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MODERNIZATION OF THE WWMCCS INFORMATION SYSTEM (WIS)

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PREPARED FOR

THE COMMITTEE ON ARMED SERVICES
UNITED STATES HOUSE OF REPRESENTATIVES

IN RESPONSE TO
HOUSE REPORT NO. 96-916

19 JANUARY 1981

PREPARED BY

THE ASSISTANT SECRETARY OF DEFENSE
(COMMUNICATIONS, COMMAND, CONTROL AND INTELLIGENCE)

WITH THE ASSISTANCE OF

WWMCCS SYSTEM ENGINEER
DEFENSE COMMUNICATIONS AGENCY

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SUMMARY

Automated data processing (ADP), one of the several elements of the Worldwide Military Command and Control System (WWMCCS), is the nucleus of a dynamic and evolving WWMCCS Information System which serves the National Command Authorities and key military commanders across a broad spectrum of planning and operational activities from day-to-day and crisis operations to conventional and nuclear war. The use of this information system, involving 83 Honeywell 6000-series CPUs at 26 sites, is growing and the system is expanding both in the breadth and depth of its operational applications. This expansion is occasioned to a large degree by the availability of a WWMCCS Intercomputer Network (WIN) which provides a high-speed, high-capacity digital data communications capability among 20 of the sites. The WWMCCS Information System is expected to continue to grow both in numbers of sites and services provided as users and system operators gain more experience with WWMCCS ADP and network applications.

The growing use of WWMCCS ADP and increased operator experience, however, have highlighted certain deficiencies in the present information system, especially in its support of time-sensitive crisis applications. In addition, rapid advances in ADP architecture and in hardware and software technology have created a situation in which the installed Honeywell hardware and system software are becoming technically obsolete. Moreover, it is anticipated that the current system will become increasing difficult and uneconomical to support logistically within ten years. Consequently, a major modernization of WWMCCS ADP and other elements of the WWMCCS Information System must be planned now and implemented. Modernization of the ADP hardware alone will not be sufficient; modernization of much of the WWMCCS software is required both to meet expanding operational needs and to take full advantage of the new hardware capabilities.

In the current WWMCCS ADP architecture, the several H6000 CPUs at each site are generally coupled together into configurations to form the equivalent of one or two large processors on which all applications software is operated. The applications software falls into two classes: standard, centrally developed software for functions implemented at a large number of sites, and command-unique software developed for use at an individual site or a small number of Service-supported sites. The standard WWMCCS applications common to many sites have been categorized by the Joint Chiefs of Staff (JCS) into at least four operational or mission-oriented families:

- o Resources and Unit Monitoring,
- o Conventional Planning and Execution,

- o Nuclear Planning and Execution, and
- o Tactical Warning and Space Defense.

Two major architectural decisions for the required modernization have now been made. The first relates to the location or distribution of ADP serving WWMCCS. The decision here is to modernize the ADP at each site rather than implement new centralized, regionalized or other ADP arrangements which redistribute the location of the ADP resources and involve a considerable degree of remote operation and shared facilities.

The second decision relates to the type or design of the ADP to be installed at each site. The decision here was based on an assessment of the current architecture and appraisal of desirable modernization factors. This led to the following conclusions:

- o there is no need for the same or simultaneous modernization of all of the WWMCCS ADP configurations supporting all functions at all sites,
- o hardware and software standardization is essential for functions common to multiple sites, but a tailored, non-standard, approach to modernization of most command unique functions is acceptable,
- o priority should be given to those areas where current performance is less satisfactory, with special early attention to the need for providing a very reliable, secure, high-capacity intercomputer communications capability, and
- o a phasing of the modernization effort would permit the cost and disruption of transition to be broken into manageable pieces.

The selected nodal architecture has been termed the "functional family" approach. It departs from the current architecture and implements a new distributed data processing system at each site rather than concentrating the processing in one or two large central machines. At each site, a local network would serve to interconnect the various equipments and ease the transition process.

This approach permits standard hardware and software treatment of the key functional families which are common to many sites, yet with tailored, site-by-site treatment of the hardware and command-unique applications at individual sites. To the extent that the functional families are independent of one another, their modernization schedules may be phased to occur at different times, easing the operational problems on the sites as well as budgetary pressures.

While the basic architectural decisions have been made, other issues remain to be addressed in the near future. Definition and specification of operational and information system requirements for the new system are proceeding in pace with the architectural activities. These efforts are now oriented to the four-family functional approach.

Near-term modernization of the ADP used for tactical warning and attack assessment command and control capabilities is a very high priority problem and one whose solution should not be constrained or otherwise affected by the mid-to-long term functional family approach. Accordingly, the Air Force has established a new Systems Integration Office at the Aerospace Defense Command to plan and engineer the necessary improvements to the ADP of the command and control systems involved: the NORAD Missile Warning and Space Surveillance System, and the Command Center Processing and Display System. This separate activity is proceeding with high priority.

It does not appear that the Nuclear Planning and Execution family requires additional attention at this time beyond already on-going ADP modernization activities. Accordingly, this family has been given a lower priority in the WIS modernization.

Cost and schedule estimates have been prepared for the selected functional family approach. They are very preliminary at this point, focus only on acquisition (R&D, hardware and software procurement) costs, and do not yet include the Nuclear and Tactical Warning families. As an order of magnitude, an acquisition expenditure of 1.0 to 1.3 billion dollars is indicated, although this might grow by several hundred million dollars if the amount of command-unique software to be converted has been seriously under-estimated. This total compares with some 40 million dollars for acquisition in the FY 82 WWMCCS ADP budget of about 200 million dollars. Extrapolation of this 40 million dollar level over a ten-year period indicates an incremental acquisition cost of 600-900 million dollars for the modernization.

The schedule calls for continued planning and requirements definition in FY 82. Specification preparation and source selection activities will extend through 1986, with the phased acquisition, test, and installation of most new hardware and software between 1985 and 1990. The portion of the modernized system which provides such command support capabilities as the local network, automatic message handling and terminal support capabilities will be procured first, and serve as the basis for the entire phased approach. All of this will build upon the currently-planned ADP and WIN upgrades to yield a modern communications and user support capability. The functional families and the command-unique applications will follow.

To provide stronger and more centralized management and direction of all WIS modernization activities, broad programmatic, technical, and fiscal responsibilities will be assigned to a newly created WIS Joint Program Manager (JPM). The JPM will be activated by mid-1981 and report through the JCS to the Assistant Secretary of Defense for Communications, Command, Control and Intelligence (ASD/C^3I). For the acquisition of new hardware and software, a new system project office will be established by the Air Force.

1.0 INTRODUCTION

This document has been prepared in response to Congressional requests that the Department of Defense (DoD) prepare a comprehensive plan for modernizing the Worldwide Military Command and Control System (WWMCCS) automated data processing (ADP).

The sections which follow report on the results of activities of the past year in further defining the operational and information system requirements and in making the basic architectural choices for this modernization. As such, this document supplements the report entitled "Planning for Modernization of the WWMCCS Information System" presented to Congress in January 1980 and represents a major step towards the final modernization plan which DoD will submit to Congress with the FY 83 budget. That report will further detail modernization planning, provide answers to issues noted herein, and will present the refined program schedule and cost data upon which the FY 83 and successive WIS modernization budget requests will be based.

The focus of the modernization effort described herein is the set of Honeywell H6000 series computers procured beginning in the early 1970s in support of WWMCCS command centers. The majority of these computers were procured under a single, competitively awarded WWMCCS ADP contract and are generally referred to as "WWMCCS Standard ADP". For reasons of compatibility, several additional H6000s were procured for WWMCCS command centers by other contractual means. The totality of these machines and supporting hardware (DN355s, H700s, peripherals, etc.) will be collectively referred to as "WWMCCS ADP". Other ADP in WWMCCS is discussed (see Sections 2.4 and 5.3) in order to put the proposed modernization in context.

In the discussion which follows, the term "WWMCCS Information System", or WIS, is adopted to indicate that the operational and technical modernization considerations go beyond ADP hardware and software to include information reporting systems, procedures, data bases and files, terminals and displays, and communications.

The word "conversion" is used herein to indicate the general process of modifying software, originally developed to operate on one computer, to operate on a different computer. While several levels of difficulty and effort in conversion have been identified, only two levels are considered here. The first and simplest is "translation", which is largely a direct mechanical recompilation process; at the other extreme is "redesign", which generally involves a complete revision of the functional design.

In response to the Congressional request for "a separate section that addresses the ADP requirements of the WWMCCS strategic warning system", Section 8.0 discusses the modernization of the ADP for tactical warning and attack assessment command and control systems.

2.0 WWMCCS ADP TODAY

WWMCCS ADP, one of the several elements of the WWMCCS, is itself the nucleus of the dynamic and rapidly evolving WWMCCS Information System (WIS). It consists primarily of the Honeywell H6000 series computers and related equipments located at 26 WWMCCS sites or nodes and performing a variety of missions and functions identified by the Joint Chiefs of Staff (see JCS Pub 19). Twenty of the sites are interconnected with the digital data communications capability of the WWMCCS Intercomputer Network (WIN). In addition to the 26 major sites with local H6000 computers, another 8 sites are served by one or more terminals from other major sites.

An appreciation of the current characteristics and growth pattern of WWMCCS ADP is essential to an understanding of the focus and direction of the modernization plan. The material of this section is based on visits to the commands equipped with WWMCCS ADP and on discussions with the personnel responsible for programming, operating, and using the current ADP system. It supplements assessment information developed in a 1979 user survey and summarized in last year's report to Congress on WIS modernization. Key assessments in that report were:

- "Use of and reliance on WWMCCS ADP is a fact of life. Almost all users commented that their ability to accomplish their operational jobs would be seriously impaired without the existing WWMCCS ADP support, despite its imperfections."

- "WWMCCS ADP is providing useful support to day-to-day operations, with planning for possible joint military operations and deployments being a particularly important application."

- "WWMCCS ADP support of command and control operations in a time-constrained crisis or conflict environment is not viewed as adequate or responsive to user needs."

- "The on-line query/response and associated information retrieval capabilities of the Honeywell-based system are clearly not up to the state-of-the-art, nor is system reliability viewed as satisfactory."

- "The timeliness, accuracy, and completeness of the source information is a far more fundamental issue affecting the operational adequacy of WWMCCS ADP support. Much of the basic data input to WWMCCS ADP applications programs originates at the operating forces, and is provided in accordance with existing reporting procedures. These procedures are embodied in the Joint Reporting Structure (JRS) and in associated Service/Command reporting systems."

- "Significant improvement in ADP support of crisis/conflict management will require more current, accurate and, therefore, credible information."

- "Other factors impacting operational performance include the reliability of the supporting communications, and the limited availability of experienced and well-trained personnel at the individual sites. Survivability of command facilities and their supporting information systems is an extremely important additional concern."

2.1 Honeywell H6000 Series Hardware

The basic element of WWMCCS ADP is the Honeywell H6000-series central processor unit (CPU). There have been 83 H6000 CPUs procured for use in WWMCCS command centers or in a supporting role; 76 of these were obtained under the WWMCCS Standard ADP contract (as part of the procurement of 35 "systems") and 7 were obtained through other means.

(Over the past 5-10 years, a number of electronic card, board and other modifications, replacements, and additions have been made to the H6000s to increase performance, improve reliability, or provide compatibility with new peripheral equipments. These changes have been made to most of the H6000 CPUs and have had the effect of achieving functional equivalence, but not physical equivalence, to the Honeywell Level 66 CPUs. These WWMCCS machines are still generally referred to as the H6000 series, and that practice will be followed here.)

A better measure of the size of WWMCCS ADP is the number of "configurations", where a configuration is defined as the assignment of one or more CPUs at a site to a specific mission or set of tasks. Figure 2.1 presents the 83 CPUs and their current assignment to 49 configurations. By agreement with the Defense Intelligence Agency (DIA), the five CPUs and three configurations devoted to the Intelligence Data Handling System (IDHS) at USEUCOM, LANTCOM, and NORAD/ADCOM will be modernized by DIA in accordance with their current plans. Eliminating these leaves 78 CPUs and 46 configurations as the target for WWMCCS ADP modernization.

The utilization of the WWMCCS hardware at the sites is expanding both in the scope and depth of applications as a result of the growing education and experience of the system users and operators in applying the WIS to a variety of planning and crisis operations and as a result

COMMAND LEVEL	SITE	LOCATION	TOTAL CPUs BY SITE	CONFIGURATIONS	CPUs PER CONFIGURATION
JCS	NMCC	Pentagon	4	Operations	2
				Development/Back-up	2
	ANMCC	Ft Ritchie, MD	4	Operations	2
				SIOP	2
Unified	USEUCOM	Vaihingen, GE	2	Operations/SIOP	1
				Intelligence (IDHS)	1
	PACOM	Camp Smith, HI	1	SIOP	1
		Makalapa, HI	1	Operations	1
	LANTCOM	Norfolk, VA	6	Operations	4
				Intelligence (IDHS)	2
	REDCOM/ JDA	McDill AFB, FL	4	Operations (REDCOM)	2
				Operations (JDA)	2
Speci- fied	SAC	Offutt AFB, NE	7	SIOP	2
				Force Status (on-line)	2
				Development/Back-up	2
				MAJCOM Support	1
	NORAD/ ADCOM	Colorado Springs, CO	14	Intelligence (IDHS)	2
				Space Computation Center	2
				NORAD Command Center	2
				NCS Back-up	2
				Comm System Segment	2
				Off-site Development	4
	MAC	Scott AFB, IL	7	Passenger	1
				Cargo	1
				Operations (Top Secret)	2
				Operations (Unclassified)	2
				MAJCOM/Development	1
Sub- Unified	USFK	Taegu, Korea	1	Operations	1
Service Hq	Army (AOC)	Pentagon	2	Intelligence	1
				Operations	1
	Navy (NCC)	Washington Navy Yard	4	Operations	2
				Development	1
				Back-up	1
	AF(AFDSC)	Pentagon	1	Operations	1
System Support- ive	Army War College	Carlisle Bks, PA	1	Back-up Operations	1
	Air Univ	Gunter AFS, AL	2	Back-up Operations	2
Component Commands	PACFLT (PACWRAC)	Makalapa, HI	2	Operations	2
	USAREUR	Heidelberg, GE	1	Operations	1
	FORSCOM	Ft Gillem, GA	2	Operations	2
	NAVEUR	London, England	2	Operations	2
	TAC	Langley AFB, VA	3	Operations	3
	PACAF	Hickam AFB, HI	1	Operations	1
	USAFE	Ramstein AB, GE	2	Operations	1
				NATO/US Support	1
Transpor- tation	MTMC	Falls Church, Va	3	Operations (Top Secret)	1
				Operations (Unclassified)	2
Support/ Develop- ment	CCTC (Reston)	Reston, VA	4	Development	4
	ATC	Keesler AFB, MS	1	Training	1
	Navy	Pax River, MD	1	Navy Test Bed	1
Totals	26		83	49	83

Figure 2.1 WWMCCS ADP Sites, CPUs, Configurations (January 1981)

of the WIN implementation. This growth curve seems likely to continue upward with the continuing interest, education, and experience of the users and with continued system enhancements.

A measure of the operational utilization of WIS is the growing number of local and remote terminals connected to the H6000s. Figure 2.2 presents the current inventory of WWMCCS work stations, where a "remote terminal" may be anywhere from several miles to several thousand miles away from its host computer (as opposed to local terminals which are in the immediate vicinity of the host processor). The growth in terminals has been very rapid, with a doubling since 1976; this has been particularly true of remote terminals, to a point today where most major US military installations in the US, Korea, and Europe are connected either via the WIN or remote terminals to WIS.

The specific utilization of WWMCCS ADP varies widely among the 26 sites. A list of typical activities served includes the following functions:

- o maintenance of status and location of forces and resources,
- o planning for force mobilization and deployments,
- o preparation of the SIOP (single integrated operational plan),
- o calculations for SPACETRACK,
- o scheduling of MAC cargo and passenger reservations,
- o estimating and monitoring Navy fleet fuel consumption,
- o assistance in preparation and processing of AUTODIN messages, and
- o assistance in preparation of Air Force tactical "frag" orders.

There is a growing use of WWMCCS ADP for a wide variety of command center support functions, including the managing of records, logs, briefings and messages. (This area is one very similar to developments in the commercial world described as "office automation".) WWMCCS ADP users are also finding very significant applications of on-line teleconferencing using WIN to communicate and exchange messages and data bases among personnel at different command centers as well as remote sites. The terminal and network aspects of WIS effectively support the on-line interactive development and coordination of contingency plans among personnel who are physically separated in

COMMAND LEVEL	SITE	WORK STATIONS LOCAL	REMOTE	TOTAL
JCS	NMCC	91	4	95
	ANMCC	39	16	55
UNIFIED	USEUCOM	30	--	30
	PACOM	27	--	27
	LANTCOM/LANTFLT	73	28	101
	USREDCOM	29	20	49
SPECIFIED	SAC	88	16	104
	NORAD/ADCOM	62	--	62
	MAC	121	118	239
SUB-UNIFIED	USFK	17	24	41
SERVICE HEADQUARTERS	Army (AOC)	34	31	65
	Navy (NCC)	27	9	36
	Air Force (AFDSC)	24	2	26
	Marines	--	1	1
SYSTEM SUPPORTIVE	Army War College	33	1	34
	Air University	10	3	13
COMPONENT	PACFLT (PACWRAC)	35	12	47
	USAREUR	29	8	37
	FORSCOM	20	81	101
	NAVEUR	45	8	53
	TAC	74	26	100
	PACAF	21	--	21
	USAFE	52	--	52
TRANSPORTATION	MTMC	39	46	85
SUPPORT/ DEVELOPMENT	CCTC-Reston	34	8	42
	ATC	26	--	26
	Navy	7	--	7
	GRAND TOTAL	1087	462	1549

Figure 2.2 WWMCCS Work Station Inventory (January 1981)

different commands and continents. This growing use of WWMCCS ADP contrasts with the more traditional batch-oriented computational aspects of computer utilization.

While the reliability of WIN has been less than desired, the WWMCCS ADP sites are generally satisfied with the reliability of the CPUs; they report that scheduled and unscheduled hardware maintenance has been low. Many sites wish to obtain additional CPUs to enhance their processing capacity, to decrease computer response time, or to provide better "back-up" capability at key sites; note that Figure 2.1 indicates very few dedicated back-up CPUs. The poor reliability of computer peripherals and supporting power and air conditioning facilities is also a matter of widespread concern.

2.2 WWMCCS Intercomputer Network (WIN)

The WIN has been one of the major enhancements to WWMCCS ADP and has grown significantly from six participating sites in 1977 to 20 sites today. The present WIN is the outgrowth of an experimental program from 1971 to 1977 to determine the operational benefit of networking and to identify the characteristics needed to support military operations. After a series of controlled tests and uncontrolled use in a JCS exercise and several actual crises, operational personnel quickly concluded that the experimental system provided positive contributions and declared the system operational despite documented technical and procedural deficiencies.

WIN performance today is less than satisfactory and is a primary target of user complaints. A major program to provide the hardware, software and reliability improvements was initiated in 1980 and will continue over the next few years. (This program is outlined in Section 6.0.) Reliability across the net is improving, but still does not meet stated operational requirements.

Some of the sites on the WIN network have Top Secret data bases and some of the data transmitted over WIN is of the same classification. Lacking multi-level security features, _all_ machines and terminals (and associated personnel) on WIN must be cleared to that security level.

The experiences of exercises and crises in 1980 indicate that some improvements have been made in WIN operational use. Improvements were made in the transmission of data bases among sites, especially in the case of lengthy transfers in which in excess of 3.5 million characters of information are involved. The components of the WIN--namely the Interface Message Processors (IMP), H6000s, DN355s and communication lines--demonstrated a wide range of availability and reliability from very poor to excellent.

Despite the improvements of 1980, much additional progress will be required before WIN can fully support WWMCCS users during exercises and crises. [redacted] ~~a major element of WIS modernization.~~

2.3 WWMCCS Software

WWMCCS utilizes two broad categories of software: system software which is standard for most sites, and applications software, which may be system standard, but in general is unique to a site or subset of sites. The system software for WWMCCS ADP was largely obtained with the hardware from Honeywell (and then modified for WWMCCS use) but also has been developed in response to WWMCCS user needs. It is estimated that there are currently about 8,000,000 lines of system software code; this is maintained at an annual cost of about three million dollars.

Quantitative data on WWMCCS applications software is presented in Figure 2.3 in several categories. "Command Unique", a generic term which will be used to refer to all software exclusive of the system software and standard applications software, has two major components. "Command Unique-Service Standard" refers to software which has been prepared by a Service for several of its sites; "Command Unique-Site Unique" includes the software implementing assigned WWMCCS functions, software for command and control capabilities at a site, and WWMCCS supportive or other general-purpose software developed at a site for its own use. The large number of lines of code estimated for Command Unique-Site Unique includes several major contributors (SAC with 2,500,000 lines of code; MAC 2,200,000; and TAC 1,000,000) with the rest associated with about 20 different facilities.

The status and adequacy of the different types of software can be characterized as follows:

System Software	The present system software is largely based on the software architecture and concepts of the late 1960s when it was first produced. Although continous improvements have been made, it does not provide the full range of user support functions felt to be available and necessary today. The government does not own the rights to this software and hence is constrained in the steps it can take in modifying, tailoring, etc.
WWMCCS Standard Applications Software	Much of this software was developed in independent, discrete subsystems or packages for batch processing. A major modernization is required to meet growing interactive terminal operations. The documentation of this software is generally good.

CATEGORIES	CHARACTERISTICS		SIZE LINES OF CODE
WWMCCS Standard Applications	-Centrally developed/maintained for all WWMCCS users		3,330,000
	-Reflect both community wide missions and NMCS/National level needs		
Command Unique-Service Standard	-Centrally developed/maintained for Service users (NWSS, MAJCOM)	AF Navy Army	715,000 1,200,000 200,000
	-WWMCCS supportive		
Command Unique-Site Unique	-Developed by Service elements for command use (CINCs, components)		13,000,000*
	-May be WWMCCS supportive		
			18,445,000 (±20%)

* estimated

Figure 2.3 WWMCCS Applications Software

Command Unique-Service Standard Software	This software is generally well documented and generally appears to be providing satisfactory support. Some modernization is required, however.
Command Unique-Site Unique	With one or two exceptions, the documentation is generally poor. Good statistics and information concerning its use are not available. Duplication of software exists among sites and with commercially available user support capabilities.

It should be noted that some of the standard applications software is quite old, dating from the 1960s, and was converted directly from other machines to work with the H6000s when they were installed in the early 1970s. This software and much of that written in the early 1970s is badly in need of redesign and reorganization. It is oriented to batch processing which inhibits the ability of the system to respond to crisis situations. As an indication of the need for modernization, it is estimated that 25-50% of the standard applications software, the Service standard software, and the site unique software requires redesign.

Limited quantitative data has been collected on the operational utilization of the different types of software. As might be expected due to the large differences in site missions, there is a wide variation in the software utilization from site to site. Air Force sites utilize their WWMCCS ADP for the WWMCCS-supportive major command (MAJCOM) support processing as well as for command and control processing; Navy sites make extensive use of their standard Navy WWMCCS Software Standardization (NWSS) for Navy command and control functions. There is no typical site profile or even a typical day. Computer utilization varies markedly from a day-to-day situation to a crisis situation; in the former, computer loads are time (day of month) and event oriented. Beyond its use for WWMCCS operational functions and WWMCCS-supportive functions, sizeable amounts of computer time are spent at most sites for personnel training and for software development, evaluation, and test.

Supporting the WWMCCS standard applications software are very extensive data bases. Two examples are the Airfield Facilities File and the Unit Status Reporting System data base. The former contains just under 60 million alphanumeric characters of information concerning the physical characteristics and available facilities of some 47,000 airfields; the latter contains over 75 million characters of information on the status, location, and capability of US military resources throughout the world. Very large command unique data bases are also maintained.

2.4 Other ADP In WWMCCS

In addition to the Honeywell ADP, there are many other ADP equipments embedded within or associated with the WWMCCS warning systems and communications links. In order to determine which of these should be considered in association with the WIS modernization, the following screening criteria were established:

- o general purpose computer,
- o not one-of-a-kind equipment,
- o not fully embedded in or procured as part of a sensor or communications system, and
- o original cost of over $100,000 for hardware and software.

The six ADP systems which met these criteria are summarized in Figure 2.4 and considered again in Section 5.0.

ADP SYSTEM	COMPUTERS AND LOCATION	FUNCTION PERFORMED	COST		STATUS
			HARDWARE	SOFTWARE	
Command Center Processing and Display System (CCPDS)	UNIVAC 1100/42s at SAC, NORAD, NMCC, and ANMCC	Provides direct readout of missile warning/attack assessment information	$10.1M	200 manyears	Planned replacement in FY 84/85
SIOP Planning	IBM 3033 and AMDAHL V7 at SAC for JSTPS	Strategic planning and SIOP preparation	$8.7M	175 manyears to convert from H6000	IBM 3033 in use
Cruise Missile Theater Mission Planning System	VAX 780 and PDP-11/60 at SAC/JSTPS, CINCPAC, CINCLANT, CINCEUR, SHAPE, AND USAFE	Provide cruise missile mission and route planning data and generate guidance discs for missiles	Combined estimate: $10M invested		Installations in progress
EC-135	Eight ROLM 1666 CPUs for SAC Airborne Command Post aircraft	Support the battlestaff in performing force management tasks	Combined estimate: $7M invested through 1980		Operational
E-4B	ROLM 1666 CPUs plus displays & terminal gear on E-4B NEACP	Damage assessment and SIOP execution monitoring	Combined estimate: $25-30M invested through 1987		Software now under development
NMCC Information Display System (NIDS)	Six DEC PDP-11/70's in NMCC	Automatic text message handling for watch officers	$2.1M	$1.5M*	Operational in 1979

* DCA effort only

Figure 2.4 Other ADP in WWMCCS

3.0 THE MODERNIZATION PROBLEM

3.1 Need

The primary ADP hardware in WWMCCS command centers, i.e., H6000 series CPUs, was procured beginning in 1970. This computer derives directly from architectures and designs introduced in the early 1960s. Since that time, ADP architecture and design have evolved through several generations each with improved and expanded capabilities. The new series of machines representing each new ADP generation have rather quickly replaced the older versions. Retaining these older machines then becomes economically unattractive because of a lack of spare parts, higher maintenance costs, and a lack of personnel trained to maintain the hardware and system software.

This replacement process, and escalating cost of maintaining older generation machines, has been the continuing experience in commercial practice and will also apply to the present Honeywell CPUs in WWMCCS. The current expectation is that in 10-15 years there will be few, if any, H6000s left in commercial service. The present Honeywell contract for maintenance and support of existing WWMCCS hardware and system software was signed in June 1980 and is effective for eight years; at that time, steeply rising H6000 maintenance costs are inevitable.

In short, rapid advances in ADP technology and architecture have created a situation in which the current H6000 hardware and system software badly lag the state-of-the art and commercial practice and are expected to be very difficult and expensive to support logistically within 10-15 years.

As noted earlier, upgrades have been made to both the H6000 hardware and system software over the past 5-10 years in order to satisfy growing user needs and overcome existing problems. Computer peripherals have been upgraded and other improvements made. Nevertheless, system users generally identify the following equipment oriented limitations for early modernization attention:

- o reliability and availability of support equipment (power, air conditioning) and computer peripherals,
- o computing capacity, and
- o flexibility in equipment selection, particularly work station equipment.

Another facet of the problem, noted in the previous section, is that the WIS is being called upon to play a growing and more critical role in a wide range of WWMCCS operations. The growing role, which can be expected to continue, requires more ADP capacity and capability.

In the software area, problems requiring modernization attention include:

- o inadequate on-line software development and data management tools (offered by the system software),
- o major deficiencies in current applications software, and
- o limited range of standard applications software.

Modernization targets bridging hardware and software include:

- o WWMCCS Intercomputer Network performance,
- o man-machine interface deficiencies (i.e., need for "friendly" terminals),
- o inadequate fault isolation aids (software and hardware), and
- o very constraining security procedures (there is no multi-level security system in WWMCCS ADP and WIN operates at a level of Top Secret, requiring appropriate security measures for all associated terminals and personnel).

Consequently, a major modernization and enhancement of the current WWMCCS ADP and the entire WIS, including the basic information reporting system and its procedures, will be required over the next ten years to meet national priorities for situation assessment, crisis operations and rapid deployment and support of military forces worldwide. Modernization of the ADP hardware alone will not be sufficient to provide the capabilities required for the wide range of WWMCCS functions. Redesign and modernization of the major applications software which supports a broad range of functions and users are essential.

3.2 Objectives

Key modernization objectives are summarized as follows:

Essential:

- improve WIS performance in time-sensitive operations,

- improve WIN performance,

- improve reliability and availability of support equipment (power, air conditioning),

- facilitate WIS evolution and growth to meet future requirements, particularly in the light of changing enemy threats, US policy, and technological opportunities,

- modernize and enhance the current capabilities of WIS hardware, software, and related reporting systems, and

- improve ADP security controls and, if possible, achieve multi-level security or an equivalent thereto.

Desirable:

- minimize ADP life cycle costs,

- minimize the costs of the software conversion,

- recognizing the inherent lack of physical survivability of all fixed command centers in the US and overseas, take this modernization opportunity to improve conventional war survivability of ADP support to sites in Europe and elsewhere by locating the modernized ADP in more survivable locations such as remote, conventionally hardened facilities or mobile facilities, and

- take cognizance of the other ADP in WWMCCS and ensure that modernization plans for all the ADP are appropriately coordinated.

3.3 Constraints

Several modernization planning and implementation issues are key concerns of the users and deserve to be highlighted as constraints:

- operationally essential and/or cost-effective near-term upgrading and improvements to the WIN, computer system and selected software should not be deferred while the longer term modernization is planned and implemented,

- the modernization must not interrupt or disrupt the continuity of day-to-day operations or the ability to provide support to other levels of conflict,

- requirements for new facilities (e.g., space, power, air conditioning, etc.) must be satisfied,

- attention must be given to the limited number of ADP operators available to operate old and new hardware in parallel during transition, and

- attention must be given to the operational problems (manpower, training, maintenance, space, etc.) created by installing a multiplicity of types of ADP at a site.

4.0 MODERNIZATION ARCHITECTURE

This section summarizes the progress and decisions on the inter-nodal and nodal architecture to be adopted for WIS modernization. The first issue addressed relates to the nodal location or distribution of the ADP serving WWMCCS; the second issue relates to the type or design of ADP to be installed at each node.

4.1 Inter-Nodal Alternatives

With advances in ADP and communications technology, the users no longer need to be in very close physical proximity to the data processing hardware and can be effectively served by remote terminals and an intercomputer network (with due consideration to the costs and reliability of the communications links). Accordingly, major variations in the physical distribution of the ADP could be considered. Specifically, the advantages and disadvantages of geographically centralizing the ADP hardware at a small number of sites; of regionalizing the hardware, say, in one or two sites each in the United States, Europe and the Pacific; or of assigning several locations to accomplish the specialized data processing for various operational missions were all studied.

The analysis of these inter-nodal architectural alternatives considered the following factors:

- o current and possible future operational concepts,
- o dominance of command unique applications software,
- o growth of software costs over hardware costs,
- o need to achieve flexibility for future growth and changes,
- o acceptability of the system management arrangements, and particularly those regarding control over the operation of the hardware, to the CINCs and other users,
- o ability to transition from the present nodal orientation to an alternative architecture, and
- o vulnerability and survivability of a centralized, regional, or functional architecture.

The **conclusion was that modernizing the ADP should be done at each of the current operational nodes**, thereby providing continuing local processing support for each user, except in those instances where the command center or node should be moved or otherwise altered **to obtain** a [redacted]y. It was also concluded, however, that the number and type of training, development, support, and back-up nodes or sites should be reviewed.

4.2 Nodal Alternatives

Architectural attention next turned to the nodal alternatives: the choices for modernizing the hardware and software at each node or site. Two basic alternatives were considered. The first and most direct approach was based on the assumption of a direct, one-for-one replacement of all configurations with new hardware and without any basic nodal architectural changes. The second approach eliminated these constraining assumptions and explored a new nodal architecture and a phased priority of modernization.

The first approach, with three options, was considered in detail and rejected as a suitable architecture for WIS modernization. It is outlined below, with the reasons for its rejection, for completeness. Section 4.2.2 then presents the selected approach.

4.2.1 Direct (One-for-One) Replacement

Here the assumption was of the same, direct, one-for-one CPU replacement (by one or two large host processors) for all configurations, accomplished over a minimal transition period. For this alternative, three generic nodal options were considered:

- o utilization of new, software-compatible Honeywell ADP hardware and associated new system software, termed enhanced baseline,
- o competitive procurement of new hardware which could emulate the H6000 and hence permit maximum utilization of all current software, termed emulation, and
- o competitive procurement of a new hardware family (and associated system software) with conversion of all existing software, termed new competition.

These three direct replacement options are addressed next.

Enhanced Baseline. Under this option, a sole-source procurement would be made to Honeywell for new, improved, upward-compatible hardware and the corresponding new system software. That part of the applications software not requiring modernization would, by virtue of the hardware compatibility and use of system software emulation, be directly usable; the remainder would be redesigned as required. Both the current and new hardware would be operated in parallel until the current software had all been converted or demonstrated to operate satisfactorily on the new machine. The length of this parallel operation might be several months at each site.

This option would be capable of providing modern hardware and system software of adequate capacity, speed, and capability to meet current and future needs. The transition would be simplified because of the compatible hardware, the software conversion costs would be minimized and the continued use of Honeywell would be consistent with present arrangements.

However, the substantial reduction in software costs and the ease of transitioning would only be achieved at the expense of perpetuating deficiencies of the existing system which require modernization and foregoing fundamental system improvements. The sole source approach cannot be expected to minimize hardware costs. Further, this option offers little potential for solving the very difficult multi-level security problems of the current system.

It was therefore concluded that a sole source acquisition was not justified and that the enhanced baseline was not an acceptable approach for overall system modernization.

<u>Emulation</u>. Under this option, a large machine capable of emulating the current Honeywell system would be competitively selected and all of the currently satisfactory software could be used with a minimum of conversion. Unsatisfactory software would be converted to operate without emulation. One or more potential emulators were identified.

The advantages are similar to those of the enhanced baseline with the further advantage of a competitive procurement. The disadvantages are also similar, but are compounded by the legal questions involved in the emulation of the Honeywell proprietary designs (current and future) and by the performance and cost uncertainties, based on the limited experience with emulation.

Emulation was judged to have too many uncertainties and constraints and to be counterproductive from the viewpoint of continuing modernization and evolution. It was rejected as a system modernization approach.

New Competition. Under this option, a competition would be conducted to select a new ADP system which would replace the current H6000s on a one-for-one CPU or configuration basis. The new ADP system would reflect the current state-of-the art in hardware and system software.

The advantages include the competitive approach, which should also minimize hardware costs. The disadvantage would be a very difficult transition to new hardware and much new software. Further, initial estimates make it clear that the need to convert all current software to operate in the new system environment would make this approach far more costly than the enhanced baseline option and yet with only limited compensating advantages (resulting from a software conversion and redesign).

While providing an excellent basis for continued modernization and evolution, this approach was rejected on the basis of its high software conversion costs and a very disruptive transition.

4.2.2 The Selected New Architecture

In contrast to the direct, similar-treatment, one-for-one modernization approaches with no change in nodal architecture, a different architectural approach was considered in view of (a) new ADP technical capabilities, and (b) the identification of several desirable system modernization characteristics and features.

The technical capabilities relate to distributed computing system designs of a very flexible and modular nature, in which smaller computers dedicated to individual functions or tasks are tied together into an integrated system and communicate by means of a local network. This local network facilitates connection of local terminals to any or all of the locally netted computers, permits utilization of different computers and provides the possibility of "graceful degradation" if major equipments other than the local network fail.

A review of desirable system modernization factors led to the following conclusions:

- there is no need for the same or simultaneous modernization or replacement of all of the WWMCCS ADP configurations supporting all functions at all sites,
- hardware and software standardization is essential for functions common to more than one site, but a tailored, non-standard, approach to modernization of most command unique functions is acceptable (where interface standards and data format standards are defined and followed),

- priority should be given to those functions whose current performance was less satisfactory, and special early attention should be given to the need for providing a very reliable, secure, high-capacity intercomputer network and associated software, and

- a phasing of the modernization effort would permit the cost and disruption of transition to be broken into manageable pieces.

Review by the Joint Chiefs of Staff (JCS) of the current functions of WWMCCS ADP identified four broad sets or families of operational functions common to more than one WWMCCS node or site:

- Resources and Unit Monitoring,
- Conventional Planning and Execution,
- Nuclear Planning and Execution, and
- Tactical Warning and Space Defense.

(For convenience in the text which follows, these will be termed as "Resources," "Conventional," "Nuclear" and "Warning" respectively.)

A fifth set of general-purpose command center capabilities can be identified as a family. It includes:

- local network (for intercommunication among computers, terminals, etc.),
- data base management system for data base storage, retrieval, and manipulation,
- security controls,
- user support functions,
- message handling, and
- graphics support.

Further details on the capabilities of these functional families are given in Section 5.0. At this point, however, it can be noted that the command center capability (or family of functions) is one which would be required at every WWMCCS site. The Resources family and function would be required at most sites and is an operational capability upon which the Conventional family and subsequent families can build. "Nuclear" and "Warning" capabilities are represented at only several sites each. While the discussion which follows is based on the identification of four operational families, it is not restricted to that number. It is likely that additional families will be identified as operational requirements are identified and further refined.

With the concept of functional families, the modernization of these common functions would generally proceed as follows:

- each functional family would be represented by a standard package of hardware and software,
- each site would install the appropriate functional family packages as required by its operational mission (see Section 5.2),
- each standard package could be developed separately and with priorities as appropriate,
- in so far as possible, all packages would use the same standard new hardware, system software, and utility/support capabilities which would be competitively selected, and
- when developed, the packages of standard new hardware and applications software--command center support and the functional families--would be installed in a phased manner at the appropriate sites using the local network to interconnect with the existing equipments; when checked-out, the associated current standard software capabilities on the present Honeywell systems would be discontinued, phasing out CPUs where possible.

There is no technical requirement for hardware standardization across families, but it will be highly desirable, if not necessary, for logistic, training and maintenance purposes. It is further recognized that unique computational problems in parts of the Warning and Nuclear families will require special ADP attention (and procurement), and further that immediate ADP modernization in the Warning family will predate the selection of the new standard hardware, and hence preclude its early use.

Command-unique hardware and software would not receive the same standard modernization treatment as the functional families, but would receive tailored treatment appropriate to the situation. Here the focus would be on continuing the use of as much as possible of the present applications software developed by the Services and sites. In parallel with the functional family activities noted above, each site would plan and implement the modernization of its command uniques, with assistance from the Services, DCA, or other appropriate organizations. It is recognized that much of the command unique software is an integral and essential part of the command and control capabilities of sites and Services.

A variety of site and Service factors can be expected to influence the course of action at each site with respect to command uniques. In general, each site could consider and implement any of the three one-for-one options of Section 4.2.1: stay with the Honeywell equipment (with its attendant support problems), temporarily employ the emulation alternative if conditions warrant it, or use newly selected hardware from the functional families and convert the command unique software accordingly. (The latter alternative is expected to be the longer-term solution if the sites desire to minimize the types of different ADP hardware which they maintain and operate.) In any case, the command unique hardware should be capable of interconnection with the local network; appropriate standards and interface guidelines will be developed and enforced accordingly.

The modernization of some of the command unique hardware and software will generally proceed in parallel with the implementation of the command support package and operational families; the rest could proceed at a different and slower pace. Centralized support of Honeywell system software would be continued, although there will be a cost tradeoff point beyond which modernization would be more economical than extended support.

In the handling of the command uniques, the Services, and especially the Army and Air Force, would be encouraged to generate more Service standard hardware and software. In addition, selected standards for command unique software should be considered.

Figure 4.1 depicts the relationship between the present architecture and a new nodal architecture, indicating the local network and the separation of common family functions and the command uniques.

By design, then, the functional family approach with distributed processing and a local network has the following attractive features:

- it permits phased modernization, with priority attention to critical improvements,
- it provides a modern, flexible, modular baseline for future growth, including the addition of new families,
- it provides for the separation of common functions from the command uniques,

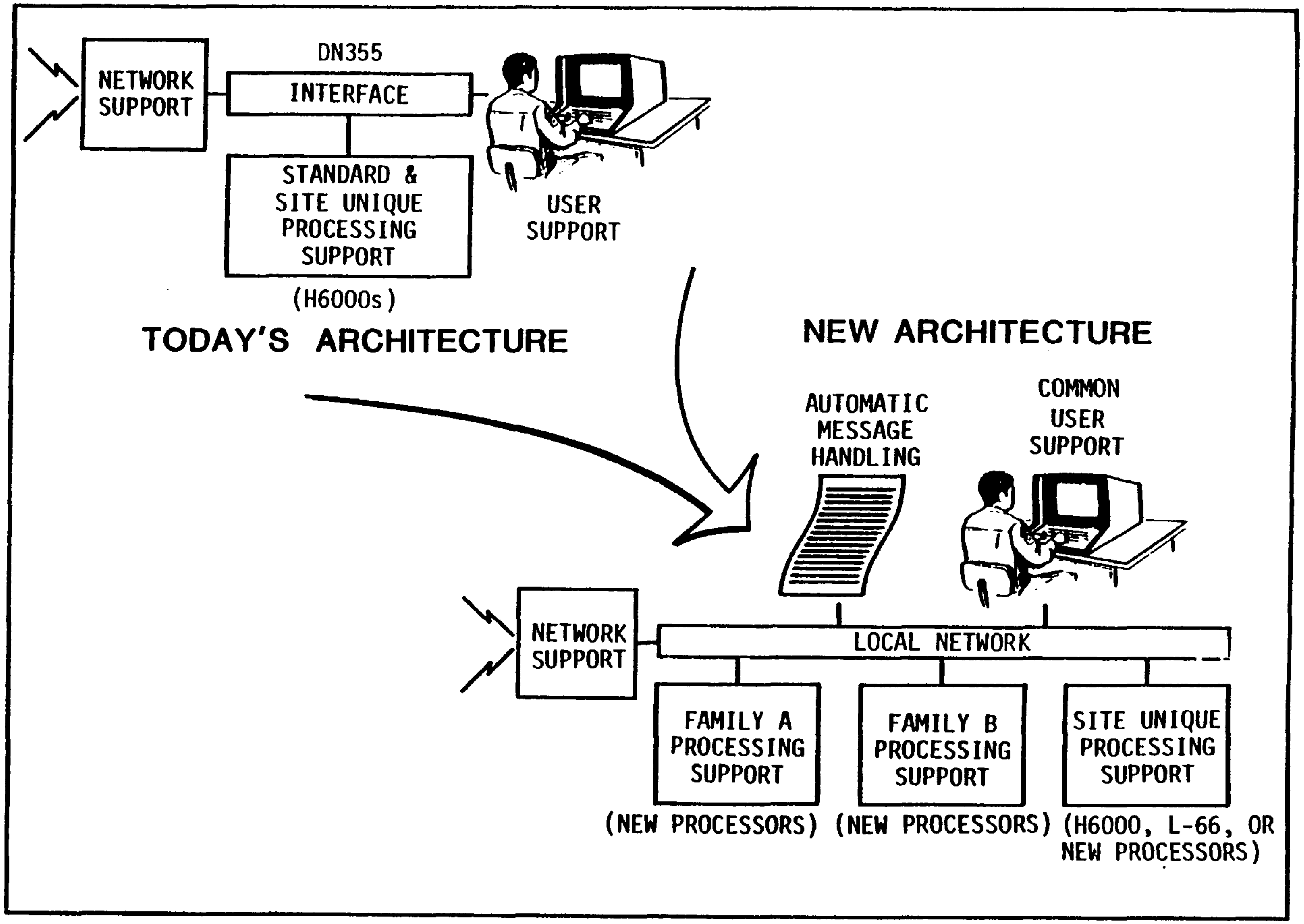

Figure 4.1 New Architecture

- it provides some isolation among the functional families and permits their separate handling,

- it permits individual sites more flexibility in the modernization of command unique systems,

- it will permit easy interfacing of heterogeneous equipment (where required), multi-purpose use of terminals, and more graceful degradation of service in case of equipment failure (except for the local network itself)

There are disadvantages to the functional family approach, and some unknowns. Development risk, proliferation of different types of hardware at a site, and a possibility of lengthy parallel operations of current and new equipment are primary concerns; security features are not yet fully understood but appear to offer some improvement due to the ability to isolate processing at different security levels in different processors. Other issues are discussed in Section 4.4.

On balance, the advantages of the new architectural approach are substantial and it has been selected for WIS modernization. It will, however, be the subject of further consideration over the coming year. This effort will address any alternatives or variations to the approach which further minimize implementation risk, reduce possible user disruption, lower transition costs by upgrading selected H6000 CPUs, or better meet the objectives and constraints of Section 3.0.

4.3 Nuclear and Warning Families

A major advantage of the new architecture is that all four operational families do not require simultaneous modernization and the methods of handling need not be uniform and may vary from one to another. By virtue of the local network, the hardware packages of the families can be interconnected and used with the others.

A review of the current status and requirements of the Nuclear and Warning families confirms that separate and individual attention is warranted at this time. In particular, it appears that the Nuclear family doesn't need immediate attention beyond the present on-going activities noted in Figure 2.4: procurement of an additional computer at SAC, the implementation of the Joint Cruise Missile Planning System, and the installation of ADP in the E-4 and selected EC-135 aircraft. In addition, a number of theater forces nuclear weapons command, control, and communications ADP improvements are now being formulated. Accordingly, a study of the details of further modernization of this family can be deferred.

On the other hand, t[redacted] problems and ADP [redacted] in [redacted] special and immediate [redacted] need for a very high level of warning system and [redacted]grity and the rather special scientific computational requirements for the space object cataloging problem. The functional family approach and the utilization of a local network facilitates this separate attention. Accordingly, it is appropriate and possible for the near to mid-term upgrading and modernization of the major elements of the Warning family to be treated as a separate problem and one which is not constrained or otherwise affected by the other modernization discussed herein. This matter is discussed again in Section 8.0.

4.4 Architectural and Transition Issues

This section presents several of the key architectural and transition issues which are under study; the identification of these issues also serves to highlight the uncertainties in the acquisition schedule and cost estimates presented in Section 6.0. These issues include:

- the possibility of a site with a small data processing requirement having access to the capabilities of a family by remote terminals alone (without implementing the associated hardware and software package),
- the need to control proliferation of different hardware from different vendors in view of the implications for operator training, operator manning and maintenance costs,
- the optimum phasing or timing of family package installation at each site, and requirements for simultaneous operations of present and new hardware,
- the transition problems of added manpower, space, power and air conditioning at sites,
- the selection of a specific local network architecture,
- availability of multi-level security features, and possible impact on the overall modernization schedule,
- possible adoption of the instruction set architecture being planned by the Army for their military computer family,
- possible adoption of Ada as a standard WIS higher order language,

- means of supporting intercomputer networking and remote terminal operations in overseas environments with less-than-optimum communications,

- desirability of engineering a common remote user terminal network in the US,

- application and enforcement of national and international data processing and communications standards so as to permit easy interfaces of WIS with other US and allied systems,

- coordination of WIS modernization plans with those of the NATO and Allied Command Europe, and

- coordination of WIS modernization plans with those of the major intelligence (DoDIIS) and communications (IASA) system efforts.

5.0 OPERATIONAL REQUIREMENTS

Work on the definition of the operational and information system requirements which WIS modernization must satisfy in parallel with the architectural efforts has proceeded. The basis for the parallel efforts is discussed below, followed by a status report on the requirements definition. The work on defining information system requirements will continue over the coming year--subject to the considerations noted below--leading to the ultimate preparation of performance level specifications to be used in the hardware and software procurements.

5.1 Approach to Requirements Definition

It is not possible at this time in the modernization planning to produce definitive and detailed future operational and information system requirements for WIS which can be used with confidence to procure the necessary hardware and software. It is possible to describe current requirements (which are reflected in present hardware and software) in considerable detail. It is also possible to describe the shortfalls or deficiencies of the current system in considerable detail. These shortfalls are reflected as requirements to the extent that system upgrades or enhancements are necessary for satisfactory performance. (An example is the need for better WIS performance in crisis situations.) However, the objective is to design and procure a system which can satisfy needs over the next 10-20 years and it is exceedingly difficult to project these long-term future requirements to which the modernization should be geared. It is useful to review some of the reasons for this situation.

A first point is that "requirements" is a rather loose term; in fact, requirements are better thought of as constituting a hierarchy of needs from the very general and abstract down to the very specific. For example, at least three levels of requirements for WIS can be identified: broad attributes, functional capabilities, and detailed performance. Similarly, there are successively more detailed levels of physical system detail: concept, architecture, and system/subsystem design. There is an obvious interplay between adjacent levels in each hierarchy, and interaction between corresponding levels in each.

A second point relates to the difficulty of describing or defining long-term WIS requirements in any great detail. This is due to significant uncertainties with respect to the future threats, weapons, procedures and processes, and military missions which may be required to meet the world situation. In short, it is possible to describe detailed performance requirements for today's needs; but, at best, only broad attributes can be stated with respect to the needs of 10-20 years from now.

A further consideration in the requirements determination process is the fact that the introduction of ADP has already had (and is expected to continue to have) a major impact on the way in which command and control is organized, broken into functions, and implemented. Thus, requirements for command and control systems involving ADP do not fall neatly into the traditional "top down" process. A serial approach of first stating requirements and then undertaking architectural aspects cannot be rigidly applied here (or in other systems with a high dependence on organizational and human aspects). Rather, a parallel requirements-architecture and feed-back approach is indicated, with interaction and feedback at each level of the hierarchies. In fact, and as noted in Section 4.0, the architectural possibility of local distributed ADP capabilities has already had the impact of reformulating WWMCCS ADP requirements into functional or operational families and to separate common functions from site uniques.

In summary, the WIS requirements definition process must be understood to be one which recognizes the parallel hierarchies of requirements and design with significant interaction and feedback and one in which specificity will necessarily be lacking for the long-term requirements.

5.2 Requirements Definition Status

In view of the short-term and long-term requirements with differing levels of specificity, the requirements definition effort has been organized accordingly. Short-term requirements are being identified as needed upgrades to the current system and expressed in terms of increased performance and system capabilities. Long-term requirements are being addressed in terms of basic system deficiencies (not addressable by upgrades), such as the need to revise reporting system procedures and to redesign applications software for access to more credible information. These are being expressed in terms of information requirements and how they relate to revised concepts of operation in the functional families. The imminent revision and publication of Annex B of Volume II of JCS Pub 19 entitled: "WWMCCS ADP Concept of Operations and General Requirements for Post-1985" will address this. It contains material both in the broad attributes and detailed performance areas. A major part of the annex deals with the four operational families and an initial assignment of family capabilities to sites. Figure 5.1 summarizes the stated operational capabilities of the four families. Figure 5.2 presents the preliminary identification of the family assignments of the current WWMCCS operational sites. JCS is presently considering additional nodes for family capabilities, including WWMCCS sites served today only by remote

RESOURCES AND UNIT MONITORING

1. Monitor, determine, and display the status and readiness of all US resources including active and reserve elements and appropriate non-US forces and resources.

2. Schedule resource utilization.

3. Prepare and disseminate orders and mission instructions.

4. Plan operations, schedule missions, and monitor/display operations and mission results.

5. Identify and display unit, resources, facilities, communications, and weapon systems characteristics and capabilities.

6. Integrate and display data from systems external to WWMCCS such as environmental and intelligence data.

7. Monitor status of actions, critical events, situations assessment, rules of engagement, major end items of equipment, crisis situations, etc.

8. Determine net situation assessment.

CONVENTIONAL PLANNING AND EXECUTION

1. Generate and refine notional and actual force and resupply requirements and options.

2. Generate and refine force movement requirements.

3. Generate and refine notional and actual resupply and non-unit personnel movement requirements.

4. Merge, modify, and tailor force requirements and force lists from different plans.

5. Merge, modify, and tailor movement requirements from different plans.

6. Merge, modify, and integrate force, resupply, and non-unit personnel movement requirements.

7. Determine option/OPLAN force, logistic, and transportation availability and feasibility.

8. Match and select OPLAN notional force and resupply requirements with real-world forces and actual resources.

9. Develop, refine, coordinate, and disseminate appropriate movement tables, schedules, orders and plans.

Figure 5.1 Family Capabilities

10. Identify force, logistic, personnel, and transportation shortfalls, limitations, and bottlenecks.
11. Rapidly reflow movement requirements and produce flow plans.
12. Conduct force, logistic, personnel, and transportation sensitivity analyses.
13. Merge movement requirements with channel traffic requirements.
14. Monitor the deployment of forces and materiel.
15. Monitor the movement of mobilized reserve forces from home station to mobilization station and the movement of non-deploying materiel within the CONUS.
16. Monitor the reception and onward movement of deploying forces and materiel within theaters of operation.
17. Identify location and status of airlift and sealift assets.
18. Provide near real-time crisis management information to include force, logistic, and movement data.
19. Provide information for the coordination of deployment routing, over-flight routes, and landing rights.
20. Provide information for the coordination of air refueling routes, requirements, timing, and schedules.
21. Generate notional and actual logistic requirements in selected functional areas to include: (a) civil engineering, (b) non-nuclear ammunition, (c) Petroleum, Oil and Lubricants (POL), (d) medical, and (e) selected supply classifications.
22. Through interfaces with appropriate systems, provide for: (a) initial mobilization of reserve forces and the marshalling of logistic resources, (b) identification of the deployability status of deploying forces, and (c) identification of critical logistic resources.
23. Incorporate host-nation support.
24. Aggregate and summarize requirements and movement information.
25. Tailor force list to crisis operations.
26. Develop, modify, and evaluate the feasibility of potential courses of action.

Figure 5.1 Family Capabilities (continued)

NUCLEAR PLANNING AND EXECUTION

1. Monitor nuclear force status and weapons.
2. Plan development and analysis.
3. Attack, strike and damage assessment, and residual capability assessment.
4. Reconstitute and redirect forces.
5. Terminate hostilities and active operations.
6. Nuclear weapons information, characteristics, and capabilities.
7. Bomb-damage information.
8. Sorties timing, routing, and target assignment.
9. Provide target information.
10. Planning factors and system performance.
11. Revise or modify plans.
12. Monitor force generation.
13. Sortie launch.
14. Weapon strike.
15. Reconnaissance planning.
16. Plan execution.
17. Nuclear detonation information.
18. Re-targeting.

TACTICAL WARNING AND SPACE DEFENSE

1. Provide air and strategic missile warning.
2. Provide tactical missile warning.
3. Support the determination that an attack is in progress and an assessment of the nature of the attack.
4. Provide nuclear reconnaissance information for damage assessment.
5. Monitor status of nuclear capable forces.

Figure 5.1 Family Capabilities (continued)

6. Monitor environmental conditions.
7. Identify nuclear detonations.
8. Provide damage assessment.
9. Communications spot reports.
10. Monitor space defense force status and weapons.
11. Plan development and analysis.
12. Attack, strike, damage, and residual capability assessment.
13. Reconstitute and direct forces.
14. Terminate active operations.
15. Space defense weapon information, characteristics and capabilities.
16. Intercept effectiveness information.
17. Target ephemeris prediction, intercept point generation, intercept profile determination, and target assignment.
18. Provide target information.
19. Provide hostile weapon information.
20. Provide vulnerability information on friendly assets.
21. Provide information on available countermeasures to defeat hostile operations.
22. Planning factors and system performance.
23. Revise or modify plans.
24. Monitor force generation.
25. Sortie launch.
26. Weapon strike.
27. Space surveillance system configuration and tasking.
28. Plan execution.
29. Re-targeting.

Figure 5.1 Family Capabilities (concluded)

	Resources and Unit Monitoring	Conventional Planning and Execution	Tactical Warning and Space Defense	Nuclear Planning and Execution
NMCC	X	X	X	X
ANMCC	X	X	X	X
AOC	X	X		
NCC	X	X		
AFDSC	X	X		
HQMC	X	X		
ADCOM	X	X	X	
SAC	X	X	X	X
EUCOM	X	X	X	X
PACOM	X	X	X	X
LANTCOM	X	X	X	X
USREDCOM/JDA	X	X		
MAC	X	X		
MTMC	X	X		
FORSCOM	X	X		
TAC	X	X		
USAREUR	X	X		
USAFE	X	X		
NAVEUR	X	X		
PACFLT	X	X		
PACAF	X	X		
COMUSK	X	X		
AWC	X	X		
AU	X	X		
LANTFLT	X	X		

Figure 5.2 Family Assignments to Current Operational Sites

terminals, mobile nodes (NEACP, RDJTF), and several test and development sites (CCTC, NCCS). As these broader issues are resolved by JCS, detailed functional, interface, and information requirements analyses are proceeding with emphasis on the Resources and Conventional families.

The JCS Pub 19 revision will be supplemented in the next year by additional requirements information to be gathered during visits to each of the sites. Each site will be asked to express its needs in terms of short-term capability upgrades to the existing system, operational information requirements relating to the functional families for long-term needs, and any problems that are anticipated for the transition period.

As part of the further work on the entire requirements hierarchy, the following operational issues are being considered:

- To what degree should logistics be considered as a WWMCCS function or separate family? What impact, if any, should this have on the architecture and modernization planning?

- Do the NMCS mobiles (EC-135 and E-4) constitute a new family?

- What actions should be taken to improve the survivability of WWMCCS ADP in the European and Pacific theater? Should the use of hardened, centralized, ADP sites with remote terminals be considered?

- To what extent are changes to the Joint Reporting Structure required? How can this best be achieved? Can compatibility of the Joint Reporting Structure with NATO reporting systems and procedures be achieved?

- Should the Nuclear family be split into two families? (Planning and Execution? or Strategic and Tactical?)

- Are other families, or subdivisions of proposed families, desirable?

5.3 Other ADP in WWMCCS

With the definition of functional families for WWMCCS ADP, it becomes possible to recategorize the existing ADP in WWMCCS. This is done in Figure 5.3, which suggests that this functional breakdown and definition of families should play a strong role in the definition of WIS and in the management and assignment of related responsibilities.

ADP IN WWMCCS	FAMILIES			
	RESOURCES AND UNIT MONITOR-ING	CONVENTIONAL PLANNING AND EXECUTION	NUCLEAR PLANNING AND EXECUTION	TACTICAL WARNING AND SPACE DEFENSE
Command Center Process-ing and Display				X
SIOP Planning			X	
Cruise Missile Theatre Mission Planning System			X	
EC-135	X		X	
E-4B	X		X	X
NMCC Information Display System*	X	X	X	
Honeywell/WWMCCS Standard ADP	X	X	X	X

* provides user assist in all NMCC functions

Figure 5.3 ADP in WWMCCS by Families

6.0 ACQUISITION SCHEDULE AND COST

This section presents initial estimates of the cost and schedule to implement the modernization approach selected. It begins with a discussion of the grouping of the modernization activities into four phases. This includes an interim baseline upgrade phase, which has the impact of defining "modernization" as including all associated activities beginning at the start of FY 82. A discussion of planning factors and assumptions is then followed by the schedule and cost estimates.

It must be emphasized that these are only preliminary, "order-of-magnitude" estimates which are subject to change and are highly dependent on the resolution of issues outlined in Sections 4.4 and 5.2 and on the refinement of the planning factors of Section 6.2. These are all to be addressed in the coming year.

As noted in Section 5.2, a major source of information in the coming year will be that which results from planned visits to collect detailed data at each of the WWMCCS ADP sites. Beyond the operationally oriented material to be addressed, these visits will cover such items as:

- o survey of space, power, air conditioning, etc.,
- o inventory of command unique software, and
- o interface of command uniques and functional families.

The result of these visits will be the initiation of modernization planning and transition scheduling for each site.

6.1 Modernization Phases

For ease in preparing the preliminary estimates of schedules and costs, the modernization efforts have been grouped into four phases as indicated in Figure 6.1 and outlined below.

6.1.1 Phase I: Baseline Upgrade

Continuing upgrades to the existing system will constitute the first phase of modernization. As an interim step, this will correct some of the major performance shortfalls and attempt to hold down operating costs until the needed major changes are made. Projected upgrades include the following WIN enhancements and selected ADP actions.

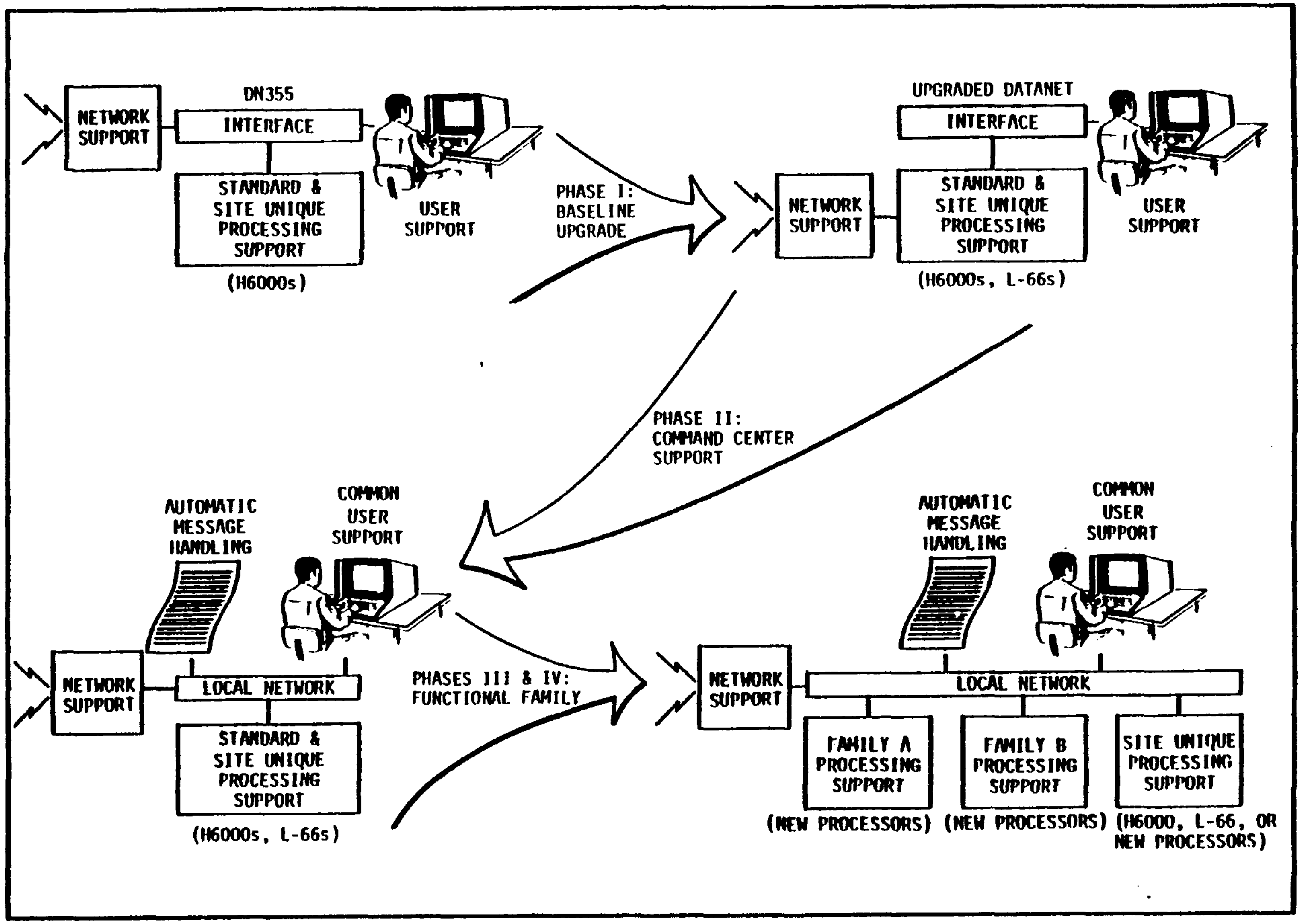

Figure 6.1 Architectural Phases

WIN. As noted earlier, a comprehensive program was initiated in 1980 to analyze the performance of WIN, to identify those factors causing or contributing to the lack of stability or reliability, and to modify, acquire or develop capabilities to effect improvements. As a result, several paths are now being pursued to provide near-term WIN improvements.

Installation of a Network Front End (NFE) between the communications subsystem and each host computer will begin in late 1982, with installation to be completed at all WIN sites within one year. This NFE will lessen user dependency on the site host computer, thereby improving network access and reliability. To provide improved reliability and speed, the WIN communication message switches (Interface Message Processors or IMPs) will be upgraded starting in the spring of 1982, with all sites to be upgraded within five months. An improved network monitoring capability will be provided in late 1981 so that network problems can be quickly detected and corrected.

In addition, experiments with new equipments to reduce circuit problems related to crypto synchronization are being performed. These experiments will be continued in an operational environment on overseas satellite circuits in February 1981. Redundant overseas satellite paths are also targeted to be available by that time and a diversity of overseas satellite paths is anticipated by early 1982. Five additional IMPs are scheduled for delivery starting in February 1981, to be installed as immediately-available replacements should the on-line switches fail at key WIN locations. Continued improvements to WIN reliability and efficiency are included in software enhancements scheduled for delivery in Spring and Fall 1981 for the WIN hosts and IMPs.

ADP Upgrades. Upgrades to the current WWMCCS ADP system will be made selectively while the longer-term modernization planning proceeds and acquisition is initiated. Candidate upgrades will be reviewed and then approved if responsive to clearly-recognized and operationally-significant needs which must be satisfied before the new hardware/software is fully available or if the changes will ease the transition to the longer-term system.

The fixed price contract used to acquire the current WWMCCS Standard ADP expired in November 1979. As noted, in June 1980 a follow-on eight year contract was awarded to Honeywell for the continued maintenance and support of existing hardware and software capabilities. This follow-on contract will allow the DoD to continue to support current operational capabilities as well as to pursue the peripheral hardware and system software upgrades and enhancements.

During the next year, steps will be taken to start the upgrading of the WWMCCS system software to be functionally equivalent to the current commercial release. This software upgrade will provide increased system reliability, more responsive data query and information retrieval capabilities, improved interactive access to command and control data, and better utilization of the upgraded peripheral hardware available under the follow-on contract. The WWMCCS contract also offers optional software packages which either replace existing software with improved functional capabilities or provide capabilities not previously available. These will be evaluated for possible acquisition.

Hardware modernization in the FY 82-84 timeframe will continue the replacement of original peripheral equipment that is no longer available or supported by the vendor (i.e., tape and disk drives, controllers, card equipment, and on-line printers), and begin the acquisition of WWMCCS ADP standard graphics terminals as well as additional interactive terminals.

As noted in Section 3.0, there is an increasing awareness of the need to provide continuous and/or back-up power supply, augmented cooling and air conditioning capabilities, redundant communication links, and alternate storage and processing facilities. These additions will also be addressed.

To achieve near-term improvements in software performance as well as increased hardware and software reliability may require additional computing capacity at some WWMCCS sites. Existing processors (H6000s, DN355s) will continue to be upgraded where it is shown to be consistent with needed expansion of operational capacity, reduced maintenance cost, or consistent configuration control.

6.1.2 Phase II: Command Center Support

Implementation of the concept of distributed system functions at WIS nodes begins in this phase as the support to command center personnel is enhanced. This enhancement comes in the form of increased user support and connectivity as well as automatic message handling. Enhancements will be made with the objective of substantially increasing the availability of the system to the user through better accessability and improved reliability.

Local Network. This capability provides connectivity among the WIS functions at any given node. It will provide the physical and logical links among the functions, and some degree of control and monitoring of the interactions occurring over the local network. Such local networks are becoming increasingly available from commercial sources; a competitive selection is planned.

Automatic Message Handling (AMH). This function provides for the user oriented automated handling of text messages at command centers. It includes supporting functions such as the composition, coordination, and transmission of messages developed by users and the automated receipt, distribution and accounting of messages received by the users. Other functions such as maintenance of historical message files, on-line preparation of private user-oriented files, and gathering of statistics will be included.

Common User Support. This function provides an interface between the system users and the WIS. It will take the form of a family of work stations where each member of the family has different levels of capability. Initially, this function will support the user's access to the AMH function, to the network interface function and to selected applications supported by the H6000s. As new WIS functions are added, the capabilities within the common user support function will be increased so that the user can access the new WIS functions using the existing or upgraded work stations. In this way, each user will eventually be able to access all WIS functions, where it is practical, through a single work station.

6.1.3 Phase III: Functional Family Processing

Implementation of the functional families begins in this phase.

Functional Family Processing. This function includes the processing performed to support the applications software for each of the operational family packages. The support for each family will consist of a full range of capabilities including processing, data storage, and input/output devices. However, the user interface for each family will generally be provided by the common user support capabilities described above.

Network Accessed Data Base. This function will provide a means of allowing selected information at each WIS node to be accessed by other WIS nodes without disruption to the functional family processing. Capabilities will include a data management system that is standard among all sites and data storage in common formats at all sites.

6.1.4 Phase IV: Command Unique Processing

This phase includes the processing performed to support the command unique application software. It includes a full range of capabilities including processing, data storage, and input/output devices.

6.2 Planning Factors

Initial modernization cost and schedule estimates are based on a number of assumptions made regarding system scope, transition approach, and characteristics of the new system. The key assumptions are briefly discussed below.

It is assumed that there will be no additional WWMCCS sites supported by WWMCCS ADP; however, based on workload estimates it is assumed that six of the sites that are currently supported by terminals connected to remote processing facilities would be upgraded and equipped with standard hardware/software packages.

Based on the discussion of Section 4.3, the cost and schedule estimates do not include or incorporate the impact of modernization of the Warning and Nuclear families, other than any transition baseline actions which impact them. As regards the Warning family, near and mid-term improvements to correct current deficiencies are being planned and are briefly addressed in Section 8.0.

Cost and schedule estimates include hardware and software to support command unique processing needs, even though most decisions relating to this must be made by the individual commands and/or Services. Also included in the estimates is automatic message handling, even though planning to this point has treated this as a separately-funded program. Finally, the estimates include separate support facilities for system development and network control.

Various aspects of an overall acquisition strategy for WIS modernization remain to be fully resolved and these will also impact the cost and schedules. Options exist with respect to selection of one or more of the following: prime contractor, integration contractor, hardware and system software contractors, and contractors for the standard software packages of the functional families.

In general, schedules and costs are based on the conventional sequential steps of requirements definition, performance specification, source selection, development, test and checkout, and installation at multiple sites. The costs and schedules include all Phase I baseline upgrade actions taken while the new system is under development.

The assumptions regarding software conversion are summarized in Figure 6.2. In addition, it was assumed that 400,000 lines of new code would be written for the functional families. Applications software cost estimates were based on utilization of the RCA PRICE S model.

APPLICATION SOFTWARE	LINES OF CODE (Thousands)	ACTION ASSUMED FOR COSTING		
		TRANSLATE	REDESIGN	DISCARD
WWMCCS Standard (Current Systems)	3,330	37%	53%	10%
Service Standard	2,100	54%	36%	10%
Site Unique	13,000	67%	23%	10%

Figure 6.2 Assumptions for Software Costing

All estimates assume that processing support for the functional families is moved to new hardware and software. As this is done, existing processors will be off-loaded, and as many as 40 of the Honeywell CPU's may be removed from the sites once the move is completed. The remaining CPUs will be dedicated to command unique processing. Of those, it is assumed that one-half will still be in use by 1990, while the remaining one-half will have been modernized in equal parts by upward compatible Honeywell CPUs and new standard hardware.

Using estimates of required data processing loads, new equipment configurations were selected for each site for costing purposes. These configurations assumed backup or redundancy for all key system elements, including power supplies, so that system availability to the user would be substantially increased. System elements were all assumed to be within the state-of-the-art.

No survivability development or implementation was assumed beyond the previously mentioned redundancy and backup assumptions, and beyond on-going efforts to develop mobile command centers. Finally, no security controls and safeguards were assumed beyond those that are currently in use or are being tested.

6.3 Modernization Schedule

Figure 6.3 outlines the modernization schedule through FY 90. New command support and functional family capabilities will reach key sites in FY 86 and FY 88 respectively. Modernization of command/site unique software is expected to extend into the early 1990s.

6.4 Acquisition Cost Estimates

Modernization costs are assumed to begin with FY 82 and to extend into the early 1990s.

Figure 6.4 estimates the acquisition costs, combining both RDT&E and procurement, through FY 90 in FY 81 dollars. Including the 250 million dollars which occurs beyond FY 90, the total estimate of the acquisition costs begins at roughly 1.0 billion dollars and extends to perhaps 1.3 billion dollars.

At this time, some 203 million dollars is being requested for WWMCCS ADP in FY 82. Of this, some 40 million dollars is for acquisition. If this figure is projected over a ten year period, the incremental acquisition costs can be estimated to be in the range of 600-900 million dollars.

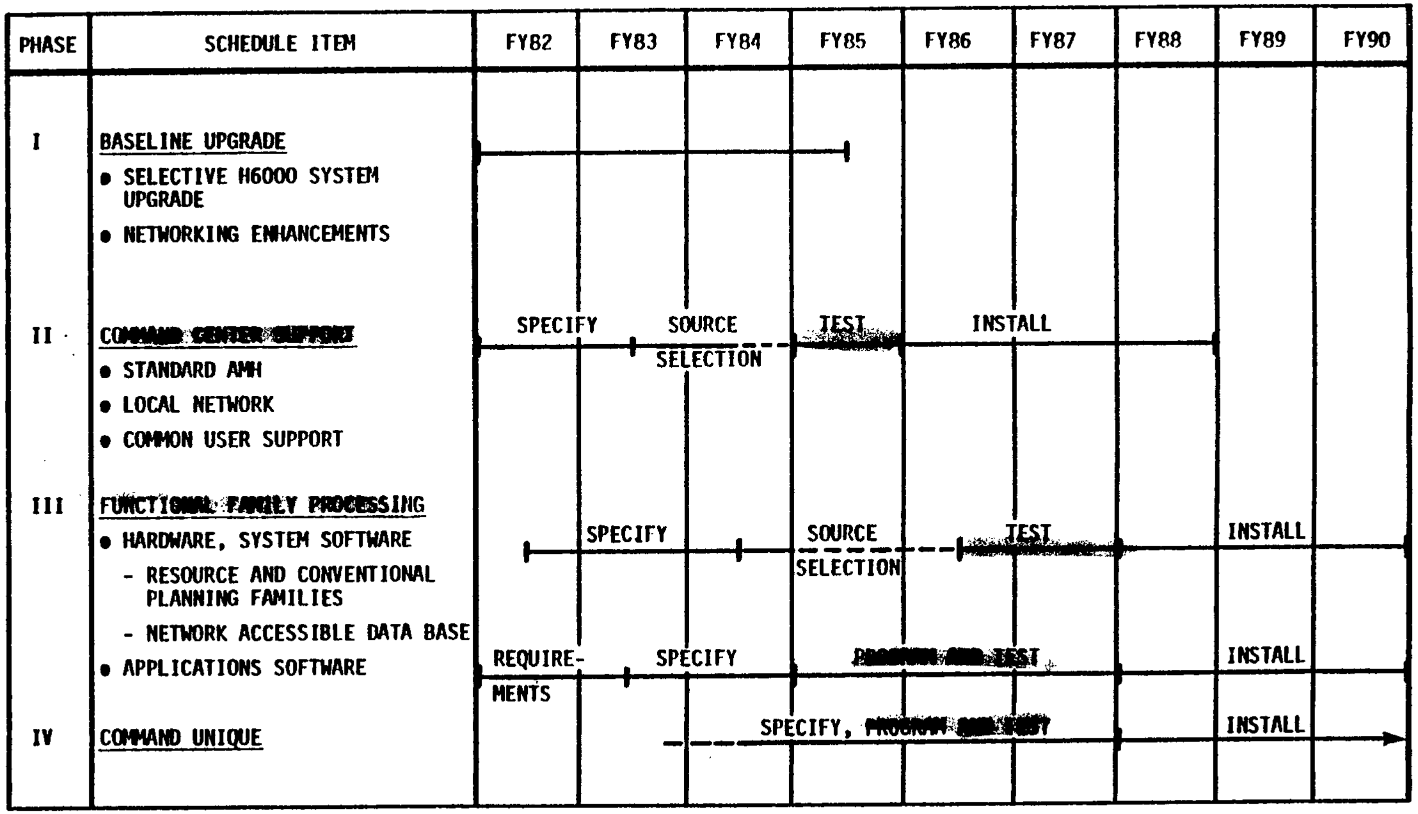

Figure 6.3 Modernization Schedule

	FY81 DOLLARS (MILLIONS)*									
	FY82	FY83	FY84	FY85	FY86	FY87	FY88	FY89	FY90	TOTAL $
• WWMCCS ADP MODERNIZATION MANAGEMENT	4	10	10	10	10	10	15	20	20	109
• PHASE I, BASELINE UPGRADE	32	35	35	30	20	10	5	-	-	167
• PHASE II, COMMAND CENTER SUPPORT	-	12	16	21	42	35	33	13	7	179
• PHASE III, RESOURCE AND CONVENTIONAL PLANNING FAMILY SUPPORT	1	3	7	13	13	23	38	37	8	143
• PHASE IV, COMMAND UNIQUE SUPPORT	-	-	5	20	20	33	28	28	28	162**
TOTAL WIS ACQUISITION	37	60	73	94	105	111	119	98	63	760

*ACQUISITION COSTS INCLUDE BOTH RDT&E AND PROCUREMENT

**OVER $250M ADDITIONAL TO BE INVESTED BEYOND FY90, MOSTLY FOR SOFTWARE REDESIGN/TRANSITION

Figure 6.4 Acquisition Cost Estimates

It will be noted that the bulk of the acquisition costs are software-related. If the percentage of site-unique software requiring redesign has been underestimated and grew to 50%, several hundred million dollars additional would be required.

It is expected that operations and maintenance costs will rise as multiple machines are operated and maintained at each site and as the system capability expands. A very preliminary estimate of the incremental operations and maintenance costs are 400 million dollars over a ten-year period.

7.0 MANAGEMENT OF WIS PLANNING AND IMPLEMENTATION

To centralize the leadership, raise the visibility, and provide strong, day-to-day line management and fiscal review of all WIS modernization planning and implementation activities, including overall life cycle management, a WIS Joint Program Manager (JPM) and supporting staff will be established during FY 81. The goal is to formalize appropriate directives and charters by 1 April 1981 and achieve initial activation by 1 July 1981.

As part of its responsibilities for the total WIS modernization activities, the JPM will assume cognizance over and be responsible for the transition from WWMCCS ADP hardware and standard applications and systems software to the WIS. A new system project office will be established by the Air Force for the actual acquisition of the new hardware and software.

As noted earlier, WIS modernization activities are expected to fall into two general categories: those hardware and software efforts of the functional families common to a number of sites, and command unique activities. Standard centrally-developed hardware and software packages for support of user-determined, functional requirements will be the responsibility of the JPM. Responsibility for Service and site unique software efforts would remain with the Services and sites, with centralized assistance and coordination by the JPM in both the hardware and software areas.

The broad relationships of the WIS JPM with other organizations/agencies are summarized in Figure 7.1 and discussed below.

7.1 Joint Program Manager (JPM)

The JPM organization will be staffed jointly by military and civilian personnel. The JPM would report through normal command channels to the JCS. In view of his special joint responsibilities, the JPM must have a direct relationship and access to the Services, Agencies, and JCS.

JPM responsibilities will include:

- o program management, direction, and policy implementation,
- o architectural and overall system engineering, including preparation of top-level performance specifications to meet requirements as specified by JCS,

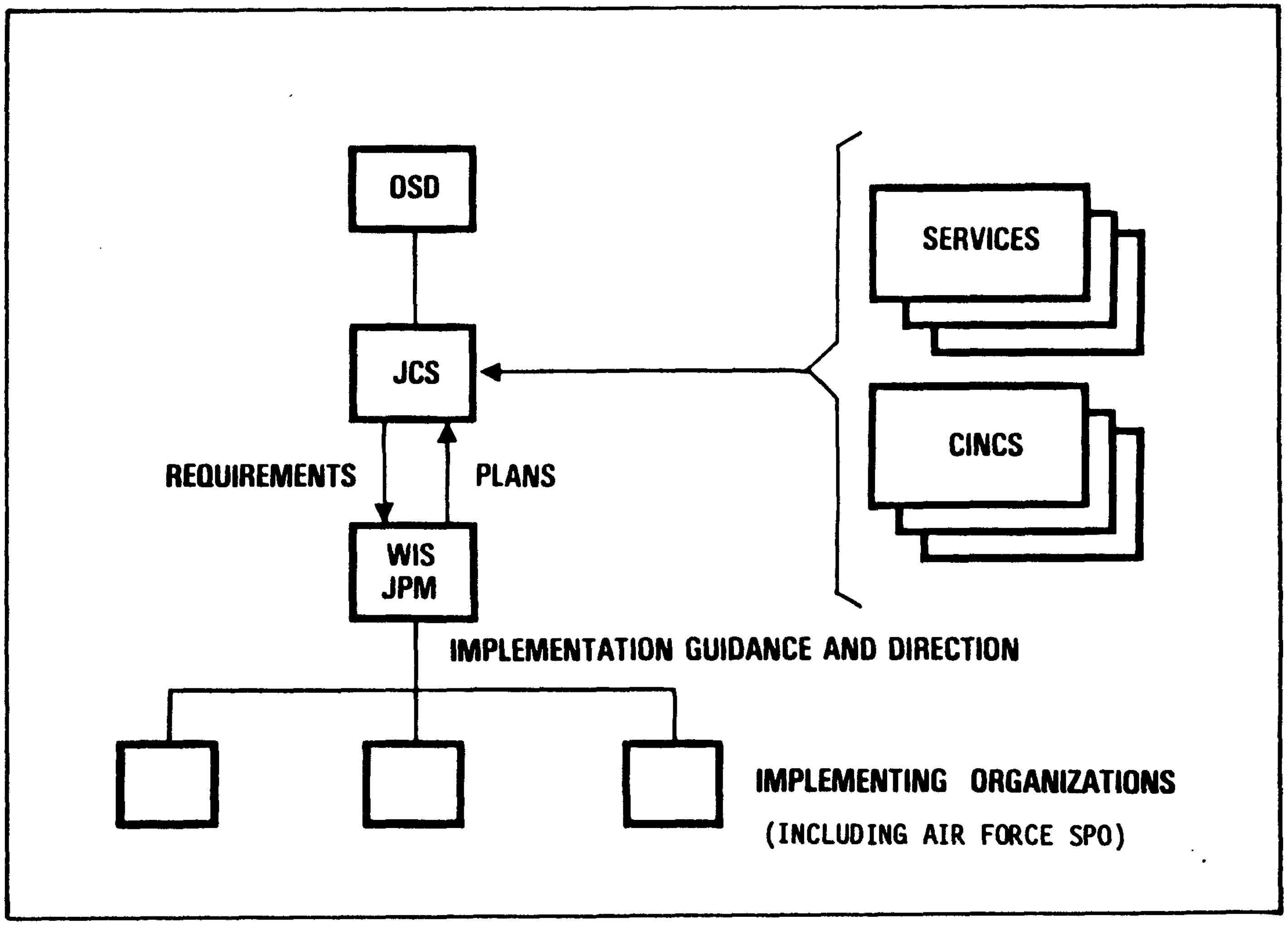

Figure 7.1 Management Framework

- guidance to Services and Agencies regarding the inclusion of WIS in the PPBS process,
- life cycle management and cost accounting overview,
- decisions and guidance on priorities and allocation of effort (as, for example, between upgrading and modernization),
- implementation review,
- basic acquisition strategy,
- establishment, promulgation and monitoring of technical and interface standards within the WIS, and
- overall interface definition with other systems (e.g., DoDIIS, IASA, etc.).

The JPM would progressively assume selected WIS architectural and planning responsibilities now assigned to the WWMCCS System Engineer (WSE). The JPM may assign specific efforts to WSE, who, in its assignment of overall system engineering responsibility for the WWMCCS, will continue its interest in WIS as a major element of WWMCCS and may undertake related long range planning for WIS.

A single program element with appropriate suffixes will be established in the budget to include the funding necessary for the planning and acquisition of all WIS-related hardware and software including associated engineering, development, and implementation activities. The JPM will assist in the support of the WIS budget throughout each military department PPBS process and before Congressional appropriation committees. Following the appropriation of funds by Congress, the military departments and DoD agencies will provide funding to the appropriate agency designated by the JPM based upon approved requirements.

The JPM will annually prepare a one-year and five-year plan to include appropriate funding information and estimates.

7.2 Joint Chiefs of Staff (JCS)

Broad overview and policy guidance for WIS modernization will be provided by JCS. The JCS will validate the operational requirements of the Services, CINCs and other users and will also formally review the JPM-produced plans to ensure that they adequately meet those requirements.

Two Functional Project Managers (FPMs) will be established within the JCS to coordinate community-wide reporting system activities and system development for the Resources and Conventional functional families. Each FPM will develop community-wide information requirements, prioritize them, and forward them to the JPM after validation by the JCS for inclusion in appropriate PPBS documents.

7.3 Office of the Secretary of Defense (OSD)

OSD, primarily the Assistant Secretary of Defense/ Communications, Command, Control and Intelligence (ASD/C^3I), will provide programmatic review and guidance. OSD will review the technical and management plans of the JPM submitted through the JCS.

7.4 Implementation

The JPM will provide implementation direction and guidance for WIS modernization. Plans of the various implementing organizations will be reviewed and coordinated with the JPM to ensure this guidance and direction is followed.

The Air Force will establish a new system project office which will have the primary procurement and acquisition responsibilities for new WIS hardware and system software modernization. This will include:

- detailed architectural and engineering support,
- preparation of detailed hardware and system software specifications,
- procurement and acquisition,
- configuration control,
- preparation of training and logistic support plans, and
- preparation of plans for and supervision of execution of test and evaluation activities.

In addition to this new project office, other common hardware/software implementing agencies will include DCA/CCTC in its role of supporting the current ADP.

8.0 ADP FOR TACTICAL WARNING AND ATTACK ASSESSMENT COMMAND AND CONTROL SYSTEMS

The design and performance of tactical warning and attack assessment systems require special and priority attention since these systems must quickly and accurately process sensor data from several sources and provide high-confidence warning information essential for the national defense to the National Command Authorities, CINCNORAD, and CINCSAC. The ADP associated with the command and control aspects of these systems plays a very key role in their performance. This ADP --as distinguished from the data processing integral to the sensors-- is in urgent need of immediate upgrading and modernization, both to correct present shortcomings and to support new and improved sensor and communication systems to be implemented in the mid-1980's. Special steps are being taken to modernize this ADP which essentially comprises the Tactical Warning and Space Defense functional family noted earlier. The flexible nature of the functional family approach to WIS modernization allows the special technical attention to this tactical warning ADP at the associated WWMCCS command centers without it being constrained or otherwise affected by that approach.

This section outlines the management approach and projected scope of the ADP modernization for the command and control portions of two key tactical warning and attack assessment systems: the NORAD Missile Warning and Space Surveillance System, and the Command Center Processing and Display System. The general need for upgrading specific systems is addressed as opposed to presentation of detailed solutions for implementing the upgrades. These specific solutions are not yet available, but will be the culmination of the requirements definition process being initiated for these required upgrades.

8.1 Acquisition Management

On 1 Jan 1981, in response to recognized important and specialized management needs, the Air Force established a Tactical Warning and Attack Assessment System Integration Office at the Aerospace Defense Command to be responsible for the architecture and system engineering of the overall tactical warning and attack assessment system, including associated command and control ADP. In particular, the System Integration Office is to ensure that the command and control system ADP is technically integrated in the overall system and will establish technical engineering policy and standards necessary to safeguard the overall tactical warning and attack assessment integrity. The System Integration Office will address the technical integration and certification of the ADP subsystems to operate within the total system. This Office is presently in the formative stage, and will shortly undertake to prepare the detailed architectural and technical studies and support efforts.

The acquisition of major upgrades to the NORAD Missile Warning and Space Surveillance System and the Command Center Processing and Display System will be managed by the Air Force Systems Command. The Aerospace Defense Center, the Strategic Air Command and the Office of the Joint Chiefs of Staff have the responsibility to specify the operational requirements for these two systems.

8.2 NORAD Missile Warning and Space Surveillance System

This system provides CINCNORAD/CINCAD with the capability necessary to exercise command and control over assigned forces, and to provide the National Command Authorities and the other unified/specified commands with essential, time-critical tactical warning and attack assessment information. The major ADP components of this system are the Communications System Segment and the Core Processing Segment.

8.2.1 Communications System Segment

The Communications System Segment (CSS) provides automated message processing and communications technical control. The ADP equipment supporting these functions today includes six Data General NOVA 840 computers and two Honeywell H6050 computers.

The CSS is the single most critical element in the NORAD Cheyenne Mountain Complex since it is the control point of all internal and external communications. New requirements are being levied upon the CSS which will increase central processor utilization to the point where the system is expected to become input/output and processor limited during periods of peak message processing. This projected increase in communications workload includes the addition of new sensor inputs and new protocols. As an example, approximately 50-75 new or upgraded circuits are planned for input to the NORAD Cheyenne Mountain Complex within the next five years.

Two initiatives are in progress to accommodate the near term impact of these new communications requirements. The first involves an upgrade of the Honeywell H6050 computers. This upgrade, planned for mid-1981, will upgrade the central processor and memory to improve system throughput in order to accommodate the projected communications circuit requirements. The second initiative involves the development of a CSS missile warning bypass capability for critical missile warning data to the NORAD Computer System (see Section 8.2.2 below) if the CSS fails. This missile warning bypass is expected to be operational in late 1982.

The longer term (post 1985) plans for the communications processing functions include the need for an evolutionary replacement of the entire CSS. This will involve the development of a new architecture for the CSS which employs distributed processing technology. This approach will be accomplished in two phases.

The first phase will provide independent and highly reliable communications processing support for the real-time circuits supporting the missile warning functions. The new system will provide the architectural basis for easy adaptation to change, will effectively separate the real-time message processing from common user message processing, and provide the basis for the application of distributive processing technology for the remainder of the communications processing functions. This phase is planned to be operational in 1986.

The second phase of the evolutionary replacement process for the CSS will extend the distributed architecture to include the functions of technical control and common user message processing. This architectural basis will provide enhanced performance, marked increases in availability and maintainability, and a life cycle far in excess of that offered by the existing CSS design. It is anticipated that this capability will be implemented in the 1989-1990 time frame.

8.2.2 Core Processing Segment

The Core Processing Segment (CPS) handles the functions of missile warning and space surveillance with three Honeywell H6080 computers: the NORAD Computer System (NCS) H6080 which supports the command and control and missile warning functions; the SPADOC Computational Center (SCC) H6080 which supports the space surveillance mission; and a third H6080 which is used for operational backup to either the NCS or the SCC.

The Honeywell H6080 currently used for the Core Processing Segment/SPADOC Computational Center processing function does not efficiently handle the demanding scientific/computational workload. Development of satellite attack warning and weapons capabilities will necessitate the maintenance of much higher accuracy satellite data element sets and a significant increase in the number of objects maintained in the precision accuracy group is anticipated. This projected computational load is beyond the current system capacity. Rapid response and increased availability will be required to process new foreign launches, suspected satellite maneuvers, and possible spaceborne threats. These tasks are key factors which make the upgrading of the existing ADP a primary requirement. This replacement is planned for acquisition in late 1982 with an operational capability in the NORAD Cheyenne Mountain Complex in late 1986.

A Honeywell H6080 system is also used for the Core Processing Segment/NORAD Computer System (NCS) functions of real-time receipt, processing, display and output of missile warning data, nuclear detonation reporting, atmospheric surveillance and warning, and weapons and sensor system status. The NCS functions require an operating system oriented toward simultaneous processing of multiple real-time tasks in order to support the dynamic nature of the tactical warning and attack assessment mission. Replacement of the existing computer system will provide improved efficiency and timeliness in processing tactical warning information and at the same time support the necessary command and control functions relating to status, reporting and operations plans development. The replacement for the NCS is planned for acquisition in 1984 with an operational capability in the NORAD Cheyenne Mountain Complex in late 1987.

8.3 Command Center Processing and Display System (CCPDS)

This system consists of dedicated UNIVAC 1100/42 computers, software, display control elements, consoles and associated system support hardware at NORAD, SAC, the National Military Command Center (NMCC), and the Alternate National Military Command Center (ANMCC). Currently, data is received at each of the four CCPDS sites directly from the Satellite Early Warning System (SEWS) and directly from the PAVE PAWS sensor systems. The NMCC, ANMCC, and SAC also receive data indirectly from the Ballistic Missile Early Warning System (BMEWS), Sea-Launched Ballistic Missile (SLBM) Detection and Warning System, COBRA DANE, and the Perimeter Acquisition Radar Attack Characterization System (PARCS) as well as SEWS and PAVE PAWS data by way of NORAD.

In 1977, HQ USAF approved the acquisition of UNIVAC 1100/42s to replace the original UNIVAC 1106s at the four CCPDS sites as a means of satisfying the increased processing requirements generated by additional and improved warning systems. In delegating the procurement authority for the UNIVAC 1100/42 acquisition, the General Services Administration initially authorized a four-year interim upgrade with a requirement that the interim system be replaced with a competitive acquisition by 1981. The Delegation of Procurement Authority for the interim system was subsequently extended to August 1986. The Air Force is now performing a hardware sizing analysis of the system to determine the technical specification for the competitive acquisition. The contract award for the acquisition is scheduled for 1983 with the operational date for the four sites to occur in mid-1986.

8.4 Schedules and Cost

The present broad schedules for the ADP modernization are shown in Figure 8.1.

The estimated cost for the associated ADP acquisitions are as follows:

($M)	FY82	FY 83	FY 84	FY 85	FY 86	FY 87
	1.7	27.2	91.5	44.4	30.4	14.7

Detailed plans, costs, and schedules will be the responsibility of the Air Force with inputs from the new System Integration Office.

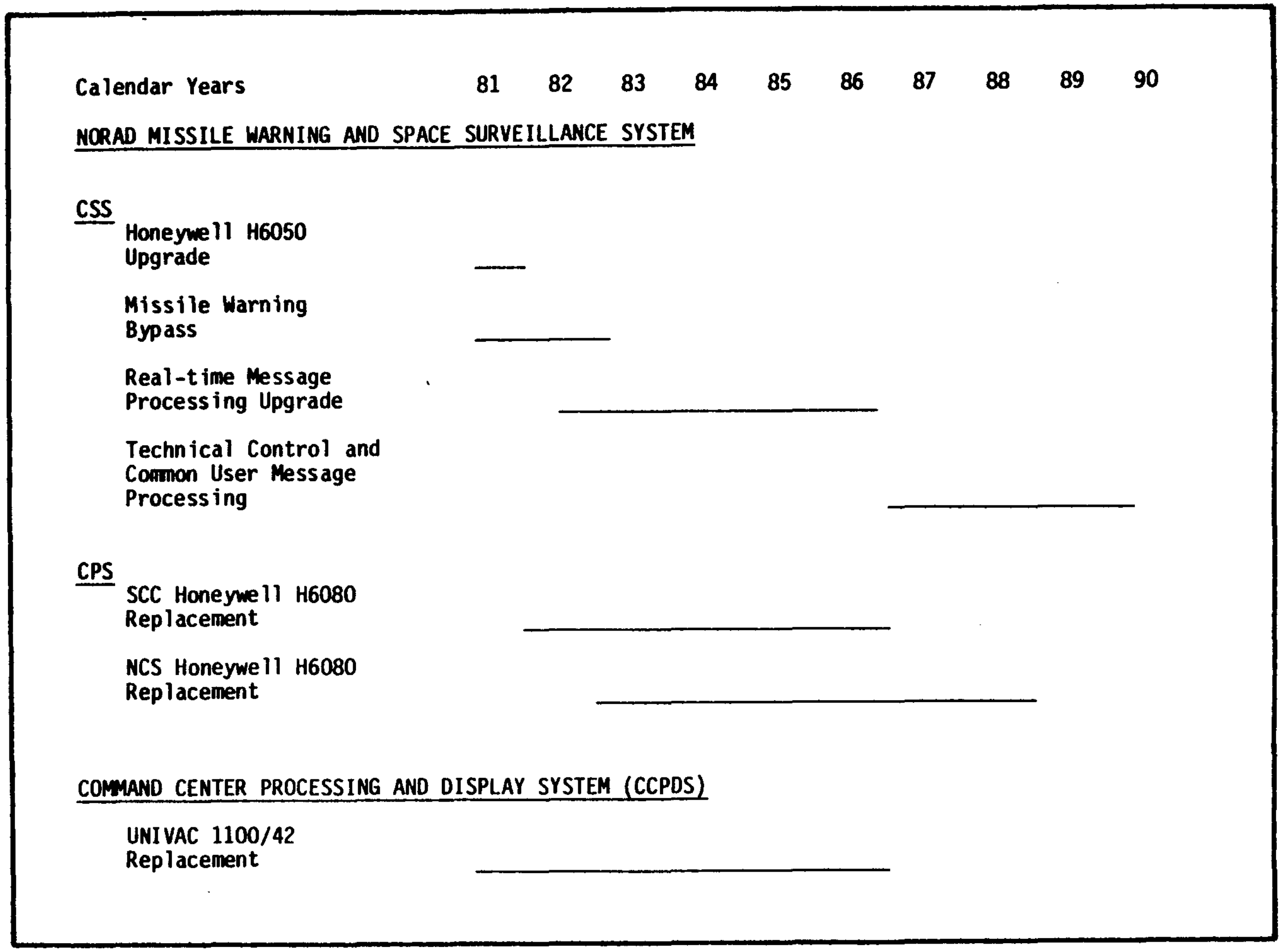

Figure 8.1 ADP Improvement Schedule

GLOSSARY

A

ADCOM	Aerospace Defense Command
ADP	Automatic Data Processing
AFB	Air Force Base
AFDSC	Air Force Data Services Center
AFS	Air Force Station
AMH	Automatic Message Handling
ANMCC	Alternate National Military Command Center
AOC	Army Operations Center
ASD/C^3I	Assistant Secretary of Defense/Command, Control, Communications and Intelligence
ATC	Air Training Command
AU	Air University
AUTODIN	Automatic Digital Network
AWC	Air War College

B

Bks	Barracks

C

C^3S	Command, Control and Communications Systems(JCS)
CCPDS	Command Center Processing and Display System
CCTC	Command & Control Technical Center
CINC	Commander-in-Chief
CINCAD	Commander-in-Chief, ADCOM
CINCEUR	Commander-in-Chief, Europe
CINCLANT	Commander-in-Chief, Atlantic
CINCNORAD	Commander-in-Chief, NORAD
CINCPAC	Commander-in-Chief, Pacific
CINCSAC	Commander-in-Chief, SAC
COMUSK	Commander, US Forces Korea
CONUS	Continental United States
CPS	Core Processing Segment
CPU	Central Processor Unit
CSS	Communications System Segment

D

DCA	Defense Communications Agency
DoD	Department of Defense
DoDIIS	DoD Intelligence Information System

E

EUCOM	European Command

F

FORSCOM	Forces Command (US Army)
FY	Fiscal Year

I

IASA	Integrated AUTODIN System Architecture
IDHS	Intelligence Data Handling System
IMP	Interface Message Processor

J

JCS	Joint Chiefs of Staff
JDA	Joint Deployment Agency
JPM	Joint Program Manager
JSTPS	Joint Strategic Target Planning Staff

L

LANTCOM	Atlantic Command
LANTFLT	Atlantic Fleet

M

MAC	Military Airlift Command
MAJCOM	Major Command
MTMC	Military Traffic Management Command

N

NATO	North Atlantic Treaty Organization
NAVEUR	Naval Forces, Europe
NCC	Naval Command Center
NCCS	Navy Command and Control System
NCS	NORAD Computer System
NEACP	National Emergency Airborne Command Post
NMCC	National Military Command Center

NMCS	National Military Command System
NORAD	North American Air Defense Command
NWSS	Navy WWMCCS Software Standardization

<u>O</u>

OPLAN	Operation Plan
OSD	Office of the Secretary of Defense

<u>P</u>

PACAF	Pacific Air Forces
PACFLT	Pacific Fleet
PACOM	Pacific Command
PACWRAC	PACOM WWMCCS Regional ADP Center
PPBS	Planning, Programming, and Budgeting System

<u>R</u>

RDJTF	Rapid Deployment Joint Task Force
RDT&E	Research, Development, Test & Evaluation
REDCOM	Readiness Command

<u>S</u>

SAC	Strategic Air Command
SCC	SPADOC Computational Center
SHAPE	Supreme Headquarters Allied Powers Europe
SIOP	Single Integrated Operational Plan

<u>T</u>

TAC	Tactical Air Command

<u>U</u>

USAFE	US Air Forces, Europe
USAREUR	US Army, Europe
USEUCOM	US European Command
USFK	US Forces, Korea
USREDCOM	US Readiness Command

W

WIN	WWMCCS Intercomputer Network
WIS	WWMCCS Information System
WSE	WWMCCS System Engineer
WWMCCS	Worldwide Military Command and Control System

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The growing use of WWMCCS ADP and increased operator experience, however, have highlighted certain deficiencies in the present information system, especially in its support of time-sensitive crisis applications. In addition, rapid advances in ADP architecture and in hardware and software technology have created a situation in which the installed Honeywell hardware and system software are becoming technically obsolete. Moreover, it is anticipated that the current system will become increasing difficult and

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