <$10M.

Where to Go From Here

Joining in is the best way to stay abreast of these or contemplated changes. Empowerment is a key tenet of the Air Force Total Quality program and IWSM philosophy. Many of the changing processes described here have bubbled up from the lower levels of the DoD acquisition workforce. When modifications management began to mirror traditional acquisitions many people in the logistics community said, "how about training us in acquisition and providing us with how to templates." This non trivial need was fulfilled with the release of the Air Force Modification Process Description (test). A dedicated group of working level modification personnel and users took the Air Force Total Quality program seriously and formed an IPT to revisit modification processes and policies. The group was sanctioned by the Assistant Secretary for Acquisition, policy group (SAF/AQX) and the HQ USAF/LG policy to put together a "how to" guide for modifications and to chart the modification process so that it might be better understood and improved. The Modification Process Description is an eight volume compilation of all facets of completing a modification or upgrade. The structure provides even relatively inexperienced staff with enough detail to successfully accomplish a modification. Another goal of the IPT was to get the description out quickly and proactively seek feedback for its improvement. The initial issue is a test, allowing individuals to use it without making it mandatory. Throughout the test period the IPT will be looking for suggestions to improve its product. More information on the Modification Process Description can be found at Appendix E. Hopefully, this encourages the user. If you have a lower cost or more efficient way to get a quality product to the user, pursue it. Included in Appendix E are some additional points of contact for the processes discussed. They are a ready source for up-to-date information on education, training and pending changes.

Summary

The Air Force's modification and upgrade policies and procedures are quickly evolving to take advantage of the mammoth changes in DoD. Reduced funds, fewer people, less infrastructure and fewer new starts drive modifications and upgrades to the forefront of the US Air Force investment strategy. The Air Force is meeting this management challenge by refining the requirement generation process, improving its modernization planning process and increasing the use of best commercial practices. The key to making these process improvements work is an integrated management approach using integrated product teams with a clear focus on meeting the users needs.

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