Technical Report 736

Program Management Offices: Structural Modeling Through Application of Stratified Systems Theory

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In response to a request from the Assistant Secretary of the Army (Research, Development, and Acquisition), this study examined (1) Program Management Office (PMO) structure over its life cycle, (2) roles and relationships between PMOs and their respective major subordinate commands (MSCs), and (3) career development of Program Managers (PMs). Data collection consisted of 60 interviews of commanders, deputy commanders, program/project managers, and directors within three of the U.S. Army Materiel Command's (Continued)

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MSCs: Tank Automotive Command (TACOM), Aviation Systems Command (AVSCOM), and Troop Support Command (TROSCOM). Information gathered through the interviews was compared to the Stratified Systems Theory model of organizational structure and role relationships proposed by Jaques (1983). Data analyses showed a trend of increased workload for the MSCs as a result of force modernization and information requirements generated at higher levels. The impact of these external requirements on the program management offices was explored. Models of SST organizational structure were explicated at Levels V, IV, and III, and two PMO models were constructed for the development and production/fielding phases of the life cycle. Knowledge, skill, and leadership capabilities for PMs were collected and classified by life cycle demands.

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FOREWORD

The U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) has actively pursued a research program to develop principles for organizational design. Portions of this research have focused on Jacques' Stratified Systems Theory (SST).

The present report describes the use of SST as a means to conduct an organizational review of the Army's primary acquisition unit, the Program Management Office (PMO). The report also includes organizational descriptions of three major subordinate commands within the U.S. Army Materiel Command (AMC) and an assessment of command and control relationships with respect to the PMOs.

This research was conducted in response to requirements stipulated by the Assistant Secretary of the Army for Research, Development, and Acquisition (ASARDA). Data collection was made possible through the cooperation and support of AMC and the three major subordinate commands: Tank Automotive Command (TACOM), Aviation Systems Command (AVSCOM), and Troop Support Command (TROSCOM).

Research results were briefed to the ASARDA in March 1986. At his request, detailed briefings were presented to the members of his staff responsible for implementing the findings of the Packard Commission's report on defense procurement. In addition, the principles and relationships identified in this research have been found to be applicable to PMOs in both the public and private sectors.

EDGAR M. JOHNSON
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PROGRAM MANAGEMENT OFFICES: STRUCTURAL MODELING THROUGH APPLICATION OF STRATIFIED SYSTEMS THEORY

EXECUTIVE SUMMARY

Requirement:

To review the structure of Program Management Offices (PMOs) and their relationship with the Major Subordinate Commands (MSCs) in response to a request from the Assistant Secretary of the Army (Research, Development, and Acquisition). The objectives of the research were to

1. Examine the structure of a program office over its life cycle.
2. Review the roles and relationships between PMOs and the matrix support received from the MSCs.
3. Assess the career development of individuals assigned to the program managers.

Procedure:

Information for the study was gathered through (1) a review of recent studies on the military use of PMOs, (2) a survey of organizational and management literature relevant to the program management concept, and (3) a series of over 60 in-depth interviews with Program Managers (PMs) and MSC personnel.

Three representative MSCs were identified: Aviation Systems Command (AVSCOM) and Troop Support Command (TROSCOM), both located in St. Louis, Missouri, and Tank and Automotive Command (TACOM), in Detroit, Michigan. The MSCs represented relatively independent, functionally staffed PMOs, PMOs receiving support from a single matrix, and PMOs in a "capstoned" double matrix, respectively. Sample selection included 6 members of the MSC command groups, 25 PMs, and 36 chiefs of functional directorates.

Two-hour, individual interviews were conducted on site, using an 11-question protocol followed by open-ended questions regarding primary tasks, internal and external relationships, and support requirements. Responses were keyed into portable computers and stored on disks for later editing and analysis.

Stratified Systems Theory (SST) (Jacques, 1976) was the theoretical basis for the analysis. SST's models and complexity criteria were used to identify the work of the MSCs and the PMOs, and to develop structural recommendations. Factors included (1) the influence of forces external to the organization that managers cannot control, (2) the numbers and needs of constituencies that make up the organization, (3) the nature and number

of types of lateral and command relationships involved in accomplishing work, and (4) time span of tasks.

In addition, the "operational spine" and support units of each MSC were identified. Operational spine units were defined as those that develop goods and services, manufacture or buy goods and services, and sell or field goods and services. SST principles were used to identify the relationships between operational and support units, and to construct two PMO models by life cycle phase.

Findings:

The Commanders of the MSCs were identified as the interface with external demands that affect their own work and, through priorities and policies, the work of the PMOs. External factors identified in earlier studies were found to be still present and had been augmented by a large increase in MSC workload without corresponding increase in staff. The MSC Commanders also are redefining PMO relationships with external lateral organizations and higher headquarters in light of AMC's move toward a comprehensive acquisition strategy and the escalating review process. This change has resulted in a loss of PMO freedom in the external environment estimated at 60% within the past 5 years.

Information demands and reporting requirements, identified in earlier studies as critical external factors, were found to have increased substantially. The effect of this increase has been compounded by the general lack of computer capability in the MSCs. Manpower to meet this demand has often been at the expense of operational requirements. Increasing workload and information demands with static resources was found to be the impetus behind two current actions: (1) an AMC directive to downsize PMOs by returning support personnel to their parent organizations, and (2) the adoption of the Air Force and Navy practice of contracting for all work to be done by outside resources (as evidenced in the LHX Program).

As components of the operational spine, PMOs were found to have specific roles and tasks different from those of the lateral support units that provide services to the operational spine over the life cycle. Authority relationships between operational spine and support units were defined to include service giving/service getting, auditing/inspecting, and monitoring.

The relationships and interdependencies between operational and support units were found to be unclear, with numerous instances of overlap. The operational spine units responsible for fielding, user satisfaction, and deficiency reporting were the least clearly defined. This lack was found to be one of the major reasons that PMOs are not being phased out at the end of the development phase.

The need for a coordinating staff officer to assist the MSC Commanders was identified in the roles of the Deputy Commanders and the capstone PMs. The critical task for this position is to prioritize demands in the face of limited resources.

MSC Commanders and PMs were found to require a personal staff to assist them with level-specific work in budgeting, programming, personnel support, and information management. Unlike services provided by lateral support units, these functions belong to the PM and cannot appropriately be delegated to lateral support units or coordinating staff.

Several other SST principles were applied to the analysis of PMO structure. These included the requirement for placing full-time support staff in operational spine units, authority relationships other than superior-subordinate for assigning lateral support personnel, mutual knowledge units, and the indirect, dual-supervisory nature of PMO work. The effects of current civilian personnel policies were noted.

Finally, SST theories were applied to hypothetical PMO staffing figures to construct two PMO models by life cycle. A development-stage PMO for a major weapon system was shown to resemble a miniature Level V organization, reflecting PMO responsibility for all three operational spine functions.

Conclusions:

This organizational review resulted in these conclusions:

- Current PMO structure varies by MSC and is not based on organizational theory.
- "Matrix management" is not clearly understood and is interpreted in many ways. A common language based in theory is needed so that requisite structure and relationships can be defined.
- The differences between operational spine and support functions are not consistently recognized.
- The roles and responsibilities of today's PMs need clarification. The current charters do not match their work as defined by AMC and the Secretary of the Army, and are meaningless as a source of guidance as to limits of authority, decision processes, and reporting requirements.
- PMs must have a personal coordinating staff to assist them with programming, budgeting, and technology/information management.
- Current matrix management philosophy does not differentiate between support functions and personal coordinating staff requirements.
- Lateral support staff working full time on PM-specific work should be assigned to the PMO.
- Two of the MSCs in the study showed a good match with SST theory; the third did not. PMOs in the MSCs with the requisite structure showed higher levels of enthusiasm and feelings of efficacy.

- Current personnel policies do not reflect the higher capability required by the nature of PMO work.

- The efficiency or effectiveness to be gained by "matrixing" the PMOs is not apparent, and has not been documented.

Utilization of Findings:

The principles and relationships identified in this research can be used to analyze PMOs in both the public and private sectors. The hypothetical models of PMO staffing are not seen as generally applicable to PMOs, regardless of circumstance. Instead, they provide a framework for case-by-case analysis of PMO staffing, based on the following factors:

1. The external demands on each PMO, including contractor history and capability;

2. Life cycle phase;

3. The requisite operational spine units (development, purchasing, fielding/user satisfaction);

4. The number and grade of full-time people required to do the coordinating work for the PMO;

5. The number and grade of full-time people required to do the auditing/integrating work for the PMO;

6. The command and control relationships that can be employed; and

7. The efficiency to be gained from using a mutual knowledge unit that shares common goals.

PROGRAM MANAGEMENT OFFICES: STRUCTURAL MODELING THROUGH APPLICATION OF STRATIFIED SYSTEMS THEORY

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CONTENTS (Continued)

PROGRAM MANAGEMENT OFFICES: STRUCTURAL MODELING THROUGH APPLICATION OF STRATIFIED SYSTEMS THEORY

INTRODUCTION

In the summer of 1985, the Assistant Secretary of the Army (Research, Development and Acquisition) requested that the United States Army Research Institute (ARI) review the structure of Program Management Offices (PMOs) and their relationships with the Major Subordinate Commands (MSCs) that support them. Information for the study was gathered through (1) a review of recent studies on the military use of PMOs, (2) a survey of organizational and management literature relevant to the program management concept, and (3) a series of over 60 in-depth interviews with Programs Managers (PMs) and MSC personnel.

The results of this research will be presented in five sections. This section introduces background on program management and its use by the U.S. Army. Findings of earlier studies will be followed by a brief literature review, including a framework for organizational analysis that is the theoretical basis for this evaluation. The details of the research will include Objective, Method, Results and Discussion, Summary of Findings, and Conclusions.

Evolution of Program Management

Today's PMOs are a return to ancient concepts. From the construction of the pyramids through early American shipbuilding, work was organized into projects that required the coordinated efforts of many disciplines. However, as the Industrial Revolution unfolded, this project focus was replaced by linear processes of mass production. Organizations to support mass production were based on function, and were modeled after the military, with decision making authority vested only at the highest levels and strict hierarchies of responsibility. These models were the key to efficient production; however, they were found to be inadequate for development activities as early as the final stages of World War II. Elements of modern program management were seen in both the Manhattan Project and German missile research and production. It took the unparalleled complexity of the ICBM-Atlas and Apollo space programs to return full-scale program management to popularity.

The first applications of modern program management had three critical components: (1) program coordination by a PMO in a single location; (2) clear PMO authority and accountability, including fiscal control of project resources; and (3) a finite life-span that ended when the development process was completed and production began.

Centralized program management quickly spread, but in a form that was adapted and modified by situation. PMOs were often given coordinating or monitoring responsibility, but without fiscal authority. "Program management" began to be applied to systems or long-term programs that were without definite end-points. And, most importantly, program management began to be viewed as synonymous with "matrix management."

Matrix management is a separate concept that divides responsibilities along two axes (Thamhain, 1984). One axis contains tasks related to resource management, traditionally associated with the functional organization. The other axis is concerned with the organization's business or outputs. The output axis, led by program managers, becomes an overlay to the functional organization. In theory, the program office contracts for specific services from the functional areas, integrates the program, and provides customer/user interface.

Today's PMOs exist in at least three models:

1. "Free standing" PMOs with complete line organizations and program manager authority over the people, facilities, and functions to execute the program.

2. One-person PMOs tasked with coordinating and integrating a program across functional lines.

3. PMOs with varying numbers of direct-reporting personnel who perform some of the work themselves and integrate other project support from the "matrix."

The purpose of this research is to assess the appropriate configurations and support relationships for the Army PMOs responsible for materiel acquisition.

Army Applications of Program Management

As the program management concept gained popularity in the 1960s, the Army Materiel Command (AMC) adopted a program management philosophy for major systems, and established some 32 PMOs. At the outset, all of these offices were centralized within the headquarters itself, and reported to the AMC command group. In subsequent years, the PMOs were moved into the MSCs that were responsible for the readiness aspects of the products being developed. The MSCs were organized along functional lines to support their commodities. The PMOs were system-oriented but without standard staffing patterns.

PMO integration into the MSCs varied from location to location. In some cases, commanders of the host MSCs were included in PM reporting channels, while other PMs continued to report directly to the AMC commander. All PMs relied on their MSCs for facilities and such basic functions as civilian personnel and legal assistance. However, because PMO staffing and capability varied widely, technical support required from an MSC differed from program to program. When special status was accorded the PMOs charged with developing the Army's "Big 5," they were returned to the fully-staffed, direct-reporting configuration, even though they continued to be located in the MSCs and dependent on them for basic support. Added confusion arose over the boundaries between development and readiness. For example, fielded systems undergoing major modifications were assigned to PM management, as was the long-term

purchase of non-development items (NDI) that required a high level of management and coordination.

During this time, the number of PMOs grew from 32 to around 60, and hovered in the 50-60 range until 1980. With the requirements of force modernization as impetus, the number has steadily increased to the 80 PMOs of 1986. In general, Army PMOs currently are established for one or a combination of three reasons: 1) to develop new products 2) to respond to changing user or system requirements, and 3) to manage critical categories of items within the National Inventory Control Points (NICP) for increased readiness.

Recent Studies of PMOs

The Army's PMOs have been the subject of a number of recent studies. Starting in 1980, the Resource Self Help/Affordability Planning Effort (RESHAPE) reviewed PMO operations, and recommended organizational analysis of roles, staffing levels, and missions. Decision making, accountability, hierarchical authority, and matrix relationships were noted as needing to be clarified and simplified as much as possible.

In 1982, the Cost Discipline Advisory Committee (CDAC) again emphasized the need for clarifying the relationships between host organizations and PMOs. Other identified problems included the time requirements and complexity of program changes and the individual qualifications of Program Managers.

The report of the Private Sector Survey on Cost Control (Grace Commission, 1983) was more specific. It stated:

1. The responsibility between the PM Office and the Host Major Subordinate Command (MSC) is not always clear.

2. The responsibility, authority, and accountability of the PMs are often a mismatch and the system does not facilitate success. Only strong, aggressive, and innovative individuals in the PM positions move the programs ahead.

3. Information requirements higher in the organization divert the attention of the PM and his team from managing the program.

4. Military and civilian personnel programs do not generate qualified people to work in the PM Offices.

In 1985, the Kerwin Board was reconvened to review AMC's Product Assurance and Testing Programs. The board identified 16 issues related to the quality of the products being acquired by the MSCs. Findings indicated that quality issues had lower priority than meeting schedules; the result was seen as equipment not ready to be fielded. Another identified problem was that the acquisition process is driven by inexperienced Army officers who establish unrealistic requirements that need to be changed many times, affecting both timely production and cost.

The Kerwin Board members also noted their concern regarding personnel requirements and organization of the PMOs. In June 1985, the AMC Commander had directed the MSCs to begin reorganizing and downsizing the PMOs, and to increase the use of "matrixed" functional support. Reacting to this guidance, Board members stressed that their interviews had indicated that relationships were unclear between the MSCs and the PMOs. Rather than full-scale reorganization, they recommended that a trial PMO in each MSC be used as a prototype to establish the most effective structure.

An AMC study of PMO termination procedures was completed and approved in December 1984. The explicit objective was to determine criteria for the termination of PMOs; an implicit objective was to establish the basis for wider application of matrix management as a means to increase efficiency.

The study determined that 11% of the high grade positions in AMC are in the PMOs at a cost of $126 million; that centralized PM management duplicates MSC functions; and that it is not possible to terminate PMOs because of complex personnel problems when the offices are destaffed. Matrix management was recommended as a means to avoid the duplicative functions and complex personnel issues, reaffirming earlier studies in 1980 and 1982.

None of the previously mentioned studies addressed the systems context of PMO work. This absence also was noted in hearings before the Committee on Armed Services, House of Representatives, Ninety-Ninth Congress (1985) concerning reorganization proposals for the Joint Chiefs of Staff. Testimony by the Center for Strategic and International Studies (CSIS) of Georgetown University stated that, "OSD has failed to provide an overall framework and set of guidelines within which service acquisition decisions can be supervised and coordinated. The military services thus develop weapons independently, each according to its own sense of national priorities."

The CSIS study noted that the acquisition process suffers from "ubiquitous turbulence." Two of the causes of this turbulence, as listed by CSIS, are important to an understanding of PMO work and requisite structure:

> . . . Congressional procedures that result in the detailed review of every program every year, together with the legislator's attention to the concerns of particular constituents, have produced strong incentives and multiple opportunities for micro-management by the legislature. Annual congressional alteration of hundreds of procurement and research and development line items produce year to year uncertainties for program managers and defense contractors. The inevitable result is less efficient management, higher unit costs, and longer production schedules.

> . . . The bureaus and officials that oversee research and development in both OSD and the military departments too frequently incorporate new advances in technology to account for altered assessments of potential adversaries' capabilities. This so-called requirements 'creep' is a natural outgrowth of laudable efforts to deploy the most modern and capable weapon systems. Nevertheless, revisions contribute to higher unit costs and slowed development and production schedules, as well as reduced reliability and operability.

A 1985 General Accounting Office (GAO) study focused on the roles of PMs and Contracting Officers (COs) in executing competitive contracting strategies. The GAO found that the responsibilities of the PM and the CO were not clearly defined, and that both positions were buffeted by factors outside their control. The report provided a summary of the problems that currently confront PMs, and PM perceptions of what the future holds:

> A lack of authority, according to some of these representatives, manifests itself in the inordinate time needed to make key decisions. They indicated that delays in decisionmaking only serve to drive weapon system costs up.
>
> . . . more legislation, regulations, and policy requirements limiting program flexibility. They also see an increase in centralized control and a decrease in local authority, with more layers of monitoring, supervision, and oversight.
>
> Attempting to prevent all failure by continuous micromanagement generally increases the incidence of failure. This increase leads to increased micromanagement, and we end up where we are now: micromanaging our way to continuous trouble.

There is a need, according to GAO, to change the manner in which an acquisition strategy is accomplished. Recommendations included a five-year commitment of funding prior to the beginning of any project, assignment of an individual or a special team with enough rank to deal with external influences beyond the control of the PM, and insisting that the PM stay with the program until some concrete goal has been attained.

In their review of the quality of PM skills and capabilities, the GAO Committee reviewed DOD Directive 5000.23, Career Programs for Program Managers. They recommended that a tri-service selection procedure follow the basic outline provided in that directive, namely: an early commitment on the part of the individual to pursue an intensive career in Program Management, experience in operational command, multiple PMO and PMO related assignments, education at the 20-week DMSC course and Senior Service Schools, and selection to positions and promotions based on PM performance, skills, and experience.

A review of the Materiel Acquisition Management Program (MAM) instituted by the Army in 1983 included a chart of the typical career path for MAM officers (p. 114). This program was considered to be in a transitional stage. The GAO committee recommended that instead of being an additional skill identifier associated with some 14 separate specialities, MAM should have its own speciality to provide greater direction and control over career paths and to give these officers a higher priority in the assignment process.

Table 1 presents a synthesis of these earlier PMO studies, and lists the main issues that were identified. In reporting the results of the current research, reference will be made to agreement or disagreement with this prior work in the areas that are relevant to the objectives of this study.

Relevant Organizational Theory

In general, prior studies have analyzed PMOs as separate entities operating in isolation from the rest of the Army. Although there is an implication that a PM works in some context, the specifics are usually not defined. This omission is important because a PMO is always embedded in an organization and its mission is almost always modified by relationships within the primary organization and the supra-organizational structure.

Organizational theorists have defined a number of issues that are relevant to the relationships of PMOs in their parent organizations. Galbraith (1968), in an assessment of future organizations, notes that the environment is becoming more dynamic and unpredictable each year. An organization's ability to adapt will determine whether or not it will survive. Both the military and industry view PMOs as a necessary organizational model that allows change to take place quickly and efficiently.

Thamhain (1984), in an extensive review of industrial/engineering program management, identifies at least three configurations for PM/ functional matrixed organizations: (1) a single-person PMO, (2) a Staff Project Organization, consisting of a PM and a limited staff, and (3) an Intermix Organization with a relatively large internal staff to actually do some or all of the functional work.

Thamhain sees the latter structure as generally short-lived and as an inefficient use of resources. He also notes personnel problems such as the temporary nature of positions and dual reporting responsibilities associated with a matrix. Organizations with PMOs embedded in functional components must insure that the short-term accomplishment of PM milestones does not interfere with the long-term development of organizational capability within the functional matrix.

Drucker (1985) also addresses the problem of potential resource conflicts that can discourage innovation. In his view, innovative product development must be done outside the existing operational environment. His reasoning is that existing operational crises will overcome the

Table 1

Comparison of prior PMO study findings

Issues Identified	RE-SHAPE	CDAC	Grace Comm.	Kerwin Report	AMC Deprojt.	CSIS	GAO
Relationships of PMOs and MSCs	X	X	X	X	X		X
Need for increased matrix management					X		
Lack of qualified PMOs		X	X			X	X
Civilian personnel issues			X	X	X		
Inexperienced requirements developers	X			X		X	
Funding uncertainty						X	X
Need for improved Technical Data Packages, warranty programs, and feedback				X			
Too many new programs						X	
Problems of increased procurement competition						X	
Upward trend in decisionmaking							X
Problems of "micromanagement"						X	X
Negative impact of increasing information requirements			X				

new systems' requirements as a matter of course. Existing organizational units will often postpone any new and innovative action until the opportunity is lost.

Drucker advocates two key principles for PMs in general. A PM (1) must have a relatively high position in the organizational structure, and (2) should never report to line managers responsible for on-going operations. A further recommendation is that PM motivation and awards be tied to future outcomes of PM ventures. He points out that individuals who decide to work on PM projects take considerable risk as they move into the more unstable and temporary environment usually found in a PMO. If the organization expects individuals with higher capability to work in this arena, adequate rewards must be offered. The differences between PM work and day-to-day operational work and must be recognized and measured in ways that give value to the difference.

Thamhain (1984) also states that leadership and management skills needed to accomplish work in PMO/matrix organizations are different from those required in traditional, single-line-of-command structures. He sees the multidimensional structural relationships and the complexity of the external environment as difficult barriers for the PM who:

> . . . builds his multidisciplinary teams into cohesive groups and successfully deals with a variety of interfaces, such as functional departments, staff groups, team members, clients, and senior management. Managing these engineering projects effectively requires special tools, methods, organizational systems and, above all, skills in human, administrative, and technological areas.

The industrial-based theories discussed above are useful background to an assessment of the structure of PMOs within the AMC organization. In fact, many of the issues are similar to those raised in earlier studies of military PMOs, i.e., competition for resources between development and readiness requirements; the different leadership and management skills to accomplish PMO/matrix work; and the need for a development program and an evaluation system that reflect such differences. In addition, the PMO/matrix configurations postulated by Thamhain are already in use throughout AMC.

However, any application of industrial theory also must take into account an important difference between commercial and military settings. For a PMO engaged in commercial product development, the incentive is to grow, to evolve from a short-term innovative group to a new division or company in the parent organization. If the development process is successful, the usual outcome is not the death of the PMO with its functions assumed by the matrix, but its reconfiguration into a stable, institutionalized organization capable of long-term sustainment. By contrast, most AMC PMOs are seen as short-term, finite organizations with missions and functions that will be assumed by others at a particular point. There has been little discussion of the type of organization or system-specific knowledge and skills that will be required for long-term sustainment. Organizational theories specific to weapons systems development and readiness/sustainment interfaces will need to be developed.

Stratified Systems Theory: An Alternative Model to the Matrix Concept

Jaques' (1976) Stratified Systems Theory (SST) was selected as the theoretical basis for the field research in response to two factors: (1) the sponsor's preference for SST-based analysis, and (2) the potential of the theory for describing the multiple functions associated with PMOs.

SST is a systems approach to organizational design. A seven-level model is used to describe organizational work in terms of what "should be" for efficient and effective operation. The first principle is that managers must be directly involved in defining and designing the work of their organizations. In this particular application, manager involvement was not possible since one of the objectives was to define who the "manager(s)" of PMO work were or should be. Thus, the research was confined to applying the theories to describe the work and to make general recommendations. Organizational change based on these recommendations will require that each MSC understand and accept SST principles, and then work through each step of analysis and reorganization with the help of SST theorists.

In addition to managers/leaders who must do their own work to design their organizations, other SST principles flow from the stratified model. The application of this model to the Army structure is shown in Table 2. Each managerial level is seen to perform a different type of work, and to "add value" to the flow of information, resources, and people that accomplish the organization's tasks. Within this context, the following design principles are used for analysis:

2. Given an organization's mission and the tasks required for execution, the number of managerial levels to achieve best performance can be specified.

3. Managers must define the work, limits of discretion, and completion times for their subordinates.

4. At a minimum, managers at each level must have the authority to (a) veto subordinate appointments, (b) rate performance and give differential rewards, and (c) initiate removal from role.

5. Work can be identified by level, based on complexity measures (e.g., number of organizational elements involved, uncertainty factors, number of feasible courses of action, time to completion), and sign-off authority of level managers.

6. Lateral and bi-lateral responsibilities and authorities must be defined at each managerial level. Jaques (1984) has identified eight different authority relationships that exist within an organization the size of the Army (Table 3).

Table 2

Functional domains in the requisite Stratified Systems Theory organization

Time Span	Stratum	Functional Domain
	VII ARMY	Systems Domain -- Operates in a nearly unbounded world environment, identifies feasible futures, develops consensus on specific futures to create, and builds required resource bases to whole systems which can function in the environment. Conditions environment to be "friendly" to systems thus created. Creates a corporate culture and value system compatible with societal values and culture, to serve as a basis for organizational policies and climate.
20 yrs.		
	VI CORPS	
10 yrs.		
	V DIVISION	Organizational Domain -- Individuals at Stratum V operate bounded open systems thus created, assisted by individuals at Stratum IV in managing adaptation of those systems within the environment by modification/maintenance/fine tuning of internal processes and climate, and by oversight of subsystems.
5 yrs.		
	IV BRIGADE	
2 yrs.		
	III BATTALION	Production Domain -- Runs face-to-face (mutual recognition or mutual knowledge) subsystems -- units or groups engaged in specific differentiated functions but interdependent with other units or groups, limited by context and boundaries set within the larger system.
1 yr.		
	II COMPANY	
3 mos.		
	I PLATOON	

Table 3
Types of Authority Relationships (Jaques, 1984)

TYPE OF AUTHORITY	EXAMPLE	LIMIT SETTING	APPRAISAL OF CONFORMITY TO LIMITS	TASK INITIATING	APPRAISAL OF PERSONAL COMPETANCE	INFLUENCING MOVEMENT IN ROLE
Command Managerial	Commander	Decide	Decide	Order	Decide	Decide
Supervisory	Squad NCOs	Recommend	Decide	Order	Recommend	Recommend
Attachment	Attached Combat Support	Decide	Decide	Order	Limited Decision (1)	Limited Influence (2)
Coordinative with Staff	G/5 - 3	Recommend	Decide	Order	--	--
Monitoring & Coordinating	IG Staff CSM	Recommend	Decide	Persuade	--	--
Quality Inspection	Financial Audit	Recommend	Decide	--	--	--
Advising	Special Staff	--	--	Persuade	--	--
Collateral	2 BDE Commanders	--	--	Persuade	--	--
Service Getting	General Support	--	--	Request	--	--

(1) Person receiving attachment is limited to deciding only whether the attached person's performance is above or below the minimum required standard.
(2) If the person receiving attachment decides that the attached is below the minimum required standard, his influence is limited to having person's attachment to him discontinued.

In addition, Jaques divides organizational tasks between operations and support. The basic premise is as follows:

> . . . it is essential to outline first the organizational pattern for the operational activities - to construct what I would term the 'operational spine' - and to build the organization of support activities around this operational spine (Jaques, 1976, p. 247).

Operational tasks of any organization as those which 1) develop goods and services, 2) manufacture or buy goods and services, and 3) sell or field goods and services. A clear understanding of the division between operation and support is crucial to the process of assigning responsibility and defining authority relationships.

Analysis based on the Jaques' model allows both the researcher and the reader to understand the requisite work by level and the relationships that must be defined to accomplish the work of the organization. The SST model has already been successfully applied to U.S. Army organizational requirements. Jaques, Clement, Rigby, and Jacobs (1985) used this template to describe the work performed by three- and four-star General Officers and Senior Executive Service personnel at the Army's systems level. The current study was structured to apply the models to PMO structure and PMO/MSC relationships, and to base findings and recommendations on the SST levels of work, operational and support tasks, and required authority relationships.

RESEARCH OBJECTIVES

Based on the request from the Assistant Secretary of the Army (Research, Development and Acquisition) (Interdepartmental Correspondence, 9/5/85), the objectives of the research were specified as follows:

1. Examine the structure of a program office over its life cycle.
2. Review the role and relationship between PMOs and the matrix support received from the MSCs.
3. Assess the career development of individuals assigned to be program managers.

METHOD

Procedure

Three representative MSCs were identified through discussions with the Chief of the AMC Office of Project Management. Each of the selected MSCs appointed a Point of Contact (POC) who was responsible for internal scheduling. One month before the interviews, a preliminary visit was made to each of the MSCs to select positions for the sample and coordinate the scheduling. To ensure that the appropriate levels of work were

investigated, interviews were restricted to those actually serving as members of the command staff, PMs, and Chiefs of Directorates. Substitutions because of lack of availability had to be cleared in advance with the research team.

The interviews were conducted by a two-person team, working together for the first two weeks and separately for a third. Interview responses were keyed directly into portable computers and stored on disks for future editing and analysis. Interviews were conducted on-site in individual offices where the interviewees had easy access to relevant information. Charts, studies, and other explanatory materials received in the course of data collection were included in the analysis process.

In addition to the three MSC headquarters, field interviews were also conducted at the Fort Belvoir R&D Center, and, as necessary, at sites in the Washington, D.C. area to coordinate with MSC personnel travel schedules. A second trip to Detroit and St. Louis was made two weeks after the original interview period to complete interviews that could not be scheduled earlier.

Instruments

A two-hour interview was scheduled for each person in the selected sample. A structured interview protocol (Appendix A) was used to solicit information about time in position, life cycle phase, reporting relationships, education and experience, and required skills and knowledge. This portion of the interview usually took about 20 minutes to complete.

The second part of the interview was more open-ended; however, during the course of the interview the following subjects were covered:

1. External relationships, including other MSCs, FORSCOM, TRADOC, AMC, and Department of the Army.

2. Relationships with various elements within the MSCs.

3. Primary tasks of their present work and how they envisioned that work to be accomplished.

4. An outline of their organizational structure, including the numbers of people required to do the work during the life cycle of their projects and to accomplish their work within the directorate.

5. A synopsis of the major problems they face.

6. Issues related to "deprojectizing" their PMO.

Sample Selection

In September 1985, 76 PMOs were located in eight MSCs. The three MSCs selected as representative of PMO/MSC organizational structures were Aviation Systems Command (AVSCOM) and Troop Support Command (TROSCOM), both located in St. Louis, Missouri, and Tank and Automotive Command (TACOM), in Detroit, Michigan. These MSC included relatively independent, functionally staffed PMOs (AVSCOM); PMOs receiving support from a single matrix (TROSCOM); and PMOs in a "capstoned" double matrix (TACOM). Capstone configurations are relatively new, and feature a Program Office with more than one Project Office under its direction. At TACOM, functional resources are assigned at the capstone level, rather than to individual projects, and individual project managers also receive support from the MSC matrix. The selected MSCs also included a range of single weapon system PMs to compare to "basket" PMs responsible for several related systems.

Based on time and resources available for the study and review of the organizational diagrams of the selected MSCs, it was decided to concentrate the research on the "organizational domain" described by Jacobs and Jaques (1986) (see Table 2, p. 11). Using Jaques' terms, a hypothetical theory of organization could be constructed that placed the MSC command groups at Level V and the PMOs and functional offices at Level IV. To test this hypothetical placement, the following positions were selected for the sample.

Major Subordinate Command Group

The Commanders of the three major subordinate commands were scheduled for interviews. The five Deputy Commanders were also included in the sample, with three interviews completed. The DCG for Readiness at AVSCOM and the DCG for RD&E at TACOM were not available; TROSCOM has only one DCG.

Unit	No. Interviewed	No. Military
TACOM	2	2
AVSCOM	2	2
TROSCOM	2	2
Total	6	6

Program/Project Managers

Of 30 possible PM interviews, 25 were completed, constituting 83% of the sample or 33% of the total population of 76 AMC PMs. Four of the PMs not interviewed were in TACOM (PM-Heavy Tactical Vehicles, PM-Tank Main Armament System, PM-Commercial Construction Equipment, and PM-Light Armored Vehicles). Three of the PMs were not available at the time of the visits, and one PMO is located in New Jersey. TROSCOM's PM-Physical Security Equipment was assigned but not yet present for duty.

Military personnel occupied 23 of the PM positions. TROSCOM has civilians serving as PM for Topographic Support Systems and acting PM for Clothing and Individual Equipment.

Unit	No. Assigned	No. Interviewed	No. Military
TACOM	16	12	12
AVSCOM	8	8	8
TROSCOM	6	5	3
Total	30	25	23

Chiefs of the Functional Directorates

Thirty-six functional directorate chiefs within the three MSCs were selected (Table 4). The areas represented were the ones primarily involved in supporting the PMs in the management of their particular weapons systems or products. Because each MSC is organized somewhat differently, it was not possible to sample the same directorates for all three MSCs. However, the following support functions were included in the sample:

- production and procurement
- quality assurance
- materiel management
- resource management
- cost analyses
- integrated logistics
- advanced systems planning
- engineering
- technical director

The TROSCOM Technical Director also provided advance system planning and resource management functions. The TACOM Technical Director position was vacant. In addition to the above directorates, interviews were conducted with the long range planning group and the safety office at TROSCOM, the design and manufacturing directorate at TACOM, and the maintenance directorates at AVSCOM and TACOM.

Unit	No. Interviewed	No. Military
TACOM	11	4
AVSCOM	9	3
TROSCOM	8	1
Total	28	8

Table 4

Total interview sample by MSC

Interview	TACOM	AVSCOM	TROSCOM
Commanding General	X	X	X
Deputy Commanding General	X	X	X
Procurement & Production	X	X	X
Product Assurance	X	X	X
Maintenance	X	X	
ILS	X	X	X
Force Development	X	X	
Cost Analysis	X	X	X
Engineering	X	X	X
Technical Director		X	
Materiel Management	X	X	X
Advanced Systems	X	X	X
R&D Center Director	X		
Manufacturing Technology	X		
Safety			X
Long Range Planning			X
	13	12	11
PMs	12	8	5
Total	25	20	16

Total number of interviews: 61

Design and Analysis

Jaques' Stratified Systems Theory (1976) was used to organize and describe the work and to develop structural recommendations. Response categories for content analysis were developed to:

1. Identify external factors impacting the sampled MSCs
2. Describe differences in structure and relationships in the three representative MSC/PMO configurations
3. Describe Level IV and V differentiation
4. Identify the operational spine of each MSC
5. Identify the components of each support staff
6. Describe the relationships between the operational spines and support staff
7. Consider impacts of proposed structural changes

RESULTS AND DISCUSSION

The models and complexity criteria of Stratified Systems Theory were applied to identify the work and the organizational level for both the MSCs and the PMOs. The following criteria were used in the analysis:

- the influence of forces external to the organization that the managers cannot control
- the numbers and needs of the various constituencies that make up the organization, particularly their resourcing
- the nature and number of types of lateral and command relationships involved in accomplishing work
- time span of tasks

The following sections will give an overview of these factors and their effects on the MSCs and PMOs.

Influence of External Factors

Externally-imposed forces identified in earlier studies (Table 1, p. 7) were evaluated in terms of continued impacts. These forces included:

- a trend toward centralization of decision-making authority and "micromanagement" of routine operations
- increasing information requirements

- turbulence created by one-year line item funding
- inexperienced requirements developers and requirements "creep"
- an unresponsive acquisition strategy process

Results of the current analysis indicated that each of these factors is still perceived as present and contributing to the complexity of the work of the MSCs. Centralized decision making was reported most consistently as having significant impact. Respondents from all organizational components cited recent examples of prior local decision authority now vested in higher echelons. In many cases, information-gathering for higher-level decisions was felt to have replaced decision-making as normative work.

Increasing Workload

In addition to external factors identified earlier, a significant increase in workload in each command was identified by the current analysis.

Using procurement funding as a proxy for workload, Figure 1 shows increases for the three commands from 1980 to 1984 and projected for 1984 to 1987. These increases probably reflect the influence of separate but related events: 1) the build-up funding and product development of modernization, 2) the increasing readiness responsibility as new products and systems are added to fleets and inventories that will not be discarded but cycled to reserve components or foreign sales, 3) the more labor intensive maintenance and repair required to keep older systems operational, and 4) increased procurement activities mandated by new legislation.

Percentage increases in procurement funds for the three commands were:

Command	1980 - 1984	Projected 1984 - 1987
AVSCOM	237 %	35 %
TACOM	45 %	59 %
TROSCOM	223 %	131 %

Information-providing identified in earlier studies is a sub-element of increased workload. Many of these requirements appeared to be driven by multiple layers of review responsibility that were without decision authority. There was unanimous agreement that the escalating review process, together with normal reporting requirements and external requests for information, were significantly affecting work and resourcing decisions.

Content analysis produced many examples of these impacts:

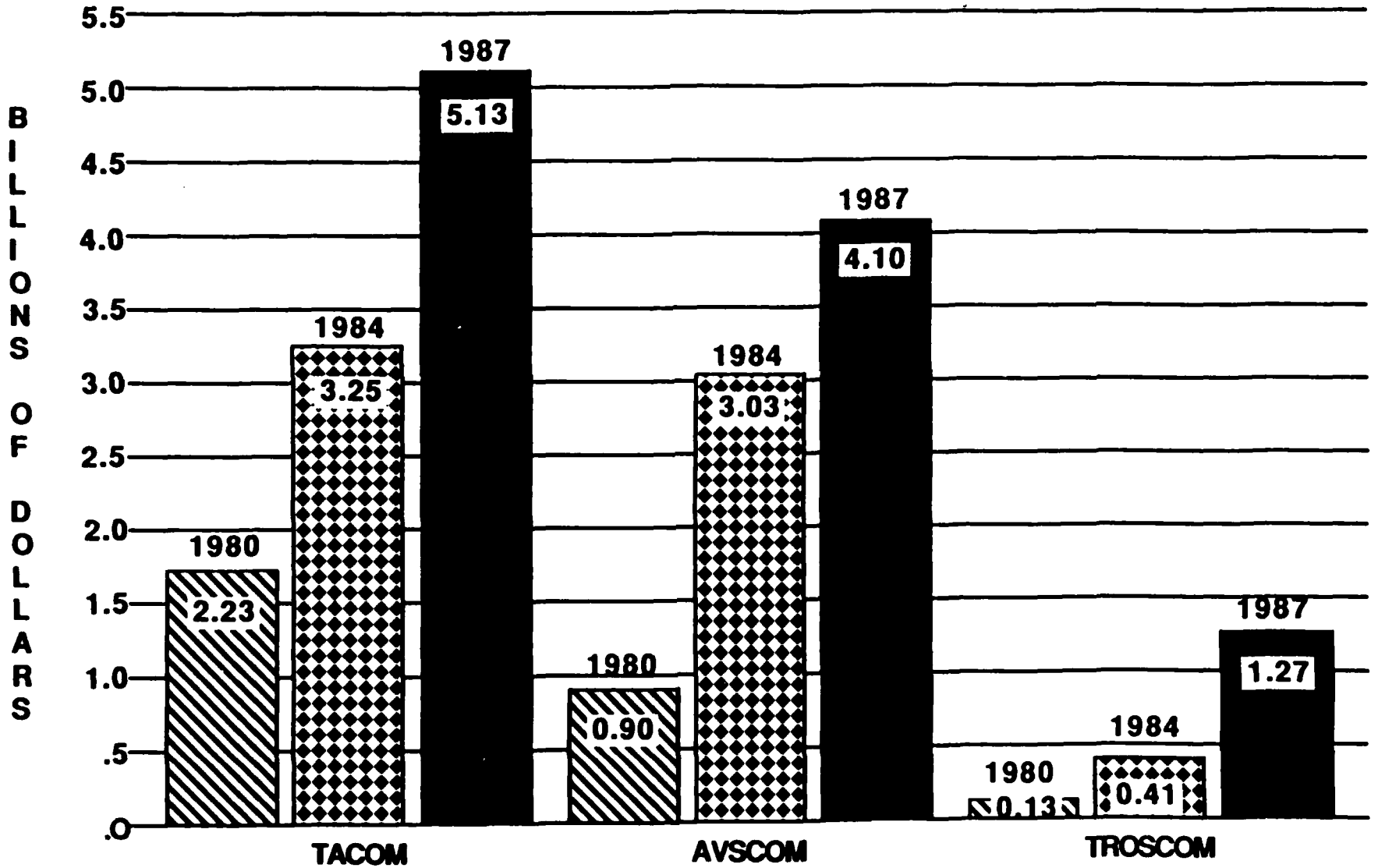


Figure 1. Procurement Funds by Major Subordinate Command, 1980-1987

- A PM in TACOM has established a cell to do nothing but answer requests for information. Three Colonels and one Lieutenant Colonel devote their total work time to responding to the five or six calls a day from members of Congress, Department of the Army staff, AMC, and interested others.

- A TROSCOM office had been created specifically to respond to outside questions. At least 10 Congressional requests for information were received each day regarding the small-business procurements handled by the command.

- An AVSCOM PM estimated at least one major request for information per day from outside the command that would require a formal, written response.

Information requirements also reflected significant changes in the frequency and nature of reporting within AMC. Responses from all components of the MSCs indicated that routine reports have increased and been augmented by a number of complex and time-consuming reporting and forecasting activities. All PMs cited AMC's PM Materiel Systems Assessment (PMSA) as an example of new, major reporting requirements that impact PMO resources and project milestones.

Resource Levels

The increased requirements of the external factors cited above have not been reflected in the most critical external influence -- resource levels. While workload and reporting requirements have increased, TDA authorizations for the three MSCs have remained basically constant. Figure 2 reflects an averaged 9% increase across the three commands from 1981 to 1984, and a 2.5% decrease projected for 1984 to 1987. TROSCOM was still part of TSARCOM in 1981; separate figures for troop support TDAs were not available from the command.

The slight increases in 1984 were almost entirely in procurement spaces. In response to heightened concern over procurement practices, Congress legislated measures to strengthen the procurement process and earmarked appropriations for procurement personnel and overseers. The process has been implemented in each of the commands. However, even with augmented staff, meeting the new requirements has resulted in lower priority for other functions. Additionally, the second order effects of this increased activity were being felt in other areas of the commands through more complicated and time consuming procurement processes but static or reduced resources.

Each external factor has a separate impact; there is a likely to be an interrelationship as well. As part of the analysis, three factors (workload, staffing, and information requirements) were quantified. TDA and procurement figures were averaged across the commands to represent percentage increase in workforce and workload. Specific numbers on information-providing requirements were not generally available. However, the System and Cost Analysis Directorate in AVSCOM had maintained such records that showed over a 900% increase in a single reporting requirement

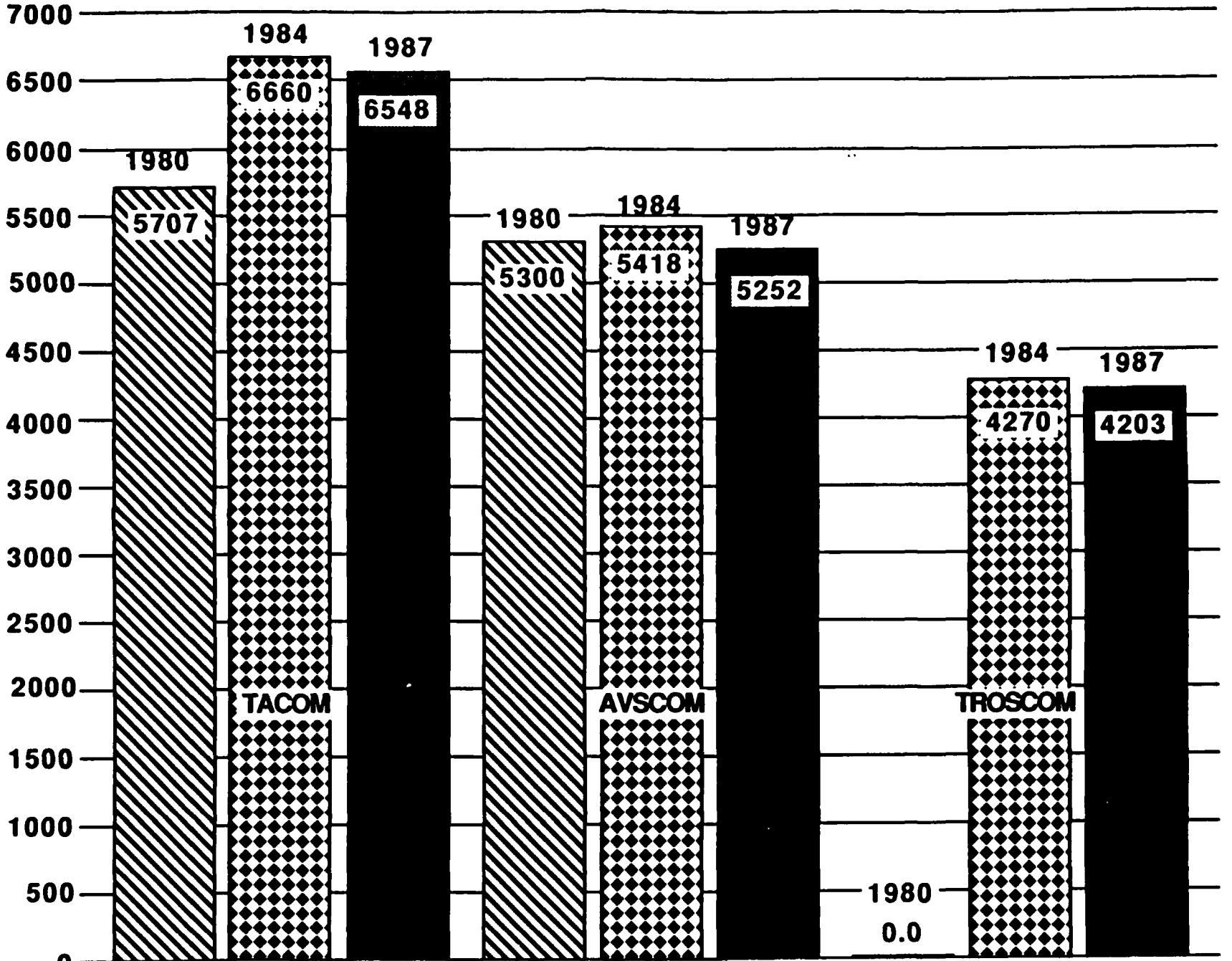


Figure 2. TDA Authorization by Major Subordinate Command, 1980-1987

in four years -- from 44 to 441. Using this single data point to represent percentage increase in information requirements, the relationships of these three resourcing and requirements areas are shown in Figure 3.

Greater workload with static resources is one indicator that work complexity is increasing beyond the levels that can be handled efficiently and effectively. Current responses to this dilemma include: (1) moving functional support from individual PMOs into a common resource pool that might prove to be more efficient, and (2) adopting the "turn-key" model popular in the Air Force and Navy as a potential solution to restricted support capability. AVSCOM's LHX development, the Army's first application of turn-key, is a radical departure from earlier methods. Contractors are assuming new levels of responsibility for concept development, production, fielding, and training. This trend will have large implications for the structure of future MSCs and PMOs, and the requisite responsibilities and skills of PMs.

Influence of Internal Factors

Response categories were evaluated across the three commands to identify and compare internal factors such as relationships between the PMOs and MSCs, differences in life cycle, and relative qualifications and experience of the PMs.

PMO Structure/Functional Support

The lack of definition of the roles and responsibilities of PMOs and the functional directorates noted in earlier studies was confirmed by this research. In addition, there was an added element of confusion as the MSCs contemplated the effect of reducing PMO size to 15 to 30 persons as instructed by AMC Headquarters.

The three MSCs showed distinctly different patterns of PMO size and the nature of PMO interactions with support elements.

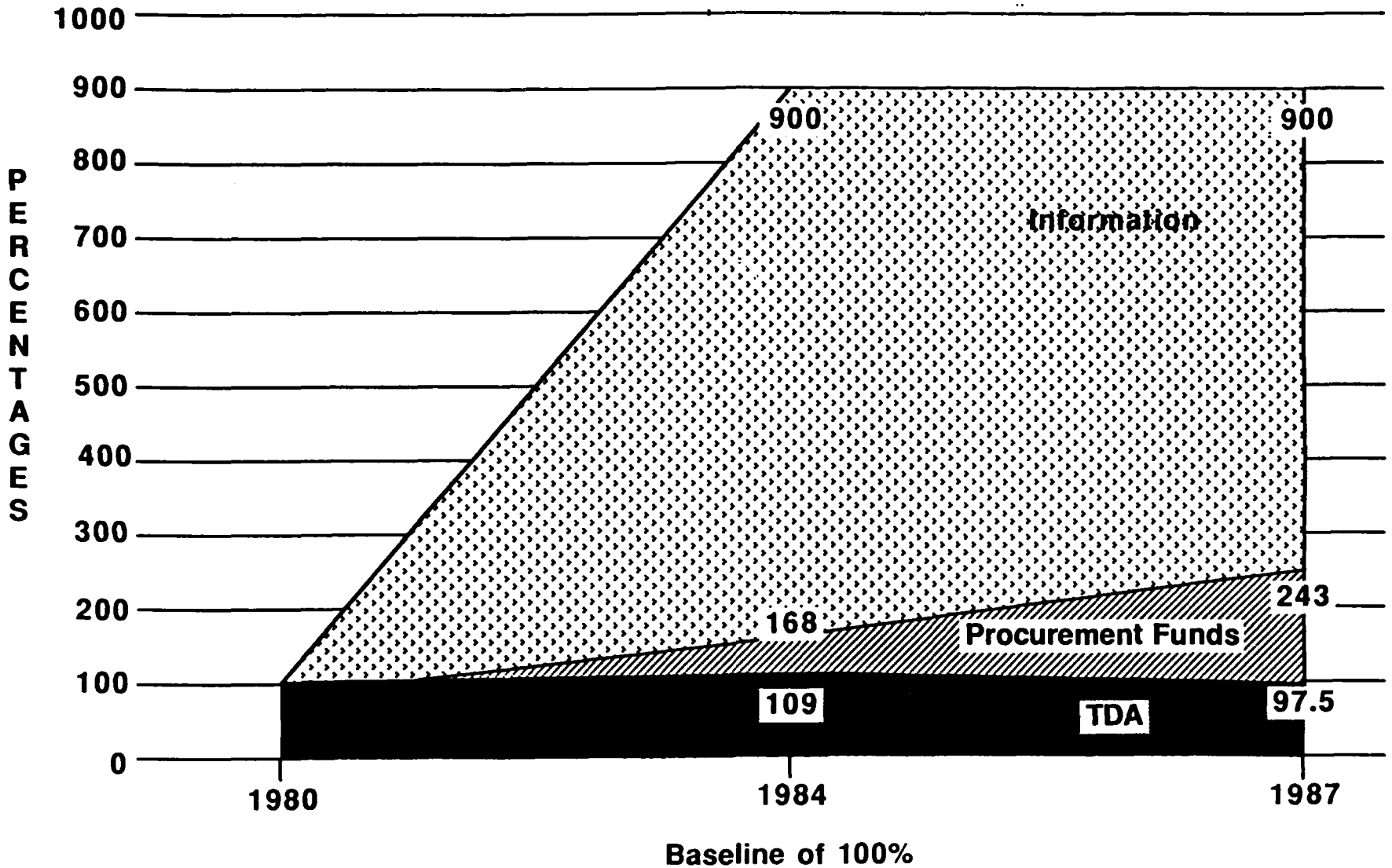


Figure 3. Comparison Requirements and Resources by Major Subordinate Command, 1980-1987

AVSCOM. AVSCOM's PMOs range in size from 42 to 87 for those reporting to the MSC. The Apache, with a TDA of 150, is one of the Army's four remaining "free-standing" PMOs. The Apache PM reports directly to AMC, rather than the MSC commander; the PMO is supported by AVSCOM in a procuring-command relationship. The larger staffs of these PMOs perform much of their own work, without functional support from the directorates. The effect of this independence is often a lack of stable working relationships between the PMO staff and those in the directorates. Because MSC functionals were only marginally involved in the PMOs' primary work, PM requests for "fire drill" assistance often were seen as disrupting routine work schedules and requiring system-specific knowledge that had not been developed. Without clear guidelines for establishing priorities in the directorates, PMs felt that a major part of their job was to apply the pressure necessary to secure this help.

TROSCOM. TROSCOM's PMOs were staffed according to a stated command philosophy that the functionals must do enough of the work to allow the PMOs to be phased out at project completion. The lone single-system PMO had a staff of 10; the four multi-system or "basket" PMOs ranged from 17 to 30. The PMO/functional relationships in this case were confused by the recent addition of Ft. Belvoir and Natick R&D centers to the command. Program managers located at these distant facilities developed their own local relationships for support, rather than interacting with Headquarters directorates. The command is developing a set of guidelines for functional/PMO roles and responsibilities. However, the current process was reported as the directorates tasking the PMs for information, and the PMs "requesting" help from the directorates. An added concern to the PMs was that a reporting change had recently been initiated that placed them under the Deputy Commanding General. This was viewed as a loss of status in the command and complicated their relationships with the directorate chiefs.

TACOM. The capstone model at TACOM has three components: (1) project managers with less than 10 assigned staff, (2) three program management capstones with from 200 to 325 in support divisions, and (3) another level of support in MSC directorates. Relationships are ill-defined between the three components. Project managers use combinations of division and MSC functionals to accomplish their work, and report a high level of frustration in securing the support they need without clear definitions of authority. A major problem was keeping track of their work in the complex sets of functional offices, a situation aggravated by the almost total lack of automated systems for processing project information. At the time of the interviews, 55 reorganizations were underway, including the RD&E Center where development and support functions had lost clear lines of separation. This command also has only two levels of project management, with completed programs handed off to Item Managers in the Directorate for Maintenance, rather than to an intermediate Weapons Systems Manager (WSM).

Life Cycle Phase

One of the objectives of the research was to investigate the internal influences of different PMO requirements relative to product life cycle. The nature of the materiel acquisition process underway in each MSC is shown in Table 5. Developing new major weapons systems (AVSCOM and TACOM) was found to have different support requirements than managing categories of NDI products (TROSCOM). For AVSCOM particularly, services provided by support elements are crucial to project success. For example, the authority to certify air-worthiness rests with the Engineering Directorate and not the PMOs.

Support requirements were found to differ with life cycle phase. The engineering and quality assurance support required during research and development are replaced by the logistics needs of fielding. It was noted that the MSCs have not been entirely successful at tailoring staffing to reflect these changes.

These differences in life cycle were also reflected in desired PM skills at each stage of the process. As noted by the MSC Commanders:

- From Milestone 1 to the beginning of production, PMs need to be technically qualified as design engineers with enough management background to get the work done in the PMO.
- During production, a PM should be knowledgeable in production engineering with a solid background in procurement and logistics management for the first fielding.
- After this point, PMs should have a strong background in Army "wholesale" logistics. It is preferable that they also have experience in a TO&E unit that will use the equipment, i.e., armor background for fielding new tanks. For this stage, an MBA coupled with wholesale logistics experience seems to be sufficient.

Even though life cycle differences were apparent, they did not necessarily translate into predictive differences in time span of tasks. The reasons for this uncertainty will be discussed in detail in subsequent sections of the report. In general, attempts to measure time spans of specific tasks are hampered by the ubiquitous changes in funding and requirements that make stated deadlines largely meaningless. Even predicted target dates for disbanding PMO offices appear to be unrealistic, given the current lack of organizational units to assume responsibility for maintaining system readiness.

PM Qualifications

The qualifications of those serving as program managers are an internal influence on the work of the PMOs and MSCs. However, this influence is also an external factor, since PMs are named through a selection process that is largely outside of the control of the MSC commander or his staff.

Table 5

Life cycle phase of PMOs by MSC

Life Cycle Phase	TACOM	AVSCOM	TROSCOM
Concept Stage	Mobile Protected Gun System (MPGS)	LHX	
Research & Development	M1A1 (some in production)	AHIP	
Production & Fielding	ACE Bradley FVS M1 Tank	Blackhawk Apache	Topographic Support System (TSS)
Mature Systems 1) Mods 2) Cont. Production 3) Readiness	M60 Tank	Cobra CH-47	
Multi-Items Within Several Categories (Baskets) Includes all phases of life cycle; ( ) indicates number of systems	M113 (13) Medium Tactical Vehicles (28) Light Tactical Vehicles (4+)	Spec. Electr. Mission Aircraft (SEMA) (19) Aircraft Survivability Equipment (ASE) (19)	Petroleum & Water (PAWLOG) (80) Mobile Electric Power (MEP) (200) Amphibians & Water Craft (AWC) (20) Clothing & Individual Equipment (C&IE) (4,000)

In contrast to earlier studies, the PMs in this assessment were found to be generally well-qualified through education and prior experience. As shown in Figure 4, a high percentage of PMs in AVSCOM and TACOM had prior Assistant PM or PM experience. Qualifying experience in RD&A, AMC, and battalions/depots was also reported. Over 80% of the PMs had completed the DSMC PM preparatory course.

PMs were found to need a broad understanding of the Army and the other agencies that are closely involved in their work. They must be able to coordinate their work through representatives of the RD&A budget processes (DASCs), DCSOPS force integration (FISOs), user requirements (TSMs), and the Army's materiel acquisition process (AMC WSMs).

A majority of the PMs in all three commands noted that technical skills were not nearly as important as the ability to manage budgets, scheduling, and personnel. In addition, because of their role as defenders of their projects, briefing skills were listed as the number one requirement by 100% of the PMs in the sample.

Experience as a Department of the Army System Coordinator (DASC) was reported as the most useful by the PMs in this sample. This assignment was noted as giving them the experience they needed to understand the budget process and to be able to defend their programs several times a year. Budget information also was the topic of a majority of the external information requests, making this knowledge especially critical.

One factor in increased PM qualifications is the recent institution of a PM Selection Board that meets concurrently with the Command Selection Board. PM work is beginning to be viewed as a viable career track, and one that can lead to promotion. This trend is reflected in higher caliber personnel attracted into the field, and a growing commitment to view it as a career.

Effects of Chartering Process

Another objective of the research was to investigate the internal influence of the chartering process for program management offices. It was hypothesized that source of charter would be reflected in authority relationships and internal staffing. Source of charter (Figure 5) was part of the data-gathering process, as was the comparative usefulness of Secretary of the Army and AMC charters.

All charters, regardless of source, named the PM as the person "responsible for project management of the materiel readiness program" for a system, and cited as having "full line authority of the CG, U.S. Army Materiel Command, as delegated to the CG (MSC) for the centralized management of the project." The PM is noted as having a "direct channel of communications to the Chief of Staff, Army and the Secretary of the Army should any of the participating organizations fail to respond to project requirements . . ."

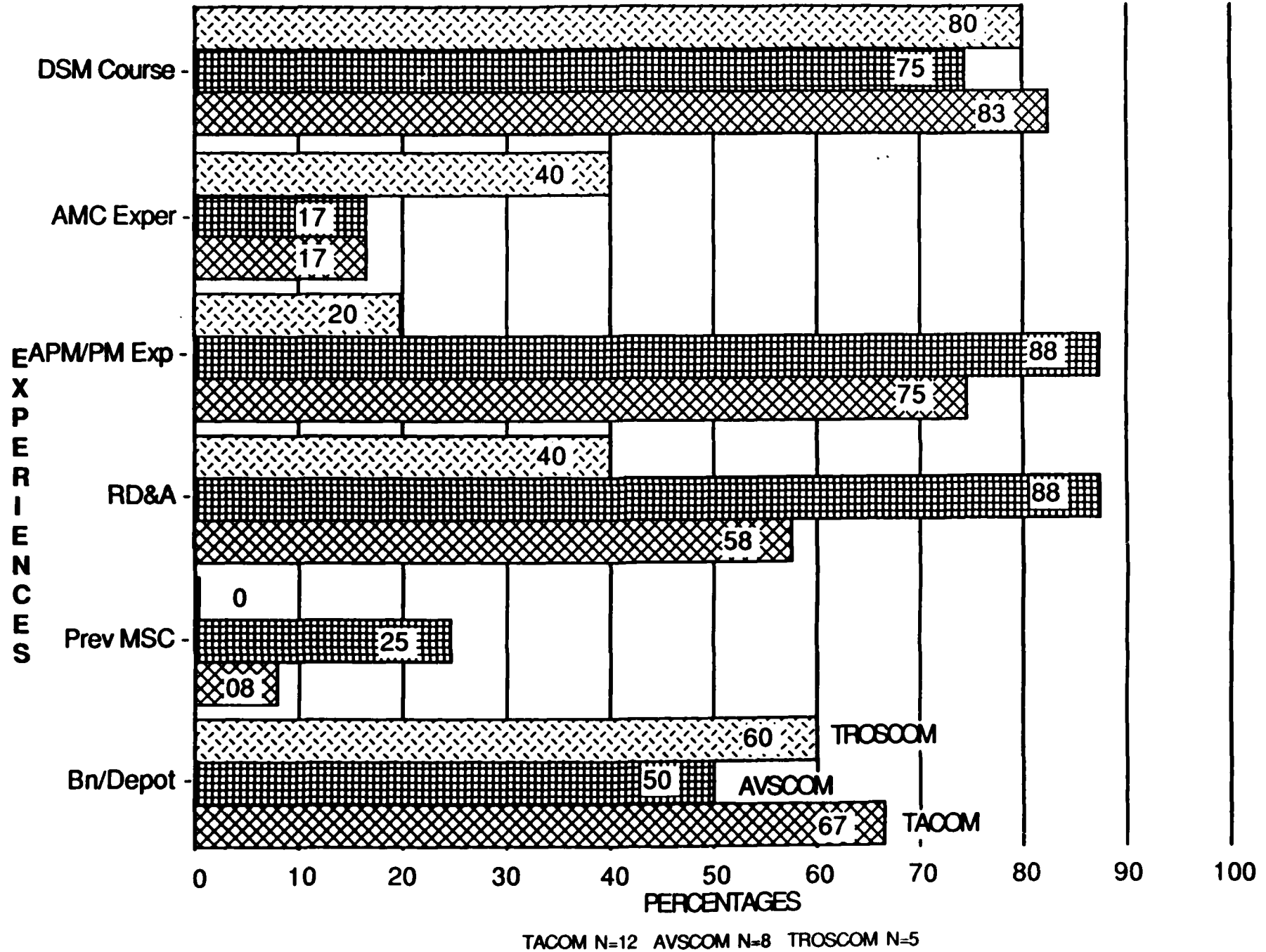


Figure 4. PM Qualification by Major Subordinate Command

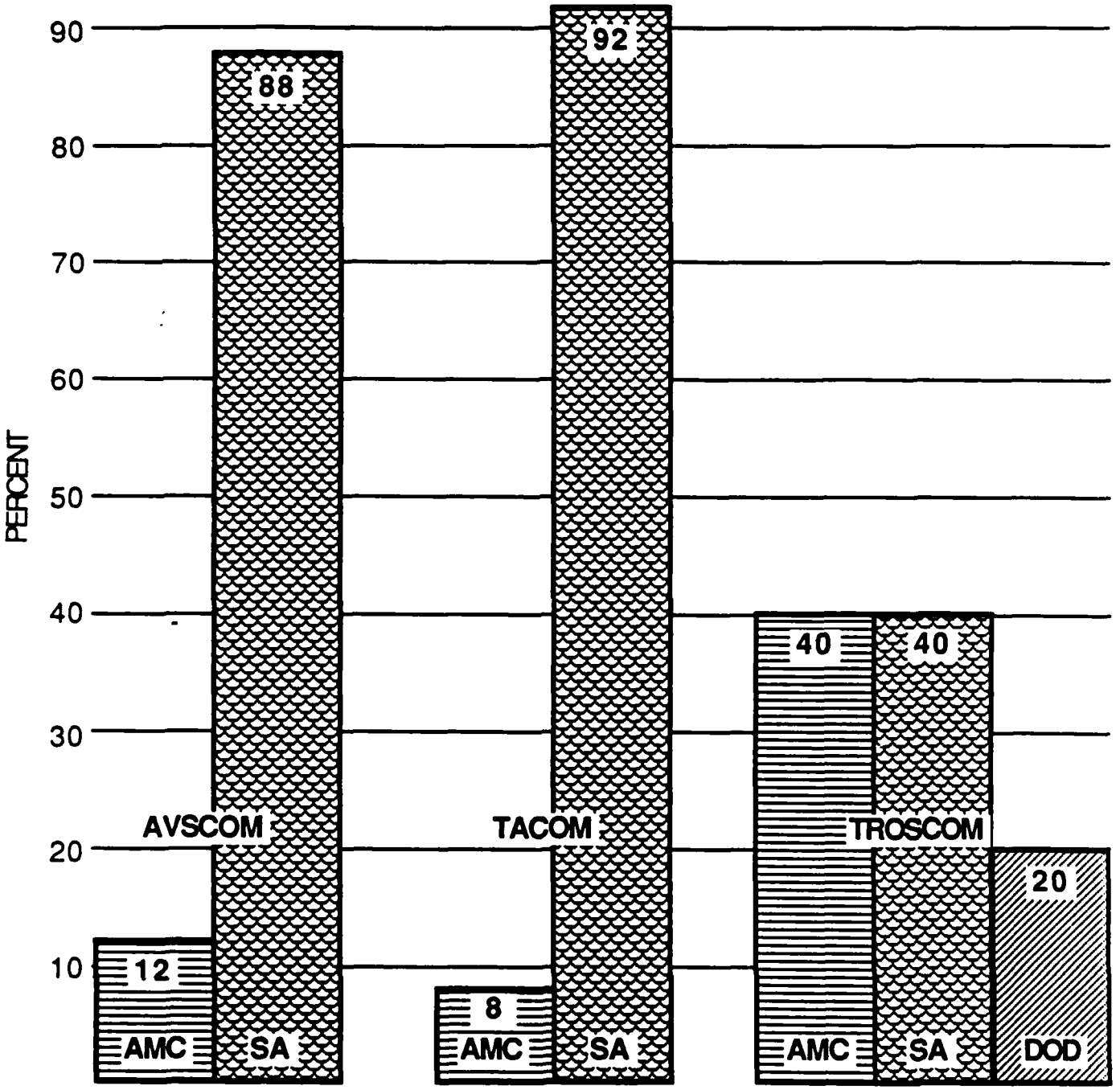


Figure 5. Source of PM Charter by Major Subordinate Command.

The stated PM authorities described in the charters were not found to be reflected in actual PM decision authority. Furthermore, PM decision discretion generally was unaffected by source of charter. The PMs themselves noted a preference for a Secretary of the Army charter. However, its usefulness was seen as restricted to operating outside the Army structure, i.e., in a DOD role or with an agency such as the Defense Logistics Agency. No PM had ever invoked his charter to see the Secretary of the Army. Such an action was seen as likely to jeopardize future opportunities. As one respondent noted, "I might have thought about it, but I knew I could only do it once."

The current charters apparently reflect reporting relationships and authority levels that were necessary for a free-standing, independent configuration. One of the requirements identified in this research is a set of documents that define the actual authorities and relationships of today's PMOs regarding both their MSCs and higher-level organizations.

Stratified Systems Theory: Levels of Work

The initial hypothesis had been that the MSCs would be operating in the organizational domain as described by SST, with the Commander at Level V and the PMOs and supporting organizations at Level IV. The results of a content analysis of complexity factors described earlier, critical tasks, time frame of work, and reporting relationships supported the hypothesis.

Level V MSCs

The MSCs were identified as fitting the criteria for Level V organizations. They are bounded open systems, operating in a five- to seven-year time frame, and preparing information for AMC Headquarters concerning the life cycle of equipment out to 20 years. They are assisted by Level IV units in accomplishing the mission of the organization. They are similar in many ways to Divisions in the Army's TO&E organization.

In general terms, the mission of the MSC and the critical tasks of the Level V Commander are to:

1. Allocate manpower, monetary, and facility resources
2. Translate user requirements (either from the field or from combat developers) into fielded hardware
3. Develop, procure, stock in depot, and provide prioritized release authorization for units of designated:
   a. Supply (equipment and major end items)
   b. Class IX Supply (spare parts)
4. Develop and document maintenance procedures and schedule depot maintenance for designated pieces of equipment

In addition, the Level V Commanders listed their value-added by their positions as the responsibility to:

- Place the MSC in strategic positions, add emphasis and support issues, and act as a buffer regarding major problems with respect to higher level commands.
- Prioritize resources within the organization and keep the command focused on problem areas. (This was consistently noted as the most difficult task.)
- Develop policy and guidance.
- Add discipline to the organization.
- Develop a command climate that promotes teamwork, creativity, innovation, and career progression for all.
- Teach subordinates.

These skills are consistent with those required at Level V by the models of SST.

Level IV Units

The analysis identified a number of Level IV organizations within the Level V MSCs. Identification was based the complexity measures outlined above including time to completion for longest task. Because of the turbulent budgeting process, time span for the Level IV PMOs and directorates ranged from two to five years. These managers generally were using the current budget year plus one or two other years as a basis for planning their work.

Another basis for Level IV placement was the identity of the individual to whom the managers reported for decisions about their work. In other words, what level above them added value to their organization. Forty-six PMOs and directorates in the three MSCs initially were identified as having the potential to be Level IV units. Responses were as follows:

Person "adding value"	No. of Responses
MSC Commander	21
Shared between DCG (rater) and MSC Commander	14
DCG	6
Higher than MSC Commander	5
	46

Thus, 76% identified either the Level V Commander or a Commander/DCG combination as the value-adding entity. In those cases where the DCG was designated as PM rater, PMs were uncomfortable with this arrangement. They believed that they were actually working for the Level V Commander, further confirmation of Level IV placement for PMOs.

One other criterion was used to arrive at Level IV placement for PMOs -- the skills required to do PM work. The following statement from an experienced PM describes the skills and knowledges required, a view that was echoed throughout the commands and confirmed by this research:

> . . . PMs have to know the game and the formal and informal rules. They have to know the capabilities of other elements within AMC, the depots, the commodity commands, and the labs in LABCOM. They have to appreciate the roles of the test agencies and independent evaluators, such as TECOM, AMSAA, OTEA, the Military Traffic Management Command and Logistics Evaluation Agency. They have to understand how TRADOC and the combat development process works and its pitfalls, and the relationships with the other major MACOMs.
>
> They need to understand the logistics computer system, force modernization system, and force integration system. They should be politically sensitive to the other services and the Defense Logistics Agency that buys 50 to 60% of the Army's spare parts. They also must understand international pacts like NATO.
>
> The PMs have to be the most knowledgeable, well-rounded people you can find, people who have the technical capability to understand the product they are developing, and who can sell their system all the time.

These are the skills that typify SST's Level IV managers.

Similar criteria was used to establish Level IV placement for major functional directorates such as Procurement and Production, Engineering, and Quality Assurance.

Stratified Systems Theory: Operational Spine

A key element of SST is that organizational structure should focus on the components that develop, manufacture/purchase, and field goods and services -- the operational spine -- and build the supporting organizations around them. In terms of levels of work, these components can be described as: the Level IV organizational units used by the Level V Commander to execute the processes necessary for the output of goods and services by his command.

Operational Components

The organizational units identified as part of the operational spine were fairly consistent across commands. Therefore, rather than analyzing each MSC separately, the following discussion will describe the operational spine in general terms, using functions as organizational descriptors, rather than specific titles.

Level IV organizations that assist the Level V Commander in the development of goods and services:

- Advanced Systems, Concepts, and Planning Directorates
- Technical Directors
- Research and Development Centers (Laboratories)

These organizational units develop new weapon systems, new components for existing weapon systems, and changes to existing systems and procedures. In terms of the life cycle model, development components are heavily involved through Milestone 1, with decreasing activity as the new systems progress through the other life cycle phases.

New development and changes can be generated by a number of sources, both external and internal to the organization. External events include requirements documents from TRADOC, usage information from field operations, and requirements generated by other Army MSCs or other services. Internal sources include PMOs, contractor recommendations, service staff directorates, and R&D Centers.

Primary services required by these organizational units include programming, budgeting, engineering, testing, procurement, and cost benefit analyses.

Level IV organizational units that assist the Level V Commander in the production or buying of goods and services:

- PMs (including program, project, and product managers)
- Weapon System Managers (WSMs)
- Directorates of Material Management (Item Managers)
- Directorates of Maintenance (maintenance documentation and depot rebuild)

The MSCs involved in materiel acquisition do very little of their own production. Even the few major production facilities that do exist are operated by contractors. Thus, the primary activity of these components is the procurement of goods and services through contractual agreements.

PMs and WSMs are usually chartered to manage the processes involved in the life cycle model from Milestone 1 through fielding. Occasionally, a PM or WSM will be appointed to manage the development of a new item prior to Milestone 1, but that is not the usual pattern. The assignment of a system or product to a PM, WSM, or Item Manager depends on system

complexity, monetary value of the project, and importance to the Army from the standpoint of readiness or visibility.

PMs generally manage a new or major modified weapons system during the demonstration, validation, full-scale development, production, and deployment stages of the life cycle model. The AMC concept of program management includes turning a fielded system over to either a WSM or an Item Manager for the sustainment phase that spans the life time of the piece of equipment. However, for major weapon systems, sustainment generally has continued to be managed by a PMO.

Primary services required by these Level IV buyers include programming, budgeting, and procurement. Engineering services are required from the demonstration phase to the production phase, changing with the life cycle from design to production engineering. Testing services are needed from the demonstration phase through full-scale development. Quality assurance services are required from demonstration and validation through the end of production.

Level IV organizational units that assist the Level V Commander in the fielding and customer satisfaction for goods and services:

- PMs
- WSMs
- Directorates for Materiel Management
- Directorates for Integrated Logistics Support (ILS)
- Fielding Teams
- Directorates for Quality Assurance
- Directorates for Readiness

The operational spine units listed above are similar to those listed in the previous category to assist the Commander in purchasing goods and services. SST postulates that such a duplication of effort would result in lost efficiency and restricted product control.

Of all the dimensions of work to be accomplished by the Level V Commanders, the functions and responsibilities for fielding and reporting user satisfaction/materiel deficiency are the least well-defined. PMs and WSMs generally have had fielding responsibility for their products. However, evolving Integrated Logistics Support (ILS) organizations are assuming some fielding coordination activities, either as separate directorates or as functional offices in the Directorates of Materiel Management or Readiness. There are also on-going discussions of centralized fielding teams. At this point, the roles and responsibilities vary by command, as do the roles of the PMs.

Field commanders have the authority to reject equipment from an MSC if operability or maintainability are in question. The MSC commanders have the final responsibility for assuring that requirements have been met before signing Materiel Release Orders. At this initial stage, fielding problems are visible to Level V Commanders and above, feedback mechanisms from the field are direct, and problems can be quickly corrected. During

sustainment, however, equipment and spare parts usually are requisitioned and shipped through the depot system. The user satisfaction/materiel deficiency reporting system tends to become indirect and diffused throughout the Level IV operational spine and lateral support units.

Without a specific organizational unit to respond to user needs and problems, the PMOs, WSMs, and Directorates of Material Management have assumed these functions. It seems likely that the extended life of PMOs can be traced directly back to the Level V Commander's need for this work to be done as he operates without the requisite organizational structure.

Primary services required by the operational spine units engaged in fielding, user satisfaction, and deficiency reporting include programming, budgeting, procurement, and the collection of field data, including quality assurance data for warranties and reliability, attainability, and maintainability (RAM) data for compliance specifications.

Supporting Organizations

The Level V Commander has the responsibility of ensuring that his organization provides the services required by the components of the operational spine. He is assisted by a number of Level IV organizations including:

- Directorates for Procurement and Production
- Directorates for Engineering Support
- Directorates for Systems and Cost Analyses
- Directorates for Quality Assurance

The mission of these lateral support organizations is to provide services to the operational spine throughout the phases of the life cycle. In earlier studies and some organizational literature, they are referred to in the aggregate as "the matrix."

Stratified Systems Theory: Authority Relationships

One of the command and control issues confronting the MSCs is the nature of the relationships between PMOs and the lateral support organizations. The authority relationships identified by Jaques (Table 3, p. 13) were used to analyze these roles. Three sets of relationships (service giving, auditing, and monitoring) were identified.

Service Giving/Service Getting

This relationship exists when the components of the operational spine request assistance from the support components to accomplish their work. Support staff are expected to 1) provide the service to meet the request, or 2) advise the operational spine units if they are unable to do so because of resource constraints, and discuss alternatives. Operational spine units are expected to 1) request the service with adequate lead time, recognizing that the supporting unit must respond to all units in the MSC organizational structure, and 2) advise the Level V Commander of

any conflicts between milestone completion and the ability of the supporting unit to accomplish the work. This should be the nature of the day-to-day relationship between the PMOs and Directorates such as P&P, Engineering, QA, ILS, etc.

The Level V Commander or a coordinating staff officer (CSO) must develop the priorities necessary to reduce conflicts between support components and the operational spine. Priority decisions should include external requirements from higher commands, lateral MSCs, and contractor production schedules.

Auditing/Inspecting

Support staff units can also audit or inspect the work being performed by operational spine components, assisting the Level V Commander in ensuring that activities are within policy limits and regulations. For example, the Engineering Directorate in AVSCOM is responsible for certifying the air-worthiness of new aircraft. This authority relationship allows the Directorate of Engineering 1) to inspect the work of the operational spine components and 2) to stop the work if air-worthiness requirements are not met. The operational spine component must comply immediately. However, if there is lack of agreement on the auditor's recommendation, the matter can be referred to the Level V Commander. This auditing authority does not include involvement in the day-to-day coordination of activities within the units of the operational spine. Similar auditing functions are provided by the contracting officers in the Directorates of Procurement and Production.

Monitoring

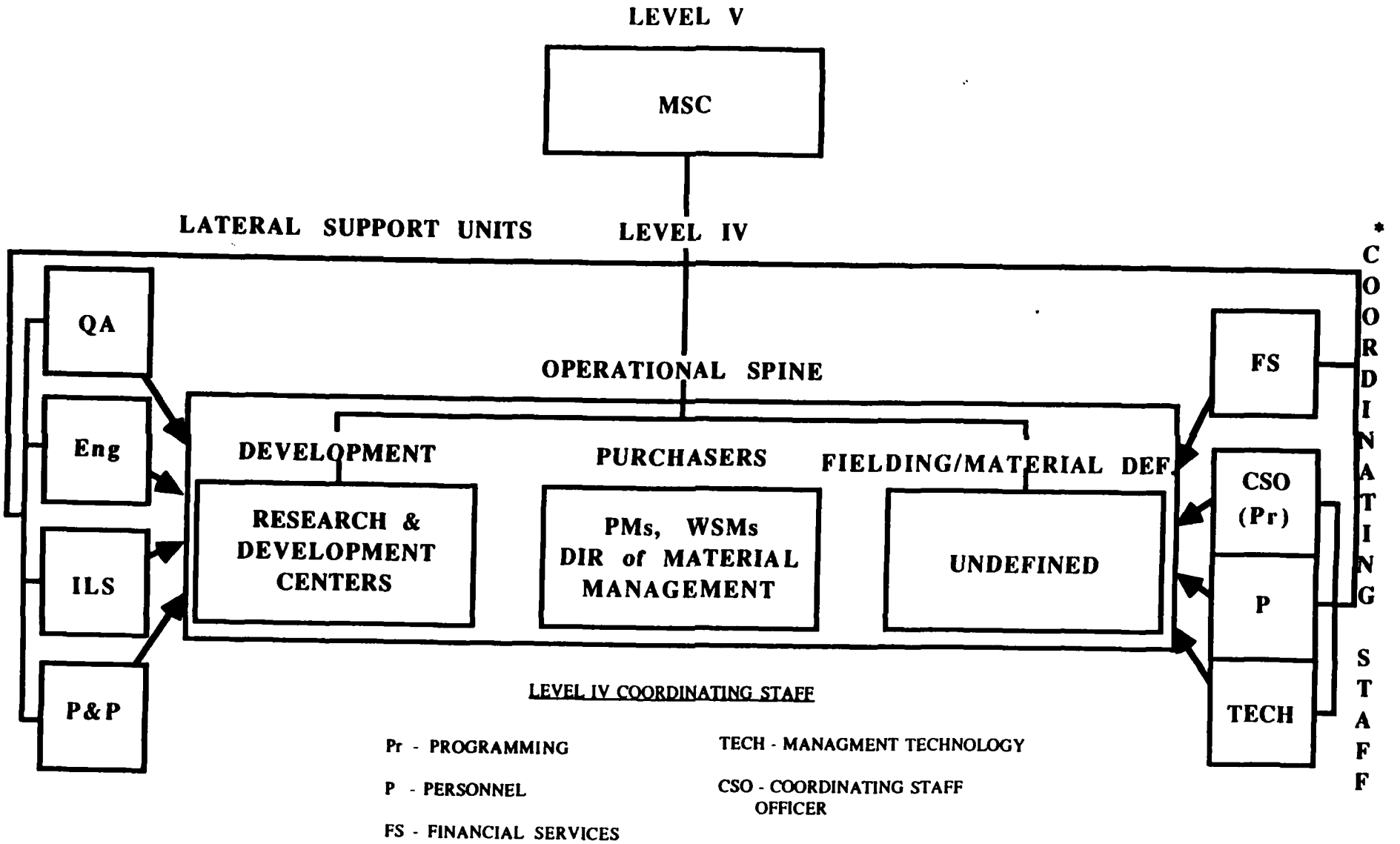
Monitoring relationships provide an independent check that standards are being adhered to, but are different from auditing/inspecting in that the monitor does not have the authority to stop work in the operational spine. The supporting monitor is expected to 1) discuss needed improvements with the operating unit, 2) report sustained or significant deficiencies to the Level V Commander, and 3) recommend new policies or standards where required. Examples of this relationship are found in Quality Assurance and support units responsible for ILS activities.

Stratified Systems Theory: Level V Coordinating Functions

In addition to the division of operational spine and support units, the SST model identifies requisite coordinating functions and their proper placement in the Level V organization (Figure 6).

Coordinating Staff Officer Role (CSO)

SST hypothesizes a Level IV CSO to assist the Level V Commander in managing the activities of the operational spine and support components. The role of the CSO includes:



*Coordinating staff is the personal staff of the PM and functions cannot be delegated to other units.

Figure 6. Stratified Systems Theory Requisite Structure Model of Level V Major Subordinate Command

- helping formulate policies and strategies that consider the experience and opinions of the operational spine and support components, in addition to any constraints from senior management
- developing programs and procedures to accomplish the organization's work
- integrating the work of the operational spine and support units, and establishing priorities necessary to reduce resource conflicts
- monitoring the information system and flow of information

The CSO needs the authority to give instructions within policy. The subordinate units 1) may not disregard such instructions, and 2) must refer any disagreements to Level V Commander. An important point, according to SST, is that the CSO should not be part of the reporting chain for the component managers.

The three MSCs in the current study recognized the need for a CSO function, but assigned it in different ways. TROSCOM fills the role with its single DCG. AVSCOM has two DCGs, divided by Research and Development (R&D) and Procurement and Readiness (P&R). TACOM has five CSOs, including the two DCGs and the three capstone PMs.

AVSCOM PMs report directly to the Level V Commander rather than through the DCG for R&D, in accordance with the SST model. However, the DCG for P&R is included in the reporting chain for the other components of the operational spine. TROSCOM also had the theoretical model in place until the recent change that brought the CSO into the PMs' chain of command. TACOM PMs have two tiers of CSO responsibility, with a reporting chain through the capstone PMs, rather than to the Level V Commander.

The need for this coordinating function is particularly acute in the MSCs where PMOs must rely on lateral support units but have no clear authority relationships. The prioritizing of critical tasks in the face of limited resources has to be an organizationally grounded. As was noted by one DCG,

> . . . More matrixing will take a coordination cell different from anything we have now. We will have to be better buffers and prioritizers at this level than we have needed to be before.

Other Coordinating Requirements

In addition to the programming and integration provided by the CSO, Level V commanders also require a coordinating staff to assist with budgeting (finances), personnel support activities (manpower, personnel management, TDA/TOE structure), and the technology to support the

organization. In today's environment of almost overwhelming data generation and information requirements, technology will include information management systems, hardware, and processes. Examples of these coordinating components are:

- Programming Divisions
- Budgeting Divisions (Comptrollers/Directorates for Resource Management)
- Directorates for Management Information Systems
- Personnel (Force Development/Civilian Personnel Offices)

These coordinating functions are in support of the Level V commander and the entire MSC, including both the operational spine and support components. Each of the commands in the study had these coordinating units in place.

Stratified Systems Theory: PMO Coordinating Functions

Level IV PMs also require a CSO function and coordinating staff in the areas of finance, personnel, programming, and technology. Examples of these coordinating components are:

- Deputy and/or Assistant PMs as CSOs
- Administrative Officers
- Programming/Budget Divisions
- Cost Management Divisions

Coordinating budget and program milestones are the PM's primary and critical tasks. One of the difficulties in assessing structural requirements for the PMOs is that these functions have been considered part of the "matrix" of support activities. This assumption implies that this work can be accomplished by lateral support units in the same manner as true "support" functions such as engineering or quality assurance. However, as coordinating functions have been removed from TACOM PMOs, the results have not been satisfactory. The following quotes provide specific examples of the importance of the correct placement of these functions:

In programming:

> . . . Our office has to deal with at least 100 points of contact. We need twice the people we have to do it well. The way we are organized now, PMs are project officers who do the briefings and answer questions, but are not responsible for the work.
>
> I have four people to handle some 28 systems . . . We are working across several MSCs to make sure milestones are going to be met. Because of the shallowness of the structure, when my people are gone I become a doer, instead of a manager. I drop several levels of work down and am working levels 1 through 5.

In the budgeting area:

> I have no one in the cost analysis area, yet quantity of production questions are massive projects done with stubby pencil. The responsibility is fixed, but we don't have any way to get the work done . . . I try to leave the work in the functional area, but it drops through the cracks and people fight about whose work it really is.
>
> We saved 60 spaces when the shop was matrixed, but too many budget and program spaces went over into the command. We used to be good at responding to DASC requests for 15% cuts in our budget, but have now lost our credibility. Your budgeteer has to be one of the best people around. He needs to know that Item #2 in your prototype has bombed and $3 million is now available and what it can fund.
>
> I have tried to make matrix management work; don't say something is not worthwhile until you have tried it. If you find something is impossible then attack that. For example, I found that in the most important area, accountability of money, I couldn't make it. They had to return the core of people so that I could get the dollars to the project in a timely manner.

For information management:

> I am unable to be proactive because there is no mechanism to tell me what is going wrong in the field. We continue to produce bad parts, but are unable to get the information to close the loop. We are bombarded with data, but have no way to transform it into information in a timely manner so that our people are able to do their work.

The following quote from a functional directorate illustrates that the problems are recognized on both sides of the staffing dilemma:

> . . . Answering what-if's requires being physically involved in the PM offices. That is a quick-response kind of action, and that is not our forte. In general, my people have a rigid way of doing analytical work. PMs are more interested in integrating and my people cannot follow the logic of their decisions. . . .

The information gathered in this study supports the thesis that the PMs require a coordinating staff to assist them with budgeting, programming, personnel support, and information management. These functions cannot appropriately be delegated to lateral support units.

Stratified Systems Theory: Full-Time Support Requirements

Another element of the operational spine/support group theory is that if there is full-time activity for a functional specialist in an operational unit, it is essential to differentiate his function and to establish his role there subordinate to the unit manager (Jaques, 1976, p. 322). The current AMC move toward downsizing the PMOs is based on the assumption that personnel in support units will be able to work on more than one project, thereby increasing efficiency. This would seem to be true only if support staff are currently underutilized in the PMOs.

The following quotes from TACOM PMs note the difficulty of securing necessary support for PM work:

> The timeliness of our work suffered when the PM was downsized and folded into the matrixes. PM work is intensive management, yet we are totally dependent on the ability of the matrix to respond. They don't give us enough time because it is not their sole function in life.
>
> When the functional matrixes have PARRs that justify every man hour against their own missions, they can't accept additional missions from PMs and still do their things. It appears we are trying to get something for nothing.
>
> The matrix comes back to me and says that it is my work. I agree that it is my responsibility, but without the people, it is not my work. At this point, we can only brief and try to keep the milestone charts going . . .
>
> My biggest worry is priorities with the functionals. They work for the BG [capstone PM]. What are his priorities? Hopefully, mine are a subset.

The importance of assigning required full-time specialists to operational units as recommended by SST would seem to be confirmed. However, placement of these personnel need not be restricted to TDA authorized, superior/subordinate positions. Other methods are available that provide shared authority between units. Attachment/co-management and outposting as described by Jaques (1976) would seem to be potentially useful, and are described in Appendix B.

Stratified Systems Theory: Mutual Knowledge Units

One of the outcomes of placing full-time specialists in operational units is described by Jaques (1976) as a mutual knowledge unit. The PMOs in AVSCOM and TROSCOM evidenced this phenomenon. In this situation, people who work together share a common goal and can coordinate their efforts. Such an organization is normally not larger than 50 people (which coincides with AVSCOM's current goal to size PMOs from 45 to 57) but, as was found in TROSCOM, it can be much smaller. The PMs in AVSCOM

and TROSCOM consistently reported that their personnel were willing to provide more dedicated, motivated work and total number of manhours than those in support directorates. Interviews with directors confirmed this perception. In PMOs where personnel providing full-time necessary services were returned to the directorates but continued working full-time for the PMO, the loss of mutual knowledge and common goals was a source of frustration and contributed to the time required to get work done.

Although PMO TDAs are only one of the variables between the organizations, it is interesting to note the total number of people in the program management components in the three commands. Tabulating only those PMOs included in the sample shows:

TACOM	No.	AVSCOM	No.	TROSCOM	No.
M113	8	Cobra	42	PAWLOG	17
M-9 ACE	6	LHX	60	AWC	23
BFVS	11	Blackhawk	87	MEP	30
PM-LCV	293	CH-47	59	TSS	10
M-1	8	ASE	62	C&IE	18
M1A1	8	SEMA	49		98
M-60	9	AHIP	62		
PM-Tank	325	Apache	150		
MPGS	9		571		
Med. TV	8				
Light. TV	11				
PM-TV	200				
	870				

Comparing TACOM and AVSCOM, the two commands engaged in major weapons system development, these figures may be at least an indicator that Level IV PMOs with requisite staffs are able to accomplish more work more efficiently through mutual knowledge, common goal units.

Stratified Systems Theory: Level III PMO Work

Although the study did not include extensive interviews with Level III units, inferences can be made from Level IV and V responses that help to explain the significance of functional placement, grade levels, and command and control relationships.

The PM is the organizational entity responsible for developing new weapons systems and products. Depending on life cycle phase, this work encompasses one, two, or all three operational spine functions -- development, production, and fielding/user interface. To accomplish this work, the PM is assisted by Level III functional specialists including:

- Technical/Configuration Management Divisions
- Procurement/Production Management Divisions
- Product Assurance and Test Divisions
- ILS Management Divisions

These divisions can be placed in either the PMOs or in lateral support directorates. The problems encountered when these components are moved from the PMOs may partially be explained by the nature of PMO Level III work.

The PM and his staff audit and integrate the work of a number of entities, including other MSCs, contractors, laboratories, and depots, in addition to the functional specialists in their MSC's. The personnel in each of these organizations are directly supervised by others or are supervisors themselves; monitoring and auditing must be accomplished by persuasion and personal leadership. Yet, PMs and their staffs are ultimately responsible for the outputs. As noted by major-system PMs:

> We are the ones who have to answer the questions. We get the calls from DA and the Secretariat. In essence, the buck stops here . . .
>
> . . . Maybe a quarter to a half of my work is 2-star level. I'm the guy who deals with the contractor to figure out how we are going to do this. I'm working with the Executive VP at FMC.
>
> A PM needs to understand that dealing with high level executives in the contracting business is different from any kind of direct control. We can't order; we have to persuade.

This auditing/integrating activity is specific to the PMOs and their work in the operational spine. It would appear that functional specialists in lateral support units can assist in this work only if they recognize the priority of operational spine activities and can identify the auditing/ monitoring role as different from internal support activities. Interview responses indicated that this differentiation is not consistently recognized:

> For PM work to get done, I must have a superior position to the directorates. They work within the general rules; that is their view of the world. They must be able to respond faster or we are kidding ourselves about PMs using matrix management.
>
> The PM's job is away from the natural tendency toward lethargic organizations with a narrow perspective. You have to allow the PM to energize the system, at least enough to get his work out, even in the face of the directorates' needs to systemize and routinize procedures.
>
> My APMs are young fellows; when they come up against the bureaucracy in the matrixes, they can't get things done. There is also resistance because I don't write their report cards. The functionals march to their own drum.

> I need control over the people who are executing my program; I have to monitor because I have no control. If you left things to run their normal course, 90% of your actions would be in somebody's in or out box, with no action. I get little help from the functionals; they tell me that it is my problem.

PMO personnel consistently reported that the work "felt different" from work in lateral support units. An explanation might be found in major-system PM estimates that they and their Level III staff must audit and integrate the work of from 100 to 600 entities, but without superior/subordinate relationships. This indirect influence is far more difficult than direct supervision, and requires higher capability:

> . . . You need GS-15s to work it, either directly or co-located with functionals but identified with the program.

> I have to have people with the appropriate levels and skills. You can't go much lower than GS-13 and get the work done.

Higher grades for PMO Level III staff have been described by earlier studies as a source of waste and inefficiency. However, given the complexity of the auditing/integrating work and reliance on persuasion to accomplish the mission, higher grades would appear to be required.

Throughout the study, current Civilian Personnel Office (CPO) policies and classification schemes were often noted as a major cause of over-sized PMOs:

> I need the grades but not the hierarchical structure. I would rather hire one GS-14 but have to hire two 13's to get him. There are no classification standards for PM civilian positions.

The factors that produce work complexity include (1) the nature and numbers of lateral relationships involved in work accomplishment, and (2) the numbers of forces external to the organization that cannot be controlled. Though both of these factors are present in the complex integrating/auditing work of PMOs, they are not recognized by the CPO. Staffing can be justified only on internal hierarchy. However, in the concepts of SST, these lower grades cannot "add value" to the work. They have not developed the capabilities and complex frames of reference required to perform program management activities. The lack of personnel policies that reflect the specific requirements of PMOs result in larger than necessary PMO staffs of lower grades when a minimum number of higher grades would be more effective. As one of the architects of the TACOM capstone model noted:

> We would have liked to have PM offices of about 40 very talented people to get the work done; however, the realities of the civilian personnel system said we couldn't support the grade structure to put that talent in the shops.

It seems clear that these troublesome issues will have to be addressed.

Models for PMO Structure

AMC's streamlined acquisition process shows PM responsibility for two stages: (1) development/production prove-out and (2) production/deployment. In theory, development ends cleanly at production and fielding marks the hand-off to MSC components for sustainment. In reality, systems are continually being upgraded and modified, and there is a lack of identified Level V operational spine structures to support sustainment. As a result, many PMOs, particularly those engaged in major weapons system development, must become miniature Level V organizations containing their own development, production, and user interface functions. It seems appropriate, therefore, to consider optimum PMO staffing in light of the structure needed to perform these tasks.

As part of the data collection process, an MSC force development specialist was asked to design "ideal" PMO configurations by life cycle stage. For the developmental phase (Figure 7), 67 positions were listed, including 15 secretarial personnel. At the production/fielding stage (Figure 8), the 75 positions listed included 12 secretaries and a fielding team of 20. One notable difference between these figures and actual TDAs is the reduction in Assistant PM positions. This appears to be a valid reduction of redundant coordinating staff; however, these positions have been used as on-the-job training for future PMs. The benefit of this downsizing would need to be evaluated against lost training opportunities for future personnel.

Figure 9 applies the SST model to PMO personnel seen as optimum for the developmental phase. The requisite coordinating functions are provided by a Deputy PM/Assistant PM as CSO, an administrative officer in the personnel function, programming and budget management sections, and product assurance and ORA specialists in the technology area.

The other three components model the operational spine units found at Level V:

Development:	Technical/Configuration Management Division
Production:	Procurement/Production Management Division
Fielding/User:	Integrated Logistics Division

Staffing emphasis reflects the phase of the life cycle, with 16 in the Tech/Configuration Management Division. At this point, these division chiefs act as the auditors/managers of the people in external and internal units, using the dual-supervisory responsibilities discussed earlier.

As the PMO moves into the production phase, the SST-modeled structure (Figure 10) again reflects the CSO functions. Components for scheduling, budgeting, personnel management, and technology are represented in the Office of the Program Manager, the Business Management Division, and the Product Assurance and Test Team. The remaining operational spine components are responsible for the production of the weapons system (Technical and Configuration Management Division) and user interface (Integrated Logistics Divsion).

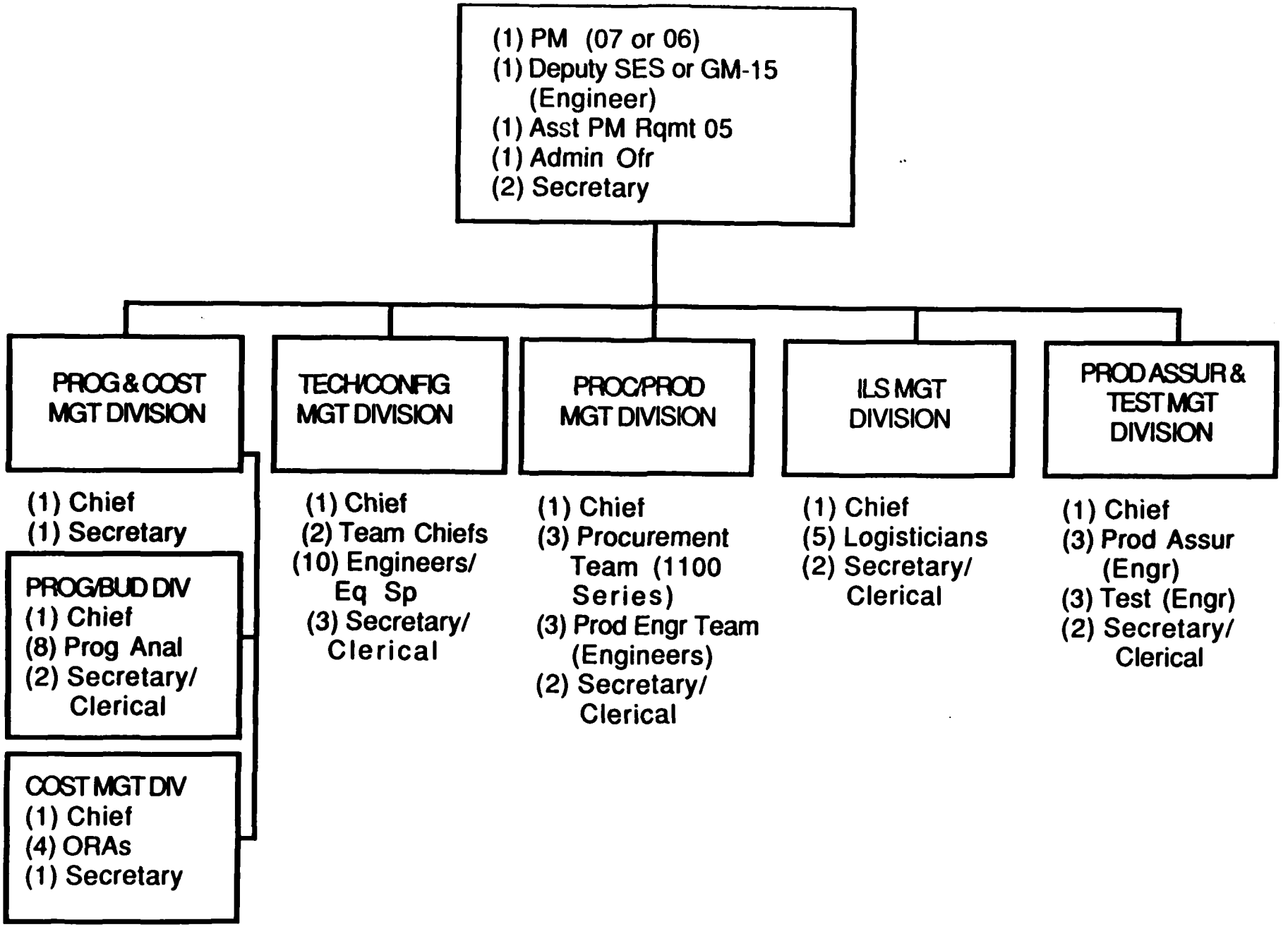


Figure 7. Hypothetical PMO Configuration for Development Stage of Major Weapon System.

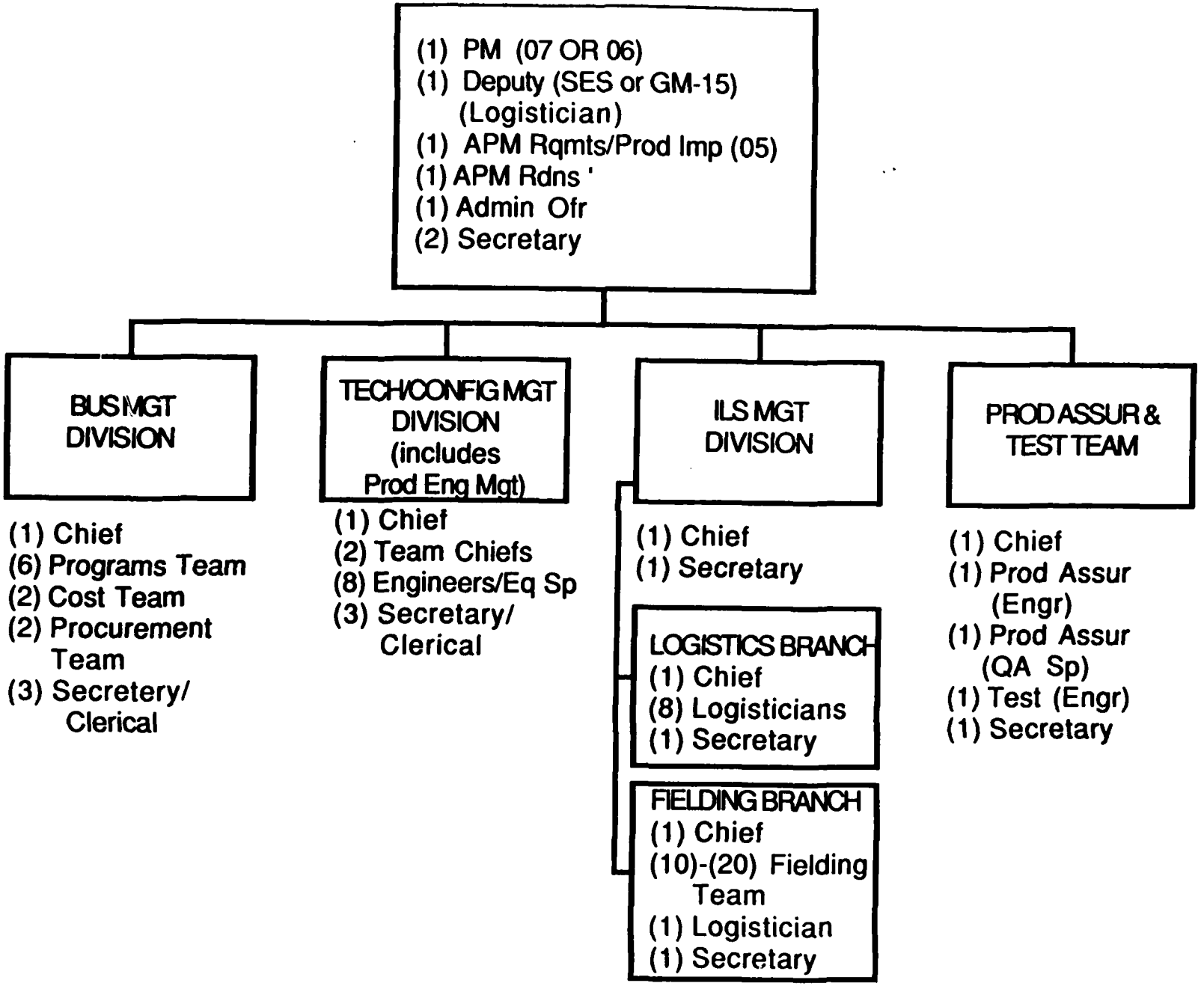
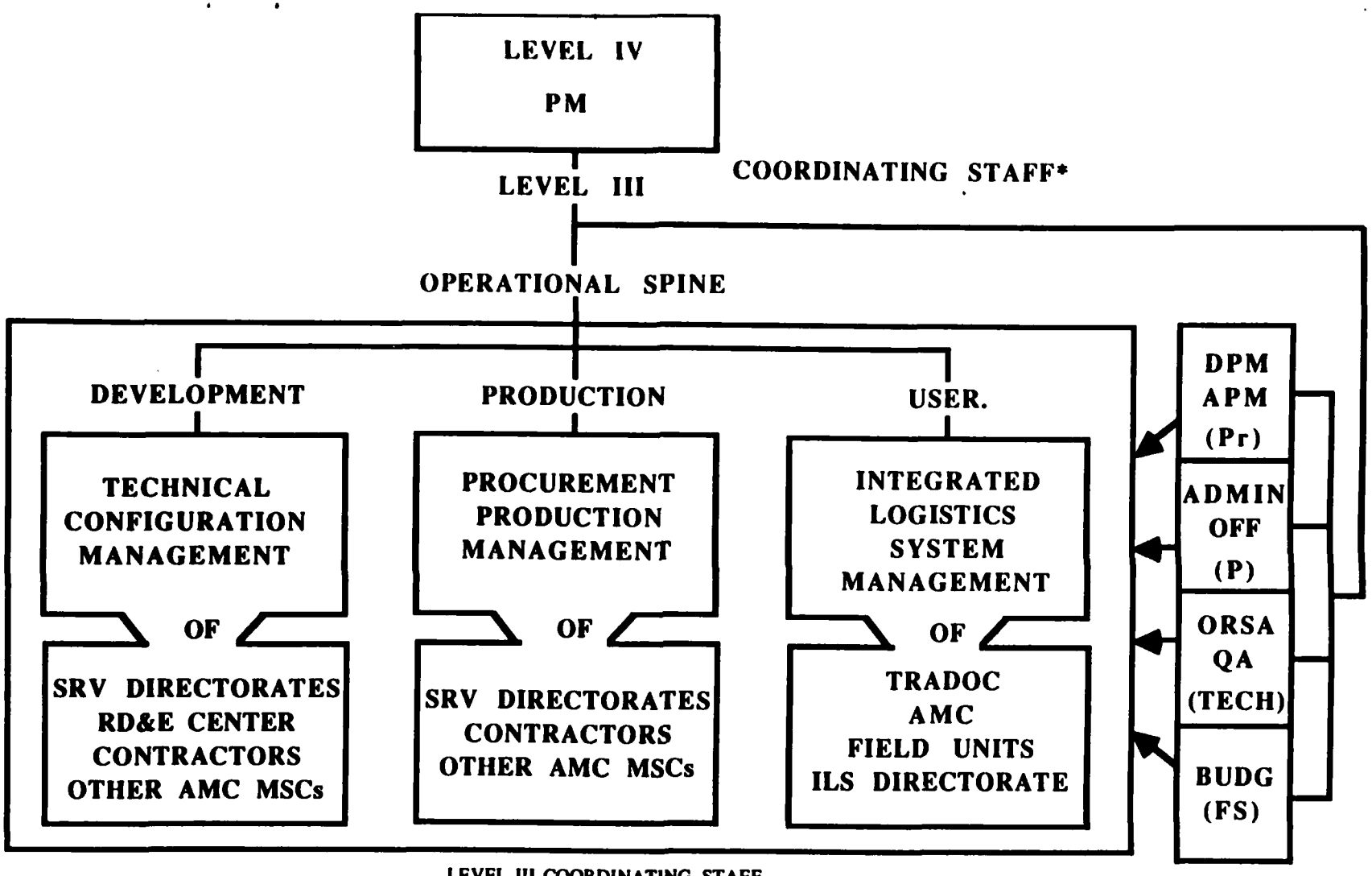


Figure 8. Hypothetical PMO Configuration for Production/Fielding Stage of Major Weapon Systems



LEVEL III COORDINATING STAFF

Pr - PROGRAMMING

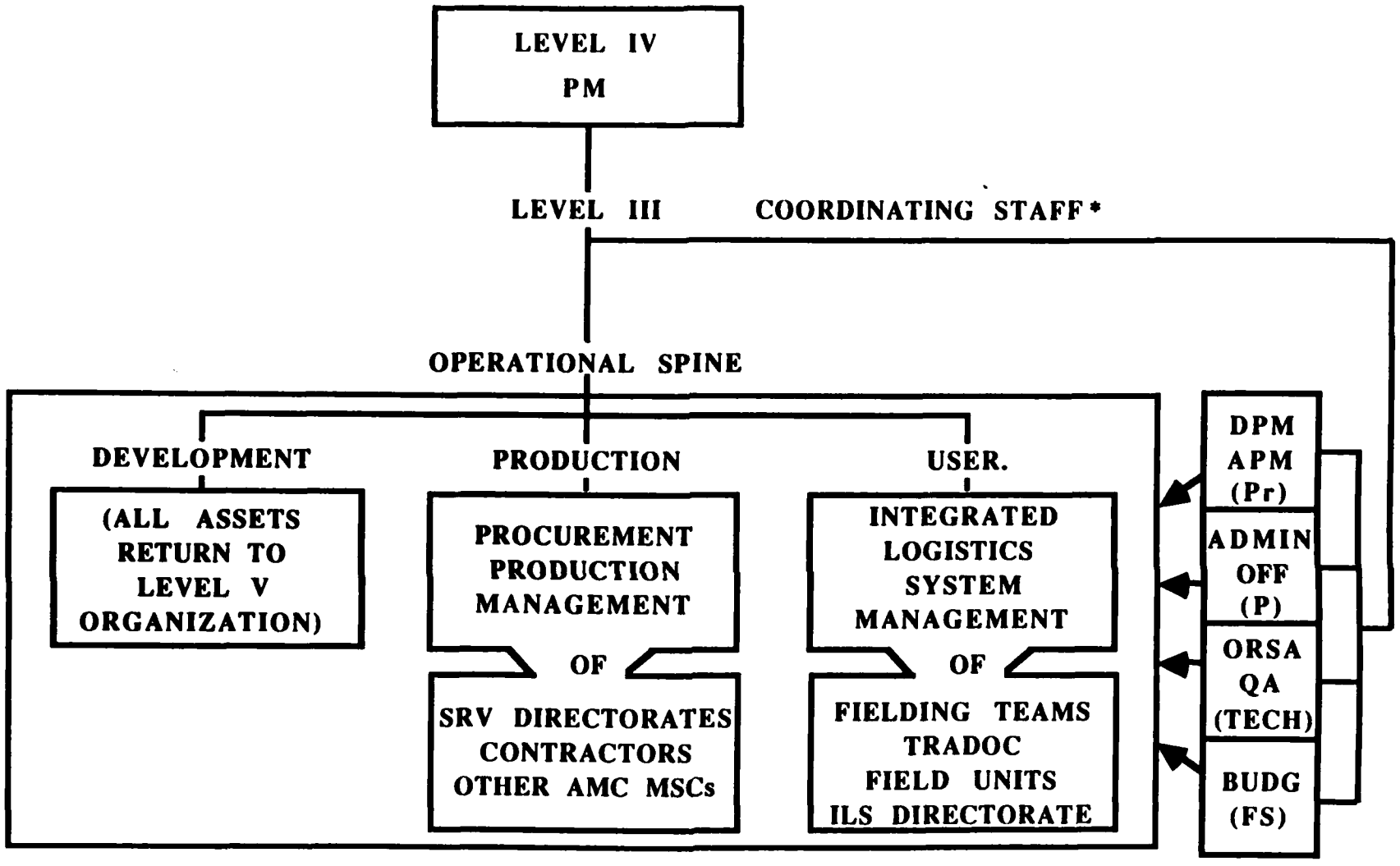
P - PERSONNEL

TECH - MANAGING TECHNOLOGY

FS - FINANCIAL SERVICES

*Coordinating staff is the personal staff of the PM and functions cannot be delegated to other units.

Figure 9. Stratified Systems Theory Requisite Structure of Level IV Developmental Program Management Office



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*Coordinating staff is the personal staff of the PM and functions cannot be delegated to other units.

Figure 10. Stratified Systems Theory Requisite Structure of Level IV Production/Fielding Program Management Office.

In response to a hypothetical ceiling on numbers of PMO personnel, force development specialists recommended removing entire functions, such as fielding branches or product assurance and test teams. In this manner, both responsibility and personnel would be removed, rather than expecting PMOs to accomplish the same number of functions with reduced staff.

These models of requisite PMO structures were designed for the development and production of single-system, major weapons programs. PMOs for NDI procurement or those managing multiple large systems would be smaller or larger, depending on specific requirements. In theory, PMO size and structure should be tailored by life cycle phase, with any significant changes made at major milestones. As shown in Figure 10, development work should be transferred out of the PMO as soon as the technology of development becomes known. However, this is difficult to accomplish as long as requirements-driven modifications require new technology and structures for user interface are not in place. Rather than a using pre-determined model, it seems clear that individual PMO size must be based on the requisite work of the operational spine by level within the organization.

In determining the optimum size for a particular PMO, the following factors should be considered:

1. The external demands on each PMO, including contractor history and capability
2. Life cycle phase
3. The requisite operational spine units (development, purchasing, fielding/user satisfaction)
4. The number of people required to do the coordinating work for the Level IV PMO
5. The number and level of full-time people required to do the auditing/integrating work for the Level IV PMO
6. The command and control relationships that can be employed
7. The efficiency to be gained from using a mutual knowledge unit that shares common goals

Since this research was restricted to Level V and IV components of the MSCs, the information is inadequate to determine the number of full-time staff required for each PMO. If a decision is made to apply these theories to Level III PMO staffing, it is recommended that SST theorists work on-site with MSC force development specialists who are familiar with the requirements and constraints of each PMO. Staffing levels and structure could then be determined, based on a case-by-case analysis of work to be accomplished and the factors outlined in this report.

Impact of PMO Structure

The importance of PMO structure has the focus of this report. In specific terms, PMOs are the MSCs' "intensive management" units. They are responsible for the enormous financial resources committed to weapons system and product development. As an example, total APA dollars in AVSCOM projects range from $121 million to $36.5 billion; RDT&E funds range from $7.07 million to $2.4

billion. Even NDI products in TROSCOM show yearly appropriations from $1.5 to $102.2 million in 1985 and are projected for $8.7 to $251 million in 1990. These figures rival large corporations' balance sheets and comprise a major portion of the operational spine work of each MSC. The effects of structure and staffing on PMO performance of this critical work were visible in the three MSCs that were the focus of this research.

The requisite PMO structure as determined by SST generally is in place in AVSCOM and TROSCOM. Each PMO has an assigned integrating/auditing staff, in addition to personal staff responsible for coordinating, programming, and budgeting. Shared goals and group identity were apparent, as was PM-expressed confidence and enthusiasm for their work. The two Level V Commanders were also confident that the work could be done and expressed intuitive feelings that any removal of support staff from PMOs had to be implemented with caution. As one Commander noted, ". . . 10% of the command resources located in the PMOs are handling 60 to 70% of workload."

The problems encountered by Project Managers in the TACOM capstone structure have been documented. In addition to the lack of staff for budgeting, programming, and auditing/integrating, these PMs appear to be handicapped by numbers of organizational layers. Only one response listed the capstone program manager as a value-adding level. In addition, the capstone functional resources were viewed as generally unavailable and unresponsive.

In contrast to generally high levels of PM morale and enthusiasm in AVSCOM and TROSCOM, 70% of the PMs in TACOM expressed a desire to stay less than two years in the job because of potential psychological burn-out. One interpretation of this result is that PMs should be selected for their capability and temperament to function efficiently in such settings. However, a second interpretation that is relevant to this research is that there is a minimum PM size and structure below which efficiency and stability are affected.

The current policy of downsizing and deprojectizing the PMOs is an attempt to increase efficiency and respond to increasing workloads. However, coordinating and integrating/auditing responsibilities of the PMOs will remain the same. Unless command and control issues can be recognized and resolved through the correct placement of support staff with well-defined working relationships doing appropriate levels of work, it seems likely that the MSCs will become less efficient as the PMOs find it more difficult to accomplish the work of the operational spine.

SUMMARY OF FINDINGS

The work of the Army's PMOs is conducted within the MSCs where they are located, and within the external influences that impact both organizations. The work of the PMOs and their requisite structures were identified in terms of the work of the MSC Commander and subordinate units assisting him in this work.

Major Subordinate Commands

In the terms of Stratified Systems Theory (Jaques, 1976), the Level V MSCs are the last bounded unit, and the Commanders are the interface between the external demands placed on the development and acquisition of the Army's supplies and equipment and the actual accomplishment of work within their commands. They are faced with the "ubiquitous turbulence" caused by budget and program changes dictated by Congress and higher headquarters.

An MSC Commander must walk a delicate line in establishing priorities between work in support of his Level IV PMOs, WSMs, and Item Managers and the specific work he is directed to do by higher headquarters. At the same time, the MSC Commander is redefining prior PMO relationships with external lateral organizations and higher headquarters. The AMC drive to bring about a comprehensive Army-wide acquisition strategy has caused the individual PMOs a corresponding loss of freedom of operation in the external environment, a loss estimated at 60% within the past five years.

In addition to these factors, the traditional workload in the MSCs has increased dramatically as a result of new weapons systems being developed, produced, and fielded while the older systems remain in place. With the advent of computer technology, and as DOD and the Department of the Army develop their acquisition strategies, the demand for information from external sources has reached staggering proportions. The MSCs generally do not have the computer technology to transform data into useful information, nor manpower to meet this demand without depleting resources necessary to the operational spine.

In an attempt to meet workload demands with static resources, MSCs have been directed to institute programs to downsize their PMOs by returning coordinating and lateral support staff members to their Level IV parent organizations. Another method identified to relieve the workload is to adopt the Air Force and Navy practice of contracting for all work to be done by outside resources (as evidenced in the LHX Program). The ultimate effects of this trend on PMO/MSC workforce are not clear, since coordinating and auditing/integrating requirements would appear likely to remain the same, or even increase.

Operational Spine/Support Units

The SST model provided the basis for selecting the Level IV units that develop, manufacture, and field goods and services -- the operational spine. In addition, Level IV lateral support units that provide services

to the operational spine over the life cycle phase were pinpointed. The interdependencies between the two types of Level IV units within the organization were explored. The authority relationships between operational spine and support units were defined to include service giving/service getting, auditing/inspecting, and monitoring.

These relationships and interdependencies were found to be unclear, with numerous instances of overlap between the two types of Level IV units. The lack of definition of units responsible for fielding, user satisfaction, and materiel-deficiency reporting in the operational spine was especially evident. This lack has resulted in the work being done by a combination of operational spine procurement units (PMOs and WSMs) and lateral support components. The MSCs have attempted to rectify this problem through various strategies, but have not been totally successful.

The need for a Level IV coordinating staff officer to assist the Level V commander was identified in the roles of the Deputy Commanding Generals and the capstone PMs. This role is critical to the prioritizing of tasks in the face of limited resources. Level IV and V managers also were found to require a coordinating staff to assist them with level-specific work in budgeting, programming, personnel support and information management. Unlike services provided by lateral support units across the operational spine, these functions belong to the PM and cannot appropriately be delegated to lateral support units or Level V coordinating staff.

Several other SST principles were applied to the analysis of PMO structure. These included the requirement for placing full-time support staff in operational spine components, authority relationships other than superior-subordinate for assigning lateral support personnel, mutual knowledge units, and the indirect, dual-supervisory nature of Level III PMO work. The effects of current civilian personnel policies were noted.

Implications for PMO Structure

SST theories were applied to hypothetical PMO staffing figures to construct two PMO models by life cycle. A development-stage PMO for a major weapon system was shown to include all three operational spine components. A theoretical production/fielding PMO would not contain development activities, although on-going modifications throughout the life cycle often preclude a PMO staff reduction in actual practice. Both models show PMO placement of a coordinating staff and the auditing/integrating personnel required by life cycle.

These models were specific to single-system major weapon development. PMOs engaged in NDI procurement and fielding could be smaller, reflecting the minimum development activity required. "Basket" PMOs responsible for multiple large systems or multi-product development may need to be larger to integrate and audit the work from many more components. In any situation, contractor experience and quality history must be considered.

To apply these models to individual PMO staffing, it was recommended that SST theorists work on-site with MSC force development specialists to determine requisite structure, based on a case-by-case analysis of work to be accomplished and the factors outlined in this report.

The impact of MSC/PMO structure could be seen in differences between the three commands. In the two commands where PMOs included coordinating and auditing/integrating staff, there were high levels of PMO enthusiasm and feelings of efficacy, in spite of demanding workloads. These positive feelings were far less evident in the capstone model, an apparent reflection of the effects of both reduced staffing and an added layer of management.

CONCLUSIONS

This organizational review of Level IV and Level V structures resulted in the following conclusions:

- Current PMO structure varies by MSC and is not based on organizational theory.
- "Matrix management" is not clearly understood and is interpreted in many ways. A common language based in theory is needed so that requisite structure and relationships can be defined.
- The differences between operational spine and support functions are not consistently recognized.
- The roles and responsibilities of today's PMs need clarification. The current charters do not match their work as defined by AMC and Secretary of the Army, and are meaningless as a source of guidance as to limits of authority, decision processes, and reporting requirements.
- PMs must have a personal coordinating staff to assist them with programming, budgeting, and technology/information management.
- Current matrix management philosophy does not differentiate between support functions and personal coordinating staff requirements.
- Lateral support staff working full time on PM-specific work should be assigned to the PMO.
- Two of the MSCs in the study showed a good match with SST theory; the third did not. PMOs in the MSCs with the requisite structure showed higher levels of enthusiasm and feelings of efficacy.
- Current personnel policies do not reflect the higher capability required by the nature of PMO work.
- The efficiency or effectiveness to be gained by "matrixing" the PMOs is not apparent, and has not been documented.

REFERENCES

Center for Strategic and International Studies. 1985. Toward a more effective defense: The final report of the CSIS Defense Organization Project. Georgetown University, Washington, DC. Feb., p. 67.

Cost Discipline Advisory Committee Report. 1982. Department of the Army, Office of the Deputy Chief of Staff for Research, Development, and Acquisition, June 1982.

Drucker, P. F. 1985. Innovation and entrepreneurship: Practice and principles. Harper and Row, New York.

Galbraith, J. K. 1958. The new industrial state. New American Library, New York.

General Accounting Office. 1985. Defense weapon system acquisition: The program manager and contracting officer. Washington, DC, September.

Grace Commission. 1983. Private sector survey on cost control. Draft summary received by U.S. Army Materiel Command, June 10, 1983.

HASC No. 99-10. 1985. Reorganizational proposals for the Joint Chiefs of Staff 1985, Hearings before the investigations sub-committee of the Committee on Armed Services. House of Representatives, 99th Congress, 1st session, June 13, 19, 26, 1985.

Jacobs, T. O., & Jaques, E. 1986. Leadership in complex systems. In: Human productivity enhancement, Vol. II: Organization and personnel, Zeidner, J. A., ed. In press.

Jaques, E. 1976. A general theory of bureaucracy. Heinemann Educational Books, London and Exeter, NH.

Jaques, E. 1984. Principles of organization structure for the U.S. Army: Developing the Army organization structure to strengthen the foundations of leadership and combat effectiveness. Briefing for Deputy Chief of Staff for Operations, December.

Jaques, E., Clement, S., Rigby, C., & Jacobs, T. O. Senior leadership performance requirements at the executive level (Research Report 1420, January 1986). U.S. Army Research Institute for the Behavioral and Social Sciences, Alexandria, VA. (AD B103-760)

Kerwin Board II. 1985. Review of AMC product assurance programs. U.S. Army Materiel Command, Alexandria, VA.

Thamhain, H. J. 1984. Engineering program management. John Wiley & Sons, New York.

United States Army Materiel Command. 1980. Resource self help/supportability planning effort (RESHAPE). Alexandria, VA, February 1980.

United States Army Materiel Command. 1984. AMC criteria and procedures for termination of PM management systems. Deputy for Management and Analysis, AMCDMA-MMR, December 1984.

Appendix A

ARMY MATERIEL COMMAND INTERVIEWS

Date:

Name of interviewee:

INTERVIEWEE DATA

1. Job title (salary grade):

2. Length of time in position:

3. Length of time on projects:

4. Point in Life Cycle Model:

5. Length of time in command:

6. Prior positions in command:

7. Prior qualifying assignments:

8. Education, training, preparation for the position:

REPORTING RELATIONSHIPS

9. Who do you report to?

10. How long have you reported to this person?

11. Who do you see as your real boss (person who judges your performance, (does your appraisal, decides your rewards)?

Appendix B

POSSIBLE AUTHORITY RELATIONSHIPS

As defined by Jaques (1983), the following relationships can be used to define and structure the interaction between support group members and managers in the PMOs or other units of the operational spine.

Superior-subordinate: This relationship gives the superior the authority to 1) help select the subordinate, 2) provide initial entry training, 3) assign work and set target completion dates, 4) keep informed about work performance and resolve problems as required, 5) review and assess performance, and 6) initiate transfer or dismissal proceedings. Both PMs and support directorate chiefs indicate a strong preference for this model.

Outposting (operational control): In this case, the service-providing unit places one of its members under the general responsibility of a operational spine component or another lateral support unit. The service-providing unit manager would 1) be responsible for the subordinate in a normal superior-subordinate relationship, and 2) be able to remove the individual from the supported unit with the concurrence of the supported unit manager. Disagreements over removal would be referred to the Level V manager. The responsibility of the supported unit manager to the newly-placed members would be to 1) induct them into the local work setting, 2) monitor their adherence to local regulations and practices, 3) permit them to carry out any tasks allotted by the service-providing unit manager, and 4) coordinate their activities when problems arise.

This authority relationship would allow the service-providing member to work in the same location as the supported unit for increased efficiency, but would also let the service-providing unit control its manpower resources, provide support at the appropriate level of work, facilitate return to the original unit, and insure that the individuals are developed for advancement within their home structure.

Attachment with co-management: This set of relationships provides a stronger position for the supported unit manager. In this model, the service-unit manager retains managerial accountability and authority and 1) selects the individuals who will be considered for attachment, 2) monitors work of attached people for technical competence, 3) insures that development occurs through appropriate training and assignments, 4) assesses work performance using recommendations from operational spine component managers, and 5) initiates transfer or dismissal proceedings.

The supported unit manager 1) helps selects and can veto individuals for attachment, 2) assigns appropriate work, 3) monitors work to insure that it conforms to the policies for which he is responsible, 4) seeks transfer of the individual if work standards are not maintained, and 5) co-signs performance assessments with the service-staff unit manager.