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The Computer Resource Management Study: Executive Summary

Stephen M. Drezner, Hyman Shulman,
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A Report prepared for

UNITED STATES AIR FORCE PROJECT RAND

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SANTA MONICA, CA. 90406

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PREFACE

This report presents the findings of a study requested by General David C. Jones, Air Force Chief of Staff, in January 1975. It addresses policy and organizational aspects of the management of Air Force computer resources. The terms of reference for the study were developed and substantive work was begun in February; the planned completion date is the late fall of 1975. A progress report was presented to the Chief of Staff and various Air Staff deputy chiefs in mid-June. Substantive major findings were reported on 24 July 1975 to a similar group; a few collateral areas remain to be examined. The present report documents the briefing content and charts of both the mid-term progress report and the semifinal report of substantive conclusions, with some additional material. A more detailed report developing the supporting arguments is in preparation.

The Computer Resource Management (CRM) Study--as it came to be known--was performed by a team of thirteen Rand staff members:

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In the conduct of the study, team members visited ten Air Force projects, each of which contained a substantial computer component. Some of the projects are admittedly in trouble; some are obviously headed for trouble; and others are generally considered to be in satisfactory condition. Among the projects visited were the Advanced Logistics System, STALOGS, BASETOP, the Advanced Airborne Command Post, the B-1 (both the System Project Office and the contractors), the AWACS, the F-16, the NORAD upgrade (427M), the SAC command-control upgrade,

and TACS-TADS. In addition, team members interviewed a large number of individuals throughout the Air Force. Discussions were held in DCS/Personnel, DCS/Plans and Operations, DCS/Programs and Resources, DCS/Research and Development, and DCS/Systems and Logistics; in the office of the Comptroller of the Air Force; at the Strategic Air Command, the Military Airlift Command, and the Tactical Air Command; at the Air Force Military Personnel Center; at the Data System Design Center; at various offices in the Air Force Systems Command, Electronic Systems Division; at Headquarters AFSC; and at Headquarters Air Force Logistics Command.

This study was performed as part of the Project RAND research project entitled "Management of Air Force Computer Resources."

SUMMARY

Based on an examination of ten Air Force projects having a large computer component and on extensive interviews throughout the Air Force, it is concluded that the difficulty in managing computer resources stems from the failure to follow an orderly development process and from the lack of a sufficiently tight discipline to enforce adherence to such a process.

To bring the Air Force into a better policy and management posture vis-à-vis the management of computer resources, the following recommendations are made (discussed on the pages noted):

- Establish an Assistant Chief of Staff for Computer Resource Management who can function as a focal point within the Air Staff for uniform policy and management procedures, and for all other matters related to computer resource management, particularly in the Air Staff but elsewhere in the Air Force as well (pp. 15-20).
- Develop all computer systems--independently of functional area and above relevant thresholds--through a development channel consisting of a significantly strengthened and expanded DCS/ Research and Development and Air Force Systems Command (pp. 20-22).
- Create a Data System Division within AFSC (pp. 22-24).
- Give each of the AFSC product divisions its own Center of Expertise to strengthen locally the capability for computer design and development (p. 25).
- Strengthen and enlarge the role of the Single Manager in all commands that are heavily involved in either software or complete computer system design and development (pp. 26-27).

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I. BACKGROUND

Computer technology today pervades the Air Force; and the Air Force, like many other organizations, is having great difficulty coping with it. The Air Force has widely exploited computer technology both in command-control systems and in management support systems, notably in such support areas as logistics, comptroller functions, and base functions. In recent years, however, it has also become an essential subsystem of modern aircraft, with regard not only to weapon delivery, both offensive and defensive, but also to navigation, to stores management, to on-board monitoring of performance sensors, to automatic ground support equipment, to crew and mission training simulators, and even to the actual flight control of the vehicle.

> Computer technology has become central to the Air Force's ability to perform its role and mission.

Thus, computer hardware failures or inadequate software can mean that an aircraft cannot fly or cannot carry out its design missions, that command-control systems cannot communicate with each other, or that important management information is not received in a timely or accurate manner. Given such essentiality, it becomes increasingly important not only to cope with the technology but to master it and exploit it, both from a technical point of view and, equally important, from a management and policy one. The Air Force, though it has done a superb job in some instances, and continues to make important improvements over time, still faces significant difficulties.

Because computer technology is relatively recent and very fast-changing, it tends not to be well-understood. The Air Force has encountered every problem that the civilian world has stumbled on, but the consequences are greater because of the penalties for degraded system performance and the slipped time and cost schedules. In particular, the Air Force experience in managing computer technology in weapon systems is minimal. The influence of a particular public law, P.L. 89-306, has led to the creation of parallel sets of regulations for

acquiring a computer-based system.* In addition to the so-called "300-series" and "800-series" regulations, there is a "100-series" for computers involved in communications systems, plus a dozen or so possible informal mechanisms. The multiple procedures for computer system development are further confounded by loose labeling. For example, a computer has sometimes been called an "avionics control unit" or a "command data buffer."

The initial study objective, then, amounted to seeking an answer to the question: For the Air Force projects examined, is there some common characteristic that explains why some are in serious trouble while others are successful? The analysis is discussed in Sec. II. The second objective was to conceive organizational and policy actions that would place the Air Force in a better posture to manage computer resources; they are discussed in Sec. IV.

Based on information from project visits and interviews, plus the the professional knowledge and insights of the study team, the team members were led to visualize matters in terms of Fig. 1. There is nothing necessarily new or unique in Fig. 1, but it helps communicate in a concise manner what is perceived to be a major element of the answer. It depicts an orderly process for development. Starting at the left and driven by technological inputs and mission requirements, the process shows a sequence of steps from a statement of mission requirements, to a feasibility check against technology, to a controlled process of design and development, to testing against the detailed design specification and then against user mission requirements, and finally to production and operational acceptance. The figure has been deliberately kept free of jargon, but it can obviously be related to the established words, check points, and management decisions embodied in the well-known Air Force "800-series" of regulations. For example:

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*Public Law 89-306 was passed in 1965, at a time when software had only begun to emerge as a troublesome problem area. The bill focused on computer hardware with the intent of assuring that federally installed machines operated a maximum number of hours. The implementing OSD and Air Force regulations encourage the hardware and software components of a computer system to be treated separately.

ILLUSTRATIVE
"SYSTEM DEVELOPMENT" LIFE CYCLE

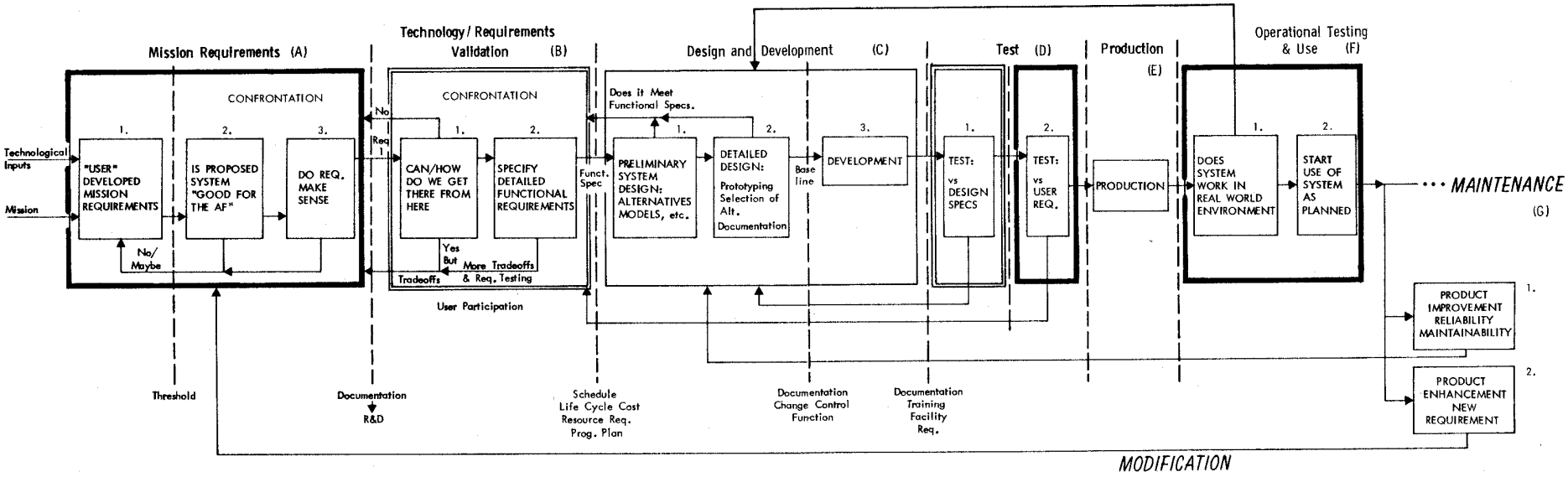

Fig. 1

C1 = Preliminary Design Review; C2 = Critical Design Review; D1 = RDT&E; D2 = IOT&E; F1 = IOC.

Several points can be made about computer system development from a study of the life cycle in Fig. 1. The process depicted in the figure can apply equally well to a weapon-system development, to each phase of an incrementally designed system, and to each step forward of an evolutionary system. Specifically, it does not imply that a "turnkey" process is either necessary or desirable for any kind of computer system.

1. The requirements process (A) is exceedingly important. It must be a user-controlled function that provides the performance inputs to drive the entire system-development life cycle.
2. The functional system designer (B), in addition to translating the needs of the user, must interact with computer and system experts to identify and analyze tradeoffs.
3. A careful distinction must be maintained between various requirements documents and implementation of the requirements (C). It is to be expected that several iterations will occur between requirements and design; thus each will gradually evolve to a final position reflecting technical feasibility and acceptable performance.
4. The line coding of Fig. 1 indicates the different kinds of organizations involved. The bold-line functions (A,D,F) are user-oriented; the double-line test function (D) is an independent group and the validation function (B) involves computer-system expertise; and the light-line function (C) is the computer-system design and development group. A single command could conceivably be responsible for all the functions indicated, but the various "organizations" within the command must be distinct in order to react to different subgoals and to encourage productive confrontation.
5. The user must remain involved during the entire life cycle, but in a carefully controlled manner to avoid intruding into the orderly conduct of the design-and-development phase (C). Significantly, the user must be responsible for the final test prior to production (D).

6. "Maintenance" in the context of computer software is a thoroughly misleading word and does not correlate with its well-established meaning in hardware and logistics matters. Computer software simply does not break and have to be repaired in the usual sense. Rather, software "maintenance" spans product improvement, improvement in product reliability or maintainability, and even product enhancement to meet new requirements. This point is stressed because, in the case of software, these attributes of "maintenance" tend to force a return to much earlier phases of the development process than in the case of hardware.

The status of various Air Force projects examined by team members can be explained in terms of the process in Fig. 1. For example, in one project, the well-stated mission requirement was never adequately contrasted with technical feasibility. In a second, the interoperability of two independently developed data systems was not seen as the complex software problem it was, but rather as a relatively straightforward system modification and test problem. In a third, the development was contracted for, but there was no documented user requirement; schedule and funding requirements were dramatically impacted--and continued to be--as the user sought to specify his need. In a fourth, a healthy project, the System Project Office (SPO) happens to have a person responsible for all software involved with the project; moreover, the Air Force fortuitously has a contractor who understands that an orderly development process is essential to computer-system acquisition--especially its software component. Anecdotes of this type are meant only to be illustrative. In some cases the system is completed later or at higher than estimated cost, but it performs adequately; in another case performance is degraded to varying degrees--including complete failure.

The points made above about the process schematized in Fig. 1, and the implications of the process, also correlate with computer experience reported by various industrial organizations.

II. THE PROBLEM

The Air Force's difficulty with computer resources can be characterized as a failure to follow an orderly development process, overlaid by the fact that Air Force management attitudes and structures do not exhibit a sufficiently tight discipline to enforce adherence to such a process (Fig. 2).

PROBLEM DEFINITION

- FAILURE TO CONSISTENTLY FOLLOW AN ORDERLY PROCESS OF SYSTEM DEVELOPMENT SUCH AS THE ONE DEPICTED

- AIR FORCE MANAGEMENT ATTITUDES AND MANAGEMENT STRUCTURES DO NOT EXHIBIT SUFFICIENTLY TIGHT DISCIPLINE TO FORCE THE DEVELOPMENT OF INFORMATION SYSTEMS TO FOLLOW A PROCESS SUCH AS THE ONE DEPICTED

FIGURE 2

The major reasons behind these difficulties are the following (Fig. 3):

REVIEW OF PROBLEM

- NEED FOR AN ORDERLY, DISCIPLINED APPROACH TO COMPUTER SYSTEM DEVELOPMENT

- REASONS FOR FAILURE TO CARRY OUT SUCH A PROCESS
  - Lack of knowledge, awareness, skills, people
  - Lack of ability to uniformly implement the intent of existing regulations
  - Inadequate focus/emphasis on requirements process
  - Lack of adequate confrontation to encourage tradeoffs between requirements and computer technology
  - Inability to account for cost of development, acquisition, and operating
  - Lack of insight into software problem by managers, resulting in unrealistic schedules, costs, and performance expectations
  - Superficial examination of critical technical questions during reviews
  - Lack of capable, independent test organization
  - Uncontrolled involvement of requirements generator in ongoing development

FIGURE 3

- A lack of knowledge, awareness, and skills in people at the management level who are involved with one or more parts of the system development life cycle. This is not an observation about technical people operating on technical issues, but rather one about the management level.
- An inability to implement uniformly the intent of the regulations now on the books. This appears to be partly a skills problem at the management level, partly an organizational problem, partly a lack of managerial insight, and partly a matter of attitudes and philosophy with respect to the required management process.
- An inadequate focus and emphasis on the requirements process, as depicted by the initial box in Fig. 1.
- A lack of adequate confrontation in the validation process, and thus inadequate encouragement to analyze tradeoffs between mission requirements and computer technology. The mechanism does not exist at present to make the necessary tradeoff studies.
- An inability to account financially in the Air Force reporting structure for cost of development, procurement, and operations.
- A lack of insight into the software problem (as opposed to hardware) by Air Force system managers; software tends to be given the "black box" treatment. The matter is pushed off onto contractors or superficially described without a clear perception of the real state of the software art. This results in overly optimistic schedules, underestimates of cost, and overly ambitious performance expectations.
- Technical expertise inadequately involved with decisions. Reviews intended to form checkpoints in the development process only superficially examine critical technical questions.
- A lack of a capable, professionally trained, and independent test organization for computer-based systems.
- Uncontrolled user interaction with the design-development phase. This point is related to an Air Force awareness some years ago that the turnkey style of system development is a difficult

one. While it is clear that the user must be heavily involved with requirements generation and must stay connected to the development process because compromises and adjustments will inevitably have to be made, interpretations will be required, and requirements can change, the user cannot be allowed to exploit his interaction by injecting a continuous stream of changing requirements as he conceives new ideas or refines his perception of need. Users must be deeply involved in the initial requirements part of the development cycle, but they must interact with other parts, especially design-development, only in a carefully controlled way under strict management supervision. Even with an evolutionary or incremental approach, each cycle of progress must be completed before expanded or revised requirements initiate the next.

III. OBSERVATIONS ABOUT COMPUTER SYSTEMS

Three significant observations can be made about computer-based systems (Fig. 4).

ATTRIBUTES OF COMPUTER-BASED SYSTEMS

- IT IS MISLEADING AND INAPPROPRIATE TO VIEW SYSTEMS IN PARTS--THAT IS, A HARDWARE PART AND A SOFTWARE PART. WHAT IS REQUIRED FOR AN ACCURATE PICTURE IS A TOTAL SYSTEMS VIEW.
- DESPITE DIFFERENCES IN APPEARANCE, ALL MAJOR COMPUTER PROJECTS, REGARDLESS OF THE FUNCTIONAL AREA--COMMAND-CONTROL SYSTEMS, MANAGEMENT SUPPORT SYSTEMS, OR COMPUTER SUBSYSTEMS OF WEAPON SYSTEMS--NEED TO BE VIEWED AND TREATED WITH THE SAME MANAGEMENT PERSPECTIVE
- ACQUISITION OF COMPUTER-BASED SYSTEMS REQUIRES A DEVELOPMENT PROCESS, NOT A PRODUCTION-LIKE PROCESS. IN FACT, WHEN COMPARED WITH HARDWARE DEVELOPMENT, SOFTWARE DEVELOPMENT IS AT LEAST AS DEMANDING OF AN ORDERLY, DISCIPLINED APPROACH AS HARDWARE

FIGURE 4

First, any computer-based system has to be regarded from a system point of view. It cannot be dealt with as an item of hardware, a separate item of software, and a separate overlay of procedures and administration with the expectation that all three will blend together smoothly at some future time. In particular, unless software and hardware are regarded jointly, the tradeoffs between them cannot possibly be made, because computer hardware and software interact in a very intimate way. This point underscores the necessity of dealing with them from an overall system point of view.

The second observation concerns the basic sameness of computer systems. From a technical point of view, the steps and the mechanisms involved in creating a computer-based system are independent of the functional area of application. The essential steps include the

creation of ideas, the design of the system, the coding of the programs, and the debugging and testing of the programs; from a management point of view, the process is independent of the application. At the detailed level, there are differences of emphasis and genuine technical differences with respect to how things are done; but at the management and process level--particularly where perspectives, attitudes, and methodology come into play--there is no reason to treat computer systems differently, whether they are intended for command and control (CC), for management support systems (MSS), or as a subsystem of a weapon system.* Such small differences as exist among computer systems tend to be matters of detail, and even then they are not necessarily attributable to a functional area.

Third, the experience of the civilian world--and especially the software companies--is that the creation of computer software has to be regarded as a development process. It is not a turn-the-crank factory- or production-like matter; neither is it a matter of artistic creativity. Although dealing with software in an orderly development way is not a guarantee of success, it nonetheless markedly improves the probability that a software project will be successful. The weight of evidence supports the assertion that software has to be treated in essentially the same orderly way that the Air Force and other organizations have learned to treat hardware. This is especially important since the Air Force has allowed software development to become the major problem area in the computer-based system life cycle.

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*A computer subsystem of a weapon system is sometimes referred to as "embedded."

IV. A PROPOSED SOLUTION

OVERVIEW

To bring the Air Force process for acquiring computer-based systems into a properly managed and controlled posture, a solution is proposed that is partly a reorganization of existing entities, partly a reassignment of responsibilities, partly a creation of new responsibilities, and partly a creation of new procedures (Fig. 5). Such a posture would include approaching computer system design from a system point of view, treating software implementation as a genuine development process, and providing uniform treatment for all types of computer systems.

> The fundamental intent is to "focalize" computer resource policymaking activities within the Air Staff, while retaining but strengthening the Air Force's decentralized development capability.

OVERVIEW OF THE PROPOSAL

ITS SALIENT POINTS ARE:

- A FOCAL POINT IN THE AIR STAFF IS ESSENTIAL FOR SUCH REASONS AS UNIFORM POLICY AND MANAGEMENT CONTROLS AND ADEQUATE TECHNICAL INPUT TO CRUCIAL DECISION PROCESSES
- A STRENGTHENED DEVELOPMENT CHANNEL OF THE AIR FORCE WILL ASSUME RESPONSIBILITY FOR COMPUTER SYSTEMS IN ALL FUNCTIONAL AREAS IN ORDER TO BRING THE IMPLEMENTATION OF COMPUTER-BASED INFORMATION SYSTEMS INTO THE FAMILIAR AIR FORCE DEVELOPMENT PROCESS
- CENTERS OF EXPERTISE ARE REQUIRED IN SELECTED PLACES IN THE AIR FORCE TO PROVIDE ADEQUATE TECHNICAL SUPPORT TO SPOs AND TO CRITICAL MANAGEMENT DECISIONS
- SELECTED GROUPS WILL BE STRENGTHENED OR ESTABLISHED IN THE AIR FORCE TO ASSURE THAT THE REQUIREMENTS-GENERATION PROCESS ADEQUATELY REFLECTS THE GENUINE NEED OF THE USER, TECHNICAL FEASIBILITY, AND REALITY

FIGURE 5

The overall process whereby a computer-based system is brought into being--from initial requirements through final user acceptance--is

inherently the same, whether it is a command and control system, a component subsystem embedded within a weapon system, or a management support system. Thus, there is need for the Air Force to establish uniform policies, procedures, management controls, and approval processes for every kind of computer system that it acquires. Furthermore, in view of the pervasiveness of computer technology within the Air Force and the importance of such technology to accomplishment of the Air Force role and mission, it is essential that adequate technical considerations enter all aspects of the decision process and management control. Furthermore, an unambiguous positive signal of interest in computer matters must be provided to the highest levels, and uniform treatment for all computer systems must be enforced.

Such purposes are best served by creating within the Air Staff a focal point for computer resource management that will establish policy, institute management controls, participate in critical reviews and decisions, and stand as both an advocate for these matters and a judge of the technical state of the art. Corresponding focalization in major commands is also required.

It is important that the Air Force realize that the implementation of a computer system--especially its software--is a development process and must be managed as such, particularly with respect to management attitudes, controls, and procedures. Furthermore, a system-oriented engineering approach must be adopted. Since DCS/Research and Development (at Hq USAF) and AFSC span the full range of development activities, it seems appropriate that an augmented and strengthened AF/RD and AFSC accept responsibility for the development of all types of computer systems needed by the Air Force. Thus, in addition to enhancing the historical role that each has had in weapon and command-control systems, AF/RD and AFSC would also develop management support systems. Of course, there would be both funding and manpower thresholds; it is not necessary that all computer systems go through the major development channels of AF/RD and AFSC. For example, a major command could develop a sufficiently small system with in-command resources but following nonetheless the same development life cycle process.

It is essential that the Air Force have the best technical advice

in each and every decision made about computer systems of whatever kind. This observation applies not only to decisions made in System Project Offices and program offices, but also to those made in the Air Staff and in the commands. Thus, it is recommended that a "Center of Expertise" be established in each of the AFSC product divisions, plus an additional one at Hq USAF to support its focal point. It may also be necessary for commands--especially major commands--that are heavily involved in computer-based systems to have a Center of Expertise.

To develop a computer-based system successfully, it is essential that the requirements specifying the system reflect user need and be technically feasible, within the state of the art. The requirements process is meant to define the need of the user, not to specify a solution to the need. Thus, it is appropriate that the recommended Air Staff focal point for computers not be the agent to generate requirements in the various areas spanned by the Air Staff. While it is essential that technical experts participate in the requirements-generation process, it is not appropriate for them to be the initiating source. The process of framing requirements in a form that permits interaction with the technical and development community is difficult and rather specialized; thus, each functional area should have its own special requirements group. In some cases, the requirements process in the present Air Force structure may not have a natural home, or may fall in a crack; this is especially true with regard to functional area applications that are cross-command or cross-organizational.

An underlying characteristic of the present proposal is that the development process must be organizationally separated from, but carefully interfaced with, the requirements-generation process. This separation and careful control of the interaction must be exercised not only in the Air Staff but also in the development channel, be it in AFSC, in a major command, in a separate operating agency, or elsewhere. "Separation" does not imply different geographical location, but rather assurance of sufficient organizational distance to guarantee clearly delineated life-cycle-development responsibilities and productive confrontation.

THE PROPOSAL IN MORE DETAIL

Focalization

Focalization of computer resource activities in the Air Staff leads to certain specific improvements (Fig. 6). It is critical that the focal point develop uniform policy and uniform management methodology applicable to every functional element. There is no evidence for sustaining the present situation, characterized by multiple ways and parallel regulations for acquiring a computer-based information system. (This is a consequence of the "sameness" argument, discussed earlier.) A focal point can acquire the records and other data essential for making computer matters visible to top levels of Air Force management, thus improving the quality of the decisions made and responding to the high-level interest and concern that have been expressed. The focal point can also be a check-and-balance to minimize the risk that the Air Force will apply computer resources to inappropriate or poorly defined goals.

FOCALIZATION

PURPOSES

- DEVELOP UNIFORM POLICY AND MANAGEMENT METHODOLOGY ACROSS FUNCTIONAL ELEMENTS
- PROVIDE VISIBILITY TO HIGH LEVELS OF AIR FORCE MANAGEMENT
- MINIMIZE RISK THAT THE AIR FORCE WILL APPLY COMPUTER RESOURCES TO UNPRODUCTIVE GOALS
- PROVIDE A SINGLE POINT OF INTERACTION
- REDUCE NEED FOR SCARCE RESOURCES
- MINIMIZE COUNTERPRODUCTIVE CONFLICTS BETWEEN DIFFERENT FUNCTIONAL AREAS
- IDENTIFY AND MANAGE INTERFACE PROBLEMS AMONG SYSTEMS
- PROVIDE STRONG POSITIVE IMPACT ON COMPUTER CAREER FIELD
- PROVIDE FOR GENERATION AND MAINTENANCE OF A "CORPORATE MEMORY"

FIGURE 6

Next, a focal point should provide a single point of interaction in Hq USAF for all computer resource matters, whether at the Air Staff level or arising from the commands. The focal point can minimize counterproductive conflicts between functional areas while providing computer-oriented technical perspective for sound decisions. While not responsible for establishing user requirements, it may carry out some of the specific Air Staff functions depicted in Fig. 1. The focal point can identify and direct management attention to the interface problems gradually developing among Air Force data systems. In an era of computer-based systems, much more attention must be given data interfaces such as those among F-16s, AWACS, and TACS-TADS.

Focalizing computer policy formulation in the Air Staff would help to conserve admittedly scarce resources; therefore, some small efficiency is to be gained. Focalizing would have a strong and desirably positive impact on the professional quality of the computer career field in the Air Force. Finally, focalization could provide a corporate memory that could carry forward from one project to the next what has been learned. This is more than just being aware of what the current situation is.

Some of the specific tasks of the focal point are noted in Fig. 7; they are representative and respond to the goals of Fig. 6. He--to invest the office with a human form--would monitor the development process in relevant ways and in appropriate places. He would participate in and conduct reviews. He would either cause to happen or otherwise assure that technical tradeoff studies are performed, so that the very important confrontation between user-stated requirements and technical feasibility can be adequately examined. He would have approval authority at certain places in the development process; in particular, his participation would take such forms as examination of the requirements document, examination of the functional specification, examination of the program management document (PMD), and so on. The focal point must provide guidance on the efficient use of computer resources, in this way being a force for their proper exploitation. He would obviously be a central clearinghouse for information and a source of expertise on computer matters, certainly within the Air Staff and perhaps on a

FOCALIZATION

TASKS OF FOCAL POINT INCLUDE

- MONITORING LIFE CYCLE DEVELOPMENT PROCESS
  - Participate in and conduct reviews
  - Exercise approval authority for certain steps in life cycle development
- PROVIDING GUIDANCE ON EFFICIENT UTILIZATION OF COMPUTER RESOURCES. ACT AS A CENTRAL SOURCE OF INFORMATION AND EXPERTISE ON COMPUTER MATTERS WITHIN THE AIR FORCE. FOR EXAMPLE:
  - Act as repository for information, and maintain records on total computer resources
  - Initiate and manage studies on current and possible future trends of computer technology
  - Maintain constant assessment of today's state of the art in relation to apparent Air Force needs
  - Provide central source of expertise
- PROVIDING AN AUTHORITATIVE AND VISIBLE POINT OF CONTACT WHICH COULD ENCOURAGE AND EXPEDITE INTERACTIONS BETWEEN THE AIR FORCE COMPUTER COMMUNITY AND:
  - The users of computers in the Air Force
  - The computer community outside the Air Force
- FOSTERING BENEFICIAL EXCHANGE OF INFORMATION BETWEEN FUNCTIONAL AREAS ON TECHNOLOGY, MANAGEMENT TECHNIQUES, OVERLAPPING REQUIREMENTS, ETC.
- ASSURING COMPLIANCE WITH DoD REGULATIONS PERTAINING TO PUBLIC LAW
- ACTING AS AIR STAFF SPONSOR FOR 51xx CAREER FIELD

FIGURE 7

wider basis as needed. He would clearly have to collect and maintain certain records. He would have to initiate and manage appropriate studies related to the tracking of computer technology. He would constantly assess the state of the art and be prepared to suggest to Air Force end-users that certain technological advances are ready for application. He would provide an authoritative and visible point of contact that would both encourage and expedite interactions and transfers of information among various Air Force entities concerned with computers--including those interacting with the world at large.

Clearly the focal point must establish Air Force policy on computer resource management. He would foster exchanges of information among functional application areas on such matters as technology and state of the art, management techniques, overlapping requirements, and the like. His relation to computer-oriented people throughout the Air Force would parallel that of DCS/Systems and Logistics to logistics people, or of DCS/Plans and Operations to operations people. Obviously, he has to assume the responsibility for complying with the OSD and Air Force regulations that implement P.L. 89-306. Importantly, he would be the Air

Staff sponsor for the 51XX field, the Air Force career field in computers. Indeed, the mere act of focalizing will be an important mechanism for moving quickly and smoothly from where the Air Force finds itself today to where the Air Force wishes to be.

Among the several ways in which the Air Force can provide the Chief of Staff with such a focalization are the following: It could create an Assistant Chief of Staff for Computer Resource Management; it could create, in the Air Staff or perhaps elsewhere, a Special Operating Agency to tend to the problem; it could establish a special assistant to the Chief of Staff; or it could create a Directorate for Computer Resource Management under one of the existing deputy chiefs. While there are other possibilities, these appear to be the most important. In particular, the question of an Assistant Chief of Staff versus a Directorate received the greatest attention in the study.

An ACS/CRM

It is recommended that an Assistant Chief of Staff for Computer Resource Management be created. Arguments in support of this position include the following (Fig. 8). First, the act of itself would transmit a strong and unambiguous internal signal to the Air Force at large that it intends to cope better with computer technology. Given that the Air Force's ability to deal with computer technology is increasing more slowly than the scope of the problem, it follows that the Air Force must apply a concentrated and strong burst of energy to improve, and moreover must address the matter from the strongest possible starting position. It is true that the strong starting position advocated may become unnecessary. The Assistant Chief of Staff (ACS) focal point may well drift to another position, such as a Directorate under a Deputy Chief of Staff (DCS). At the moment, the power and prestige attached to the position of Assistant Chief of Staff is of dominant importance.

An Assistant Chief of Staff would have the stature that would permit him to interact productively with the existing power structure in the Air Staff; he would have access to important top-level meetings--in particular, Air Force Board and Air Force Council meetings--and would

AN ACS/CRM

CAN BETTER ACHIEVE:

- UNAMBIGUOUS, STRONG SIGNAL OF INTENT
- GIVEN THAT WE PERCEIVE THE AIR FORCE IS BEHIND THE POWER CURVE, THE STRONGEST STARTING POSITION POSSIBLE IS REQUIRED
- THE STATURE OF THE FOCAL POINT SHOULD BE SUCH AS TO PERMIT HIM TO PRODUCTIVELY CONFRONT THE EXISTING POWER STRUCTURE
- ACCESS TO TOP LEVEL MANAGEMENT TO ENSURE THAT DECISIONS MADE ARE "AIR FORCE" DECISIONS
- PARTICIPATION IN THE CURRENT FORMAL AND INFORMAL DECISIONMAKING STRUCTURE WITHIN THE AIR STAFF--FOR EXAMPLE, BOARD AFFAIRS AND COUNCIL SESSIONS RELEVANT TO COMPUTERS
- CREDIBILITY AND ACCEPTANCE WITHIN THE AIR FORCE

ADDITIONALLY, NO DCS IS AN OBVIOUS AND NATURAL HOME FOR THE FOCAL POINT BECAUSE:

- NO DCS HAS THE CORRESPONDING SCOPE--A BIRTH-TO-DEATH INVOLVEMENT WITH COMPUTER-BASED SYSTEMS THAT CUTS ACROSS ALL FUNCTIONAL AREAS
- WE CONCEIVE THE FOCAL POINT TO BE AN ADVOCATE OF PROCEDURE AND MANAGEMENT BUT NOT OF A PARTICULAR SYSTEM

FIGURE 8

participate in the normal decision process in the Air Staff. He cannot be seen as only a mechanism that merely collects information and provides records.

In terms of the personal characteristics of the ACS, one of the attributes that seem important is that he be familiar with computer matters. He must know enough about the technology to judge the advice given him and feel comfortable with the technology; but it is of overriding significance that he be acceptable to and able to interact with the operational elements of the Air Staff and the Air Force. Obviously, the ACS will need assistance. To support the mission outlined for him, he will need technical experts in command control systems, embedded systems, and management support systems.

There are two arguments against creating a Directorate under a Deputy Chief of Staff, and these implicitly argue for the ACS position. First, there is no DCS that has the birth-to-death involvement with computer-based systems which occurs in many present functional application areas. In particular, a large part of the Air Force computer issue involves monitoring and managing a collection of standard functional computer software packages through their entire lifetime of

operation in the Air Force. Furthermore, it involves the monitoring and management of the inventory of computer machines on which the applications run. Second, a Directorate under a DCS could not avoid becoming an advocate for the functional area represented by the DCS. Importantly, the focal point must not be an advocate for some particular system; rather, he must be an advocate of procedure, an advocate of management, and an advocate for exploitation of computer technology. A DCS, by its nature, is directed toward a given functional area; there is an essential conflict with the independent objective posture that the focal point must have.

Other Air Staff Implications

A fundamental premise behind the proposal is that the requirements-generation process and design-and-development activities must interact, but only in a controlled way. Throughout the Air Staff it is essential to create or to strengthen, as the case may be, the requirements-generation process wherever a functional application area exists which requires computer-based information systems (Fig. 9). In some parts of the Air Staff, adequate groups already exist, but unfortunately some tend to drift into detailed design of the computer system instead of focusing on specification of requirements. For some functional areas, particularly cross-command, there is no requirements focus in the Air Staff.

Given that the acquisition of a computer-based system is to be treated as a development process independent of a functional area--and it is stressed that management support systems are included--and that it is to be *managed* as a development process, it is natural for DCS/Research and Development to be the technical advocate within the Air Staff. Since AF/RD is that part of the Air Staff which the Air Force has identified as responsible for the development process, it would continue to be responsible, as now, for weapon systems and for command and control, but would assume the additional area of management support systems. Thus, both Data Automation Requirements (DARs) and Required Operational Capabilities (ROCs) would flow into AF/RD for

OTHER AIR STAFF IMPLICATIONS

- STRENGTHEN REQUIREMENT-GENERATION FOCUS IN FUNCTIONAL AREAS--ESPECIALLY AREAS THAT CUT ACROSS COMMANDS
- AF/RD CONTINUES TO BE RESPONSIBLE FOR COMPUTER SUBSYSTEMS OF WEAPON SYSTEMS, AND COMMAND AND CONTROL, AND TAKES ON THE ADDITIONAL FUNCTIONAL AREA OF MANAGEMENT SUPPORT SYSTEMS
  - Computer system acquisition needs to be treated as a development process
  - AF/RD is Air Staff organization that currently has this type of focus and experience
- BOTH DARs AND ROCs WOULD FLOW INTO AF/RD FOR COORDINATION
- AF/RDQ AUGMENTED, OPR ASSIGNED FROM AF/RDQ
- FOCAL POINT FOR ALL COMPUTER-BASED SYSTEMS OR SUBSYSTEMS ESTABLISHED IN AF/RDQ
  - Special channels needed
  - ACS/CRM should not be advocate for a system
- FOCAL POINT FOR ALL COMPUTER-BASED SYSTEM PROGRAM ELEMENT MONITORS CREATED IN AF/RDP
- AF/ACD FUNCTIONS HAVE BEEN REDISTRIBUTED TO ACS/CRM AND AF/RD
- AIR FORCE DAA ASSETS
  - Federal Simulation Center--ACS/CRM
  - Data Service Center--ACS/CRM or Headquarters Command USAF
  - Air Force DSDC

FIGURE 9

coordination.* This is in contrast to the present situation in which ROCs flow into AF/RD but DARs flow into the Directorate of Data Automation (AF/ACD). There would still be thresholds for both DARs and ROCs, but they need not be the same. The expectation is that the DAR threshold might be higher, especially if the decision process can be handled within a command itself, using technical expertise as required from AFSC or from the ACS/CRM at the Air Staff.

Thus, AF/RDQLM would become the recipient for all DARs and all ROCs over some specified threshold. An Office of Primary Responsibility (OPR) would be assigned from the appropriate organization and AF/RDQ would be augmented as required to accommodate the additional DAR workload. An organization within AF/RDQ--which might be called AF/RDQPK--would be required as a central contact point for computer-based systems or subsystems. In effect, development responsibility would be focalized within AF/RD for all computer-based systems. Thus, AF/RD, together

*The Data Automation Requirement is associated with the 300-series regulations, the Required Operational Capability with the 800-series regulations.

with the functional area(s) involved, would become an organizational advocate for each and every Air Force computer-based system.

While it may seem that this line of argument gives computer technology a very special treatment, it is to be observed that computer resources have become so vital to the Air Force, especially at the present time, that special attention and special organizational arrangements are needed to deal with them.

One effect of the foregoing discussion is to reassign the responsibilities now centralized in AF/ACD; but the Director of AF/ACD is also the Commander of the Data Automation Agency (AF/DAA). There are three components of AF/DAA to be examined. First, the Federal Simulation Center is a government-wide undertaking for which the Air Force is executive agent; it provides computer simulation expertise to analyze user requirements, relating them to specific computer hardware configurations and software capabilities. In general, the Center assists in just the kind of studies and decisionmaking that the new Assistant Chief of Staff would be expected to participate in. It is, therefore, appropriate that the Federal Simulation Center be continued as part of the office of the proposed Assistant Chief of Staff. Second, there is the Data Services Center in the basement of the Pentagon, which supports the entire Air Staff; here there are two possibilities. It might become a part of the office of the Assistant Chief of Staff, in which case the latter could function in effect as the single manager of computer matters for the Air Staff; or it might equally well become a part of the Hq USAF command that now runs all other administrative and support facilities for the Air Staff. Third, the Data System Design Center (DSDC) needs further study; but, consistent with the general strategy of the proposal, the following posture is appropriate, at least for large systems.

Data System Design Center

In the Data System Design Center, the Air Force has institutionalized all development efforts plus the required continuing attention for the so-called Standard Functional Packages that run both at base level and in the major commands (Fig. 10). Situated at Gunther Air

AFDSDC

- CHANGE MIX OF SKILLS; SEPARATE FUNCTIONAL FROM COMPUTER SPECIALISTS
- HOME FOR FUNCTIONAL PART--UNRESOLVED
  - Logistics in LMC, create corresponding organization for other functional areas
  - Create BMC--reporting to inter-DCS committee
- HOME FOR DESIGNERS AND DEVELOPERS
  - Nucleus of new division in AFSC
  - Responsible for development of management support systems
    - Organic
    - Project offices
  - Changed role for AFSC. Product enhancement and product improvement functions would remain with the developing agency

FIGURE 10

Force Station, it currently consists of many hundreds of people who help to create user requirements and who design and implement management systems. It is involved in a special way with Air Force computer users because (1) it delivers capability to the user on an incremental basis, (2) it has responsibility for managing much of the inventory of computers on which all such packages run, and (3) it is expected to support functional-area users until the function is discontinued. Certain changes in this Center seem indicated; it should be realigned organizationally--but not relocated geographically.

Careful attention needs to be given to the controlled interaction of the requirements-generation process with the development process. With respect to the functional system-design part of the Data System Design Center, two possibilities were considered by the Rand team. One is that the Logistics Management Center (LMC), plus various Special Operating Agencies such as the Military Personnel Center and the Finance Center, could continue to be the source of user requirements and functional system design for the various base-level activities. A second

possibility is that the Air Force could create what might be called a Base Management Center (BMC) that would address itself to all computer-based functional-area applications at base level. A specific position on this point is not taken.

The part of the Data System Design Center that responds to user-stated requirements and creates appropriate management support systems for either bases or major commands can become the nucleus of a new division of AFSC, perhaps called the Data System Division. It is stressed that the new organization should not become part of the Electronic Systems Division for several reasons. First, ESD is a weapon-system-oriented organization geared to respond largely to ROCs. Second, it already has a major task on its hands just coping with its present workload. Third, and very important, the way of life in the weapon system ROC-driven process which ESD is accustomed to is different from the total-life involvement of the Data System Design Center. The Data System Division of AFSC should have both an in-house design-and-development capability to accommodate such tasks as could be done by an organic staff, and a project-oriented component through which it could contract and conduct outside procurements as necessary. The Data System Division should be housed at Gunther Air Force Station; the functional system designers and the computer specialists should still be collocated, but there must be appropriate organizational controls to assure a proper interface between the two.

The Data System Division would continue to deal only with management support systems; its proposed structure is consistent with that suggested elsewhere for Air Staff reorganization. It is important to note that the total-life involvement for the proposed Data System Division is significantly different from the way of life for normal AFSC product divisions. In particular, a system created by the Data System Division would never transition; it would never be turned over to AFLC or to a major command for product improvement and product enhancement. Rather, the Data System Divison would retain responsibility for that functional application throughout its life. AFSC must be willing to accept this quite different responsiblity.

AFSC

Since AFSC must strengthen its capability to develop computer systems, and it would be asked to accept a new responsibility, obvious changes would be needed in the Hq AFSC organizational structure (Fig. 11). Each of the divisions of AFSC should be given a "Center of Expertise." This concept derives from the observation that computer expertise must be strengthened throughout AFSC to support System Project Offices and program offices, and to participate in management decisions. A possible image is that of ESD/MCI, which lends scores of experienced computer people to projects for varying periods of time. It is acknowledged that creating three Centers of Expertise would demand more personnel, but since the eventual goal of the Air Force is to have computer expertise wherever needed, it is appropriate to create the several Centers now. Furthermore, a single Center of Expertise operating from Headquarters/AFSC might be seen as an outsider and intruder by each of the product divisions, and therefore as largely unwelcome. An in-division Center would be seen as an insider and should have better acceptance by the System Project Offices and program offices. Several Centers of Expertise have the collateral benefit of providing an excellent training ground for computer specialists who would have multi-faceted, multi-functional-area experience, and therefore would be qualified for later career assignments in System Project Offices or the Air Staff.

AFSC

- NO CURRENT ORGANIZATION IN HEADQUARTERS AFSC THAT CAN COPE WITH MANAGEMENT-SUPPORT-SYSTEM DEVELOPMENT

- ESTABLISH CENTERS OF EXPERTISE (COEs) WITHIN ESD, ASD, AND SAMSO AS WELL AS DSD
  - Need to strengthen computer expertise in all product divisions
  - COEs need to be closely associated with programs

FIGURE 11

Other Organizational Implications

The proposed solution would have other organizational implications throughout the Air Force (Fig. 12). To be consistent with the idea suggested previously, there must be a strong organizational separation but a controlled interaction between the requirements-generation process and the development process in the major commands engaging in computer system development. It is not suggested that major commands would discontinue development; rather, the development process and the requirements-generation that drives it must interact in a controlled way. The image that seems appropriate is that of the Strategic Air Command, where the so-called "Single Manager" is an Assistant Chief of Staff; he can, in fact, properly confront and interact with the functional people in SAC who ask for computer-based capabilities. Therefore, it is proposed that the Single Manager, who was originally created to be a focal point only for management support systems, now become the focal point in each major command for computer matters. He would have two functions. He would be responsible for all computer systems in the command that are not subsystems of weapons; and he would oversee, control, and manage the development process--especially of

OTHER ORGANIZATIONAL IMPLICATIONS

- SEPARATION BETWEEN FUNCTIONAL REQUIREMENT-GENERATING ORGANIZATIONS AND THE COMPUTER DEVELOPMENT ORGANIZATIONS WITHIN MAJOR COMMANDS
- SINGLE MANAGER IN EACH COMMAND SHOULD BE THE FOCAL POINT FOR ALL COMPUTER RESOURCE MANAGEMENT WITHIN THE COMMAND
- SINGLE MANAGERS HAVE PROFESSIONAL, NOT FORMAL, RELATIONSHIP TO ACS/CRM
- COEs IN MAJOR COMMANDS REPORTING TO SINGLE MANAGERS

FIGURE 12

software--within the command. The Single Manager would have no formal authority-relation to the Assistant Chief of Staff in the Air Staff, but he would have a *functional* relation in the same sense that the operations people of the command relate to DCS/Plans and Operations, or the logistics people of the command relate to DCS/Systems and Logistics. It may be that a major command heavily involved in computer system design and development would need its own Center of Expertise reporting to the Single Manager; alternatively, the purpose could be fulfilled by a special mechanism to obtain technical support from AFSC as needed. One effect of the proposal would be that the experience and knowledge of the single-manager organization will have to be expanded and its authority and responsibility broadened. Such an action does not affect the present scope and responsibilities of the command, but rather represents a modification of organizational responsibilities within some commands.

Miscellaneous

A recurring theme, not only in the Air Force but in the civilian world at large, is that communications and computers are rapidly becoming a common field (Fig. 13). While it is true that they share an electronic capability for solid-state switching, processing, and storage, and therefore ultimately depend on a largely common technology, there seems to be no reason at this juncture to force the two into a common management structure. What does seem important is that the Air Force make no decision now that would preempt joining the two areas a few years in the future as the present trend continues.

Some of the suggestions that have been made about the Air Staff may have repercussions for the Secretary of the Air Force structure. There are some obvious issues related to career management, training, personnel management, and career progression. The Air Force regulations may need to be restructured or redrawn to be consistent with the framework proposed. All of these points have yet to be studied.

MISCELLANEOUS

- TELECOMMUNICATIONS AND COMPUTERS
- RELATIONSHIP OF ACS/CRM TO CIVILIAN STRUCTURE
- TRAINING
- CAREER MANAGEMENT
- FINANCIAL VISIBILITY AND BUDGET
- REQUIREMENTS GENERATION--ORGANIZATIONS AND PROCEDURES
- REGULATIONS

FIGURE 13