THE COST OF INFORMATION SYSTEMS MODERNIZATION

A Comparison of Options for Life-Cycle Project Management Systems

Report CE002R1

August 1990

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Prepared pursuant to Department of Defense Contract MDA903-90-C-0006. The views expressed here are those of the Logistics Management Institute at the time of issue but not necessarily those of the Department of Defense.

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LMI

Executive Summary

THE COST OF INFORMATION SYSTEMS MODERNIZATION

A Comparison of Options for Life-Cycle Project Management Systems

The U.S. Army Corps of Engineers (USACE) has undertaken a systems modernization program that will govern its information management for the next decade. One of the major systems being developed under this plan is the Life-Cycle Project Management (LCPM) system, which will automate the Corps' approach to managing design, engineering, and construction projects and will provide management information for forecasting, budgeting, controlling funds, and scheduling activities. Several activities within USACE are currently developing prototype LCPM systems.

We found that the current LCPM prototypes not only differ significantly in design and configuration but also in the functions they perform and their flexibility for further modification and enhancement. The estimated life-cycle costs for each prototype at a single site range between $1.1 million and $1.4 million. We also found that Corps-wide LCPM costs will be dominated by the costs of systems design and development and systems operations and maintenance. The costs associated with the options for Corps-wide implementation of LCPM at multiple sites vary widely – ranging from $12 million for a centralized system to $49 million for a totally decentralized system.

If the USACE does not alter its current plans for LCPM, a relatively expensive decentralized system costing approximately $43 million will likely be implemented. We have identified implementation options that can meet LCPM needs for less than half that cost.

We recommend that USACE incorporate the following concepts into its information system master plan to minimize the life-cycle costs of fielding LCPM Corps-wide:

- Minimize the number of prototypes to be continued. In the best (lowest cost) case, narrow the choice to a single system.
- Select an LCPM system that is built around existing commercial project management software.
- Centralize systems management and maintenance for the LCPM system, including the activities for configuration management, software maintenance, and system upgrades and enhancements.
- Set priorities for LCPM system development and implementation plans; establish firm milestone schedules for completing Corps-wide implementation within 18 months.

These recommendations provide the basis for reevaluating and redirecting LCPM development and implementation plans which will ensure that LCPM needs are being met at the least cost.

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CHAPTER 1

INTRODUCTION

BACKGROUND

The U.S. Army Corps of Engineers (USACE) provides planning, engineering, and construction management services for military programs and civil works, and to do the best possible job in those areas, it needs up-to-date management information for forecasting, budgeting, controlling funds, and scheduling activities. Currently, however, many of its information systems are outdated and can no longer effectively support its operations. To overcome that problem, USACE has undertaken an information systems modernization program (ISMP) that will govern its information management for the next decade.

One of the major systems being developed under the ISMP is the Corps' Life-Cycle Project Management (LCPM) system. It was planned as a means of automating the Corps' approach to managing design, engineering, and construction projects from start to finish.

Senior USACE managers are currently making major decisions on the direction of LCPM. They must now decide whether to develop a centralized LCPM system or a number of decentralized systems. If they take a decentralized approach, the districts will develop, implement, and sustain their own individual systems; if, on the other hand, the Corps selects a centralized approach, it will design, implement, and sustain a single system. Within the Corps, the decentralized and centralized options for LCPM are referred to as Options 5 and 6, respectively. The Corps needs to determine the total costs associated with the implementation options and consider them in the decision-making process.

Several Corps' organizations are currently developing prototype LCPM systems. The pending implementation of these separate systems raises three key issues:

- What are the estimated life-cycle (i.e., 10-year) costs for each prototype?
- What are the major options for implementing LCPM systems Corps-wide?
- What are the costs associated with each of these options (Options 5 and 6)?

The Logistics Management Institute (LMI) was tasked by the Corps of Engineers' Director of Information Management to analyze the costs of the software, hardware, and implementation options associated with LCPM to support a USACE cost/benefit decision.

ANALYSIS FRAMEWORK

We identified the costs associated with each prototype system alternative by interviewing the system development teams at each activity and estimating the cost of all past and future tasks over a 10-year life cycle for LCPM. We interviewed five activities: the Waterways Experiment Station (WES); district offices in Chicago, Sacramento, and Mobile; and the Lower Mississippi Valley Division Office. We also interviewed personnel at the Engineering Automation Support Activity (EASA) and the Huntsville Division to discuss the costs associated with developing a headquarters project management reporting system and supporting databases for LCPM systems.[1]

We developed the life-cycle cost estimates for each prototype for the as-planned prototype system implementations. For comparison and generalization purposes, we normalized each prototype's size to serve an average Corps district (25 users). Using the normalized costs, we then developed scenarios for several implementation options and performed sensitivity analyses to gauge the cost effects of such key variables as centralized-versus-decentralized implementation, maintenance requirements, and prototype selection. Our analysis also included the costs of a headquarters project management reporting system and alternative database configurations. All costs

[1]LMI Report AR905R1. *Managing Engineering and Construction Information: An Industry Overview.* Moore, William B., and Robert A. Hutchinson. May 1989. In that report, LMI reported the results of interviews with industry trade associations, private-sector engineering and construction organizations, and software vendors to determine industry project management practices and commercial software capabilities.

were developed according to guidelines promulgated by the DoD, Major Automated Information Systems Review Council (MAISRC).

The remainder of this report presents the findings, conclusions, and recommendations of our study. In Chapter 2, we define the decentralized and centralized LCPM implementation options under consideration. Chapter 3 describes the prototype LCPM system alternatives currently under development. The estimated costs for each prototype development and implementation alternative are presented in Chapter 4, followed by an analysis of cost differences in Chapter 5. Our conclusions and recommendations are presented in Chapter 6. Detailed data and notes on the cost analyses are contained in Appendices A, B, and C.

CHAPTER 2

DECENTRALIZED AND CENTRALIZED OPTIONS

OVERVIEW

This chapter defines the hardware, software, staff, procedures, and requirements that comprise the Option 5 and 6 implementation. The options in this chapter were developed from the LCPM Structured Requirements Analysis Planning (STRAP) and from discussions with Headquarters USACE staff, EASA, WES, and USACE district and division offices visited during the study. We begin by describing the common features of both options and conclude with the unique features of the decentralized and centralized options.

COMMON FEATURES

Overall, Options 5 and 6 have more common features than uncommon ones. The commonality comes from two main sources: the recommended functionality described in the LCPM STRAP, accepted in principle by ISMP, and the results of the HQ USACE LCPM "data scrub" – a determination of the LCPM data elements headquarters needs as management information.[1]

Headquarters LCPM Data Scrub

The Data Scrub Committee consists of representatives of HQ USACE, the divisions, and the districts. To date, the committee has identified approximately 230 unique data elements that will be required for upward reporting. These data elements would form the core data from which HQ USACE summary and other management information reports would be generated. This common core of data elements will be an integral part of the LCPM system functions whether the LCPM system is centralized or decentralized.

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[1]U.S. Army Corps of Engineers Memorandum. From CEASA-SM-A to CEZP. Subject: *Project Management Database*. 27 November 1989.

Meeting the LCPM STRAP Requirements

The principal purposes of the LCPM STRAP are to analyze the change in the Corps' management philosophy from one centered on functions to one that emphasizes project management (PM) and then to identify the processes involved in LCPM, the data required, and specific prototype development concepts (PDCs) required. The STRAP team – a team established by the Corps to prepare the STRAP document – had secondary assignments from the Corps' STRAP proponent to identify voids in existing LCPM guidance, describe LCPM application to both military and civil works design/construction projects, establish priorities for STRAPs, and recommend the essential components of an automated management information system to support LCPM.

The STRAP team recommended an LCPM system with the following common features:

- Standard electronic transmission of data/reports
- Consistency with the ISMP data encyclopedia
- Capability to interface with other ISMP databases (e.g., real estate and financial management databases)
- Ability to track key cost elements
- Capacity to be networked among required project participants
- Capabilities to automatically download data to produce LCPM reports.

Standard electronic transmission of data/reports means that USACE field operating activities (FOAs) would send or receive project-specific data to or from a district database and to or from other Corps databases. The project managers in an FOA would be using a stand-alone or a networked version of project management software either on a personal computer (PC), minicomputer, or mainframe computer and would periodically communicate electronically with the district database and other Corps databases for project information. In addition, the project manager should be able to electronically transmit a standard set of data elements and/or reports upward to the division and headquarters. Who develops the software, LCPM databases, and interfaces depends on the differences between the decentralized and centralized options; both options are to have this same functionality.

Consistency with the ISMP encyclopedia means that project data elements transmitted to the division and HQ conform with the data element definitions and coding specifications in the ISMP encyclopedia. That conformance allows headquarters to be more efficient in rolling up data on all projects for management summaries and analyses.

Related to both electronic data transmission and encyclopedia consistency is *the ability of the LCPM system to interface with ISMP databases.* For efficiently receiving updated resource cost and usage information electronically from the Corps of Engineers Management Information System/Financial Manager (COEMIS/FM), the LCPM system should have software interfaces with these other ISMP systems. These interfaces could take alternative forms, depending on the hardware and software configurations of the LCPM and ISMP systems.

An LCPM system should be *able to track key cost elements.* The ability to transmit and receive electronic information easily between the PM and other Corps databases is one major component of tracking key cost elements efficiently. The other major component lies in the PM software; it must be able to accept actual resource cost and usage information and compare budgets to actual costs.

To maximize efficiency, the LCPM system should be *networked among all project participants* within a Corps district. With this feature, more accurate, up-to-date project information can be transmitted. In effect, this means that the LCPM system should reside and run on a network at the district level, and a PM database containing information on all district projects should be accessible to all FOAs on the electronic network. Both systems should also ultimately have the capability to exchange data electronically with project participants outside the Corps [e.g., architect and engineer (A&E) and construction contractors].

A complete PM system should be capable of being networked and *be able to automatically download data.* Network and precedence diagraming is the capability to show the timing and resource interrelationships among activities and tasks within a project – one of the most basic functions of a project management system. Resource leveling is the capability to analyze resources and schedules within and among projects and make adjustments to balance the workload to fit within resource constraints of the district. Automatic data downloading means that project managers should be able to easily download standard or customized sets of data from the PM

system to generate reports or to transmit upward; this function is normally part of PM commercial software.

Both the decentralized and centralized LCPM options are to use off-the-shelf PM/network scheduling software, and both must specifically utilize the USACE work breakdown structure (WBS) for defining activities and tasks within projects. The PM software lies at the heart of the LCPM system. Several good PM off-the-shelf software packages can provide this capability for both PCs and mainframe use, and most of them are already being used by one or more districts.

Hardware and peripherals are not likely to be different under either the decentralized or centralized options. Both options imply networked software and databases at the district level. Software development, production, and maintenance and the residence of project-level data for HQ USACE uses are the primary differences between the two options.

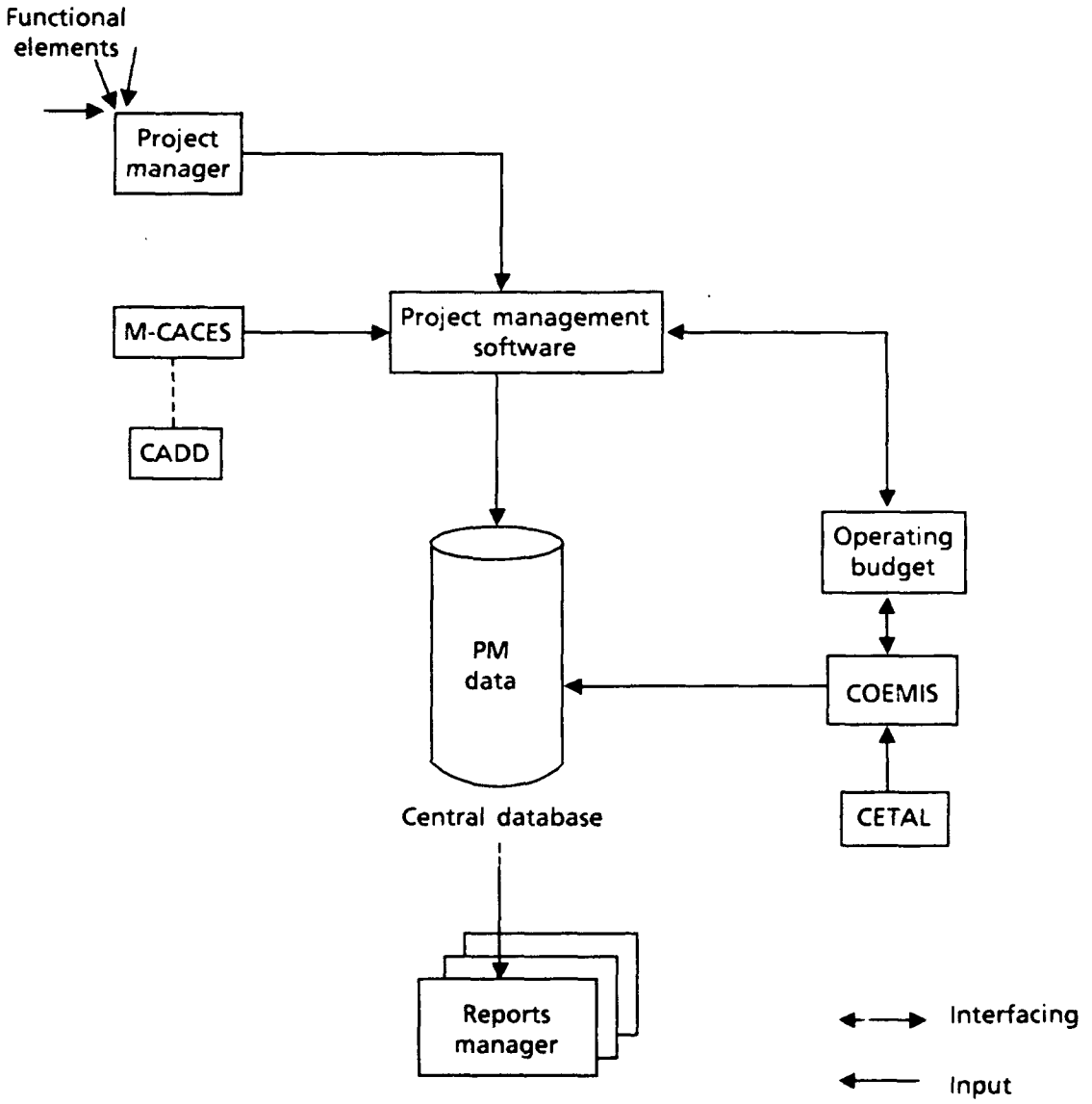
The LCPM system that embodies these common features is diagramed in Figure 2-1. Decentralized and centralized options differ in the nature of the "central database," the Corps unit or units responsible for the PM software, and the various interfaces with ISMP and Corps databases.

THE DECENTRALIZED OPTION (OPTION 5)

The decentralized option has three unique characteristics:

- It does not require direct access from HQ USACE or a division; the required 230 data elements are electronically transmitted to division and HQ USACE.
- Districts may develop their own, different, LCPM systems.
- Individual districts are responsible for development, testing, implementation, documentation, training, upgrading, and maintenance over the LCPM life cycle.

The decentralized option requires the districts to electronically transmit project-level data – the 230 required data elements – to the divisions and HQ USACE. A HQ USACE LCPM database for this purpose would reside on a computer at the headquarters; each month, the districts would transmit updated data in a standard format to that database. HQ USACE management reports and analyses would be generated from the database. Although this is the decentralized option,



Notes: CADD = computer aided drafting and design; M-CACES = Military-Computer Aided Cost Estimating System; COEMIS = Corps of Engineers Management Information System; CETAL = Corps of Engineers Time, Attendance and Labor System.

FIG. 2-1. USACE PROJECT MANAGEMENT SYSTEM (RESIDES AT THE DISTRICT LEVEL)

there would be only one HQ USACE database, developed and maintained by the headquarters. A prototype database, the Headquarters Project Management Database, is being developed by EASA for the decentralized option, and the final design should be completed by the end of FY90.

Apart from the location of the headquarters database, each district may develop its own LCPM system. In practical terms, this means that each district would select its own hardware configuration (e.g., PC, minicomputer, or mainframe computer), off-the-shelf project management/scheduling software (e.g., Open Plan, Primavera, etc.); and database for storing data on projects at the district level (e.g., D-BASE, Oracle, Foxbase, or a custom program). The district would also be responsible for development of any custom PM software. In addition, each district would be responsible for developing its own software interfaces (i.e., computer programs for electronic communication) among these District-unique LCPM systems and other ISMP and Corps databases.

Decentralized LCPM system development would necessitate decentralized LCPM production, testing, implementation, training, documentation, sustainment, and maintenance. Under a decentralized philosophy, each LCPM system must be designed, produced, and implemented. Each district's staff must be trained and each system must be continuously operated and maintained over its life cycle. Under a decentralized system, all of those tasks are the responsibility of the individual districts.

In the extreme case, each district would perform these myriad activities to develop and sustain an LCPM system on its own for 10 years. In reality, other scenarios are more likely. For example, all districts in one division could decide to adopt the same system and most or all of the development and sustainment activities would take place at the division level. Other districts might decide to implement one of the prototypes currently under development, and sustainment would be some combination of individual district effort and shared district effort for maintenance and upgrading. Other districts might develop and sustain completely new systems. Chapter 5 presents a description and cost estimates for these various decentralized scenarios.

THE CENTRALIZED OPTION (OPTION 6)

The centralized option also has three unique characteristics:

- It requires direct access from HQ or a division. The 230 required data elements would reside in a "command" database of project information at the district level.

- A single USACE LCPM software system would be developed.
- Development, testing, implementation, documentation, training, upgrading, and maintenance would be centrally performed or coordinated.

Direct access from HQ USACE or division means that the 230 data elements required for headquarters management information and analysis *would reside on a headquarters-accessible database at the individual district.* This concept is known as the headquarters command database. Conceptually, it is the same as the headquarters PM database or district command database described under the decentralized option except that it exists "in pieces" at each of the districts (i.e., it is a "distributed" database). Headquarters staff accessing the distributed database would not realize that the database was distributed (i.e., it would be transparent to users), and staff could generate reports or analyses using any single district or combination of districts. The information in both databases is essentially the same – project-level data elements that are consistent with ISMP encyclopedia definitions and coding structures. In both options, the project-level data elements will be electronically transmitted from the district's PM system to the headquarters database. In addition, the headquarters command database would be centrally developed and maintained, just as the headquarters PM database would be centrally developed and maintained. Development of a command database has not yet begun.

We found no major functional differences between the distributed headquarters command database and the headquarters PM database; either could be joined with the centralized or the decentralized options for an LCPM system.

CHAPTER 3

LCPM PROTOTYPES BEING DEVELOPED

OVERVIEW

The LCPM system will be one of the major business systems of the Corps of Engineers. An overview of ISMP (Figure 3-1), shows the relationship of the LCPM system to other major Corps business systems. In anticipation of LCPM being implemented under an Option 5 (decentralized) scenario, several organizations within the Corps began developing prototype systems. As part of our study, we analyzed in detail four of those prototypes – those under development by the Lower Mississippi Valley Division (LMVD), the Mobile District, the Sacramento District, and the North Central Division, Chicago District and Waterways Experiment Station (NCD/WES) jointly.

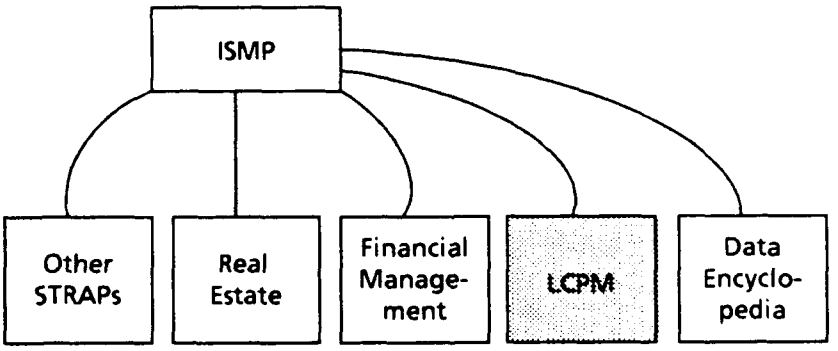


FIG. 3-1. OVERVIEW OF ISMP

A reason behind the rush for prototype development was that in most cases the division or district felt it had to have a modernized LCPM system to manage effectively, and the full effect of the ISMP was too far from implementation to be a realistic option in the next few years.

FINDINGS

As might be expected, major differences in defined systems requirements has led to variation in the way each Corps organization designed its prototype. Besides differences in the accompanying hardware and software, the prototypes are significantly different in most other respects, including functionality, database integration, level of custom design, report formats, etc. Each organization designed a prototype based on its own local management requirements and styles. The systems also differ in their degree of flexibility for handling both military and civil works projects and in their overall flexibility for use by other districts.

Features common to all the prototypes include the use of existing Corps information systems such as COEMIS and the use of high-end commercial project management software. All are designed to be fit into a network configuration. Table 3-1 presents a comparison of the LCPM prototype systems.

TABLE 3-1

COMPARISON OF LCPM PROTOTYPE SYSTEMS

LCPM prototype	Hardware configuration	PM software	Database	Major interfaces	Major customization
LMVD	• PC network, linked to division	• Open Plan		• COEMIS F&A • CETAL • CWS • Open Plan	• Data interfaces • Screens, reports • Open Plan functions
Mobile	• Sperry 5000/95 • Harris	• Primavera	• INFORMIX-SQL	• COEMIS F&A • CETAL, PMRS • CWS • Primavera • COBOL	• INFORMIX cost query system • Data interfaces
Sacramento	• PC network		• Custom C program • DB_Vista III	• COEMIS F&A • PRISM • PM software	• Screens and reports in C • Data interfaces
NCD/WES	• PC network	• Open Plan	• D-BASE IV • ORACLE • Foxbase	• COEMIS F&A • CETAL • CWS • Open Plan	• Data interfaces • Screens and reports in Open Plan • Screens and reports in database

Notes: COEMIS F&A = COEMIS Financial and Accounting; CWS = Civil Works System

LMVD Prototype

The LMVD system is designed to be run on PC networks at each district office and linked to a division-level system at LMVD. The prototype uses Open Plan commercial project management software and has automated links to provide interfaces with COEMIS (F&A), CETAL, and CWS. Data from the existing standard and local Corps systems are imported to the Open Plan database. Development of the system included major custom design of data interfaces, screens, reports, and Open Plan functions. All custom design was done directly in Open Plan. Data or reports required for upward reporting to division and HQ to meet ISMP objectives could be generated directly from Open Plan.

Mobile Prototype

The Mobile prototype is designed to be run on a Sperry 5000/95 minicomputer and networked at the district level. It consists of an LCPM database implemented in INFORMIX-SQL. The system uses Primavera project management software, which will reside on PCs, and has automated links to provide interfaces with COEMIS F&A, CETAL, Project Management Reporting System (PMRS), CWS, and Primavera data. Data from existing Corps systems are imported into the IMFORMIX-SQL database. Queries and reports are generated directly from the database. The system is being built in two phases. Phase I, the cost query system, was completed and implemented in March 1990. In Phase II, Mobile will build interface links between the cost query system and CWS, PMRS, CETAL income extract files, and Primavera.

Sacramento Prototype

The Sacramento District LCPM prototype is a PC-based, networked system designed to run at the district level. It consists of a database written in C language with custom-designed functions for screens, data queries, and report generation. The system will use the DB_Vista III database to generate schedule and project description information for the C database. The system is designed to interface COEMIS F&A, CETAL, and DB_Vista III. Data from existing Corps systems are imported into the C database through a COBOL interface to Project and Resource Information System for Management (PRISM) at the division office.

NCD/WES Prototype

The NCD/WES prototype is a PC-based system adaptable for networking at the district level. It will use Open Plan PM software with a separate database (ORACLE and D-BASE IV) to generate reports. Custom-designed functions for screens, formats, and Open Plan functions have been built into the PM software. The system will use the LCPM Reporting System (LRS) database to generate headquarters reports. The system uses a combination of D-BASE IV programs along with FORTRAN and C programs to extract data from existing Corps information systems, COEMIS F&A, CETAL, and CWS into a D-BASE IV database, and then into Open Plan.

COMPATIBILITY WITH CEAP AND ISMP

As part of the prototype analysis, we also examined how each prototype would have to be adapted or modified to be consistent with the Corps of Engineers Automation Program (CEAP) and ISMP efforts. All prototype LCPM systems must eventually meet the following baseline requirements:

- Ability to transmit 230 data elements specified by HQ USACE as the LCPM reporting requirements
- Consistency with the HQ USACE data encyclopedia
- Ability to interface with other ISMP systems (e.g., FM and real estate) for data export and import
- Capability to interface with CEAP 1-A hardware and communications in order to access ISMP systems
- Capability with existing systems currently in redesign, particularly COEMIS
- Ability to perform PM functions for both military and civil works projects.

While none of the prototype systems meet all these requirements at the current time, the divisions and districts involved do not believe ISMP compatibility presents any major problem. However, custom interface software would be needed for any of the prototypes under a decentralized or centralized option.

CHAPTER 4

COST OF DECENTRALIZED AND CENTRALIZED OPTIONS

OVERVIEW

As discussed in Chapter 3, four prototype LCPM systems are currently being developed at USACE divisions and districts; all should be ready for implementation by the end of FY90. Chapter 2 describes the common and unique features of the decentralized and centralized options under consideration, while this chapter discusses the specific costs of developing, implementing, and sustaining LCPM systems under both decentralized and centralized scenarios within the Corps.

The methodology used to construct the cost estimates is based on instructions set down by the Office of the Assistant Secretary of Defense (Program Analysis and Evaluation) [OASD (PA&E)]. Those instructions and format are known as the Major Automated Information Systems Review Council (MAISRC) methodology.

The MAISRC methodology requires the requesting Service to account for all costs of an information system over its entire expected life cycle. The primary MAISRC categories of costs correspond to five stages in a system's life cycle:

- Development
- Production
- Military construction
- Fielding
- Sustainment/operations and maintenance.

Each category is divided into a hierarchy of cost elements, or cells, which are separately identified. The cost cells relevant to LCPM were included in our analysis. Appendix C is a listing of the complete MAISRC hierarchy.

The *development* phase of the system's life cycle includes all the activities going into the planning, design, and design documentation stages of the system. These activities may include the design and development of hardware and software for

prototype systems. The *Production* phase consists primarily of constructing (i.e., programming) the physical system, including purchasing any hardware that may be necessary. That phase also includes providing training for users. Prototype systems that may have been constructed in the development phase are taken through the "alpha" and "beta" test stages during the production phase; all testing is completed during this phase, and the systems should be ready for implementation. *Military construction* is an unneeded phase for the LCPM system.

Fielding is the implementation phase of the system – the hardware is put in place; the software is activated; necessary historical data are loaded into the databases; all automated and nonautomated procedures are activated; and the system is put in operation, either totally or *in* phases. At this point, the system's "operational" life cycle begins. For LCPM systems, the life cycle is considered to be 10 years. The final phase of a system's life cycle is the *sustainment/operations and maintenance stage.* All recurring costs for keeping the system running, including planned hardware or software upgrades and maintenance, are accounted for in this category. Since the LCPM's planned operational life cycle is 10 years, the costs for all 10 years are accumulated here.

We developed full life-cycle cost estimates covering all four phases (military construction costs excepted) for each of the prototype LCPM systems currently under development. During visits to each prototype site, we gathered as much detailed cost information as possible. Since all of the prototypes have nearly completed the development and production phases, we were able to obtain accurate *actual* cost data on the prototypes for those phases. Based on those actual costs and discussions with the managers of the prototype development projects, we estimated the costs for the remaining phases of the life cycle.

We developed two cost estimates for each prototype. The first is the cost to implement and sustain the prototype in the district or districts for which it is specifically being developed. For example, the Sacramento prototype is intended for use only within the Sacramento District – a large district with about 85 project managers/users. On the other hand, the LMVD prototype is being developed for use by all districts within the LMVD. We were given cost for those specific applications of the prototypes, and we modified those costs where necessary and sent our completed cost estimates to the managers of each prototype development team for comment. The life-cycle cost estimate for the prototype LCPM systems, including the

headquarters PM and headquarters command databases, are presented in Appendix B along with detailed explanations of the cost calculations for each cost cell.

The second cost estimate we developed was a "normalized" prototype cost based on implementation and sustainment in an average-size district (i.e., one with 25 project managers/users). To reach this estimate, we adjusted the variable cost elements of the production, fielding, and sustainment/operation and maintenance phases to be consistent with 25 users. For example, while the Sacramento as-planned prototype production costs included 85 copies of an off-the-shelf PM software package, the Sacramento normalized prototype production costs included only 25 copies. We used the as-planned or normalized prototype cost estimates, as appropriate, in deriving our total Corps-wide cost estimates of alternative decentralized and centralized LCPM systems.

COST OF A DECENTRALIZED LCPM SYSTEM

The normalized life-cycle cost of implementing and sustaining each prototype in a single average-size district is shown in Table 4-1. The base cost ranges from $1.1 million to $1.4 million – a variation of about 32 percent. When the cost of a headquarters project management database is added, the total costs range from $2.7 million to $3.1 million – a variation of only 11 percent.

The more relevant question with regard to the decentralized option is: What are the estimated costs for Corps-wide implementation? To answer this question we constructed six scenarios representing the full range of implementation decisions that the districts might independently make under a decentralized option. Those scenarios are:

- Option 5A: All districts develop, field, and maintain their own systems with the exception of existing prototypes.
- Option 5B: All divisions develop their own systems for use by their districts, with the exception of existing prototypes, with centralized maintenance at each division.
- Option 5C: All divisions develop their own systems for use by their districts, with the exception of existing prototypes, with decentralized maintenance at each district.

TABLE 4-1

LCPM PROTOTYPE
LIFE-CYCLE COST ESTIMATES WITH HQ DATABASE[a]

(Thousands of 1990 dollars)

	LMVD ($)	Mobile ($)	Sacramento ($)	NCD/WES ($)
LCPM cost[b]	1,163	1,079	1,415	1,360
HQ database	1,632	1,632	1,632	1,632
Total	2,795	2,711	3,047	2,992
LCPM sunk costs[c]	254	310	274	335

[a] The HQ database cost estimate is the 10-year life-cycle cost for the entire Corps.

[b] The LCPM cost estimate is the 10-year life-cycle cost for a single, average-size district with 25 users.

[c] LCPM sunk costs are the costs from concept development through production.

- Option 5D: Most districts use an existing prototype, with some developing their own systems, with decentralized maintenance at each district.
- Option 5E: All districts use the LMVD prototype, with the exception of other existing prototype sites, with centralized maintenance Corps-wide.
- Option 5F: All districts use NCD/WES, with the exception of other existing prototype sites, with centralized maintenance Corps-wide.

We estimated the life-cycle costs for each of these options using the relevant as-planned and normalized costs for the prototypes. Our cost estimates are based on two key assumptions. First, we calculated the average normalized cost for the four prototypes, excluding the Headquarters PM database cost, and used that average as the average cost per district for developing, implementing, and sustaining additional LCPM systems. Second, since the Headquarters PM database is a centralized database residing on a single headquarters computer, its cost is added only once to the total Corps-wide cost of PM systems to arrive at total LCPM costs. The estimated life-cycle costs for options 5A through 5F are summarized in Figure 4-1 and in Tables 4-2 through 4-7, respectively.

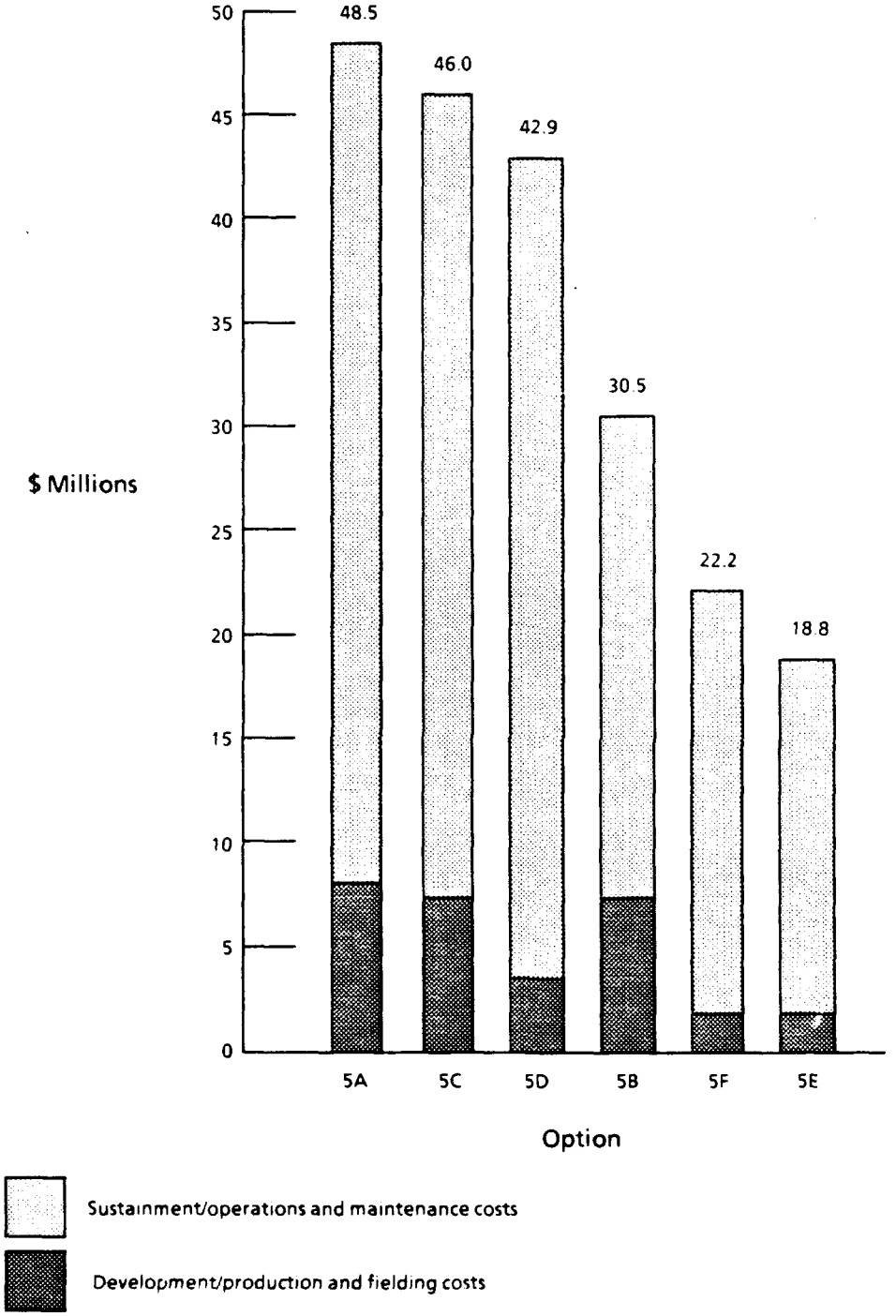


FIG. 4-1. COMPARISON OF COSTS FOR CORPS-WIDE IMPLEMENTATION OF OPTIONS 5A THROUGH 5E

TABLE 4 2

ESTIMATED COSTS FOR IMPLEMENTATION OPTION 5A

Prototype	Districts	Estimated cost ($ millions)
ScSramento	1	1.4
NCD/WES	5	5.6
Mobile	1	1.1
LMVD	9	8.7
Other	24	30.1
PM system	40	46.9
HQ database	1	1.6
Total		48.5

TABLE 4-3

ESTIMATED COSTS FOR IMPLEMENTATION OPTION 5B

Prototype	Districts	Estimated cost ($ millions)
Sacramento	3	2.1
NCD/WES	5	2.9
Mobile	1	1.1
LMVD	9	3.7
Other	22	19.1
PM system	40	28.9
HQ database	1	1.6
Total		30.5

TABLE 4-4

ESTIMATED COSTS FOR IMPLEMENTATION OPTION 5C

Prototype	Districts	Estimated cost ($ millions)
Sacramento	3	3.8
NCD/WES	5	5.6
Mobile	1	1.1
LMVD	9	8.7
Other	22	25.2
PM system	40	44.4
HQ database	1	1.6
Total		46.0

TABLE 4-5

ESTIMATED COSTS FOR IMPLEMENTATION OPTION 5D

Prototype	Districts	Estimated cost ($ millions)
Sacramento	8	9.6
NCD/WES	10	10.9
Mobile	1	1.1
LMVD	14	13.3
Other	7	6.4
PM system	40	41.3
HQ database	1	1.6
Total		42.9

TABLE 4-6

ESTIMATED COSTS FOR IMPLEMENTATION OPTION 5E

Prototype	Districts	Estimated cost ($ millions)
Sacramento	3	3.8
NCD/WES	5	5.6
Mobile	1	1.1
LMVD	31	6.7
Other	0	0
PM system	40	17.2
HQ database	1	1.6
Total		18.8

TABLE 4-7

ESTIMATED COSTS FOR IMPLEMENTATION OPTION 5F

Prototype	Districts	Estimated cost ($ millions)
Sacramento	3	3.8
NCD/WES	27	7.0
Mobile	1	1.1
LMVD	9	8.7
Other	0	0
PM system	40	20.6
HQ database	1	1.6
Total		22.2

Option 5A is the most extreme option because it involves the largest number of uniquely developed LCPM systems. In addition to the districts that plan to use the existing prototypes, the 24 remaining districts would develop, implement, and sustain their own systems. We estimate the total life-cycle costs of that option to be $48.5 million. This is the highest cost of all decentralized options because of the number of unique new systems developed and the fact that all districts would perform their own separate operations and maintenance for the life of the systems.

Option 5B assumes that each division develops, implements, and sustains its own system for use by its districts. The existing prototypes would be implemented throughout their respective divisions (Mobile would still be unique), and the other 22 districts would be served by their divisions. We estimate the life-cycle costs of that option to be $30.5 million. That option is significantly lower than the high-cost Option 5A because sustainment activities are centralized at the division level.

Option 5C is the same as Option 5B, except that once the division-developed systems are implemented, the individual districts perform maintenance separately. We estimate the life-cycle costs of that option to be $46.0 million, or almost as much as the high-cost option (5A), because of the decentralized sustainment activities.

Option 5D assumes that most districts select one of the existing prototypes, with some districts developing additional unique systems; operations and maintenance is performed at the individual districts. To make this estimate, we distributed the currently uncommitted districts to each of the categories (Mobile is assumed to stay unique). We estimate the life-cycle costs of Option 5D to be $42.9 million – somewhat less than the higher cost options (5A and 5C), and considerably more than Option 5B. *We believe that Option 5D is the most likely scenario if no further direction is given by HQ USACE.*

Options 5E and 5F assume that all districts would voluntarily select the same existing prototype system and that sustainment would be voluntarily centralized (e.g., with the prototype developer). These unlikely scenarios represent the lower bound for cost purposes for the decentralized LCPM option. The LMVD and NCD/WES prototypes were selected for these two options because they primarily use off-the-shelf software packages, whereas the Sacramento prototype contains significant amounts of custom C programming and the Mobile prototype uses a

minicomputer and a UNIX operating environment. We estimate the costs of Options 5E and 5F to be $18.8 million and $22.2 million, respectively.

Option 5A, in which all remaining districts develop, implement, and sustain their own unique LCPM systems, is the "pessimistic" scenario – at a cost of $48.5 million. Similarly, Options 5E and 5F, in which all the remaining districts select the same existing type of prototypes and accept centralized sustainment, represent the "optimistic" scenarios – at a cost of $18.8 and $22.2 million, respectively. We believe the most likely scenario is Option 5D, in which most districts select one of the existing prototypes, some districts build their own new systems, and all districts independently sustain their LCPM systems once implemented – at a cost of $42.9 million.

COST OF A CENTRALIZED LCPM SYSTEM

In the previous section, we presented cost estimates for six decentralized LCPM scenarios that the districts and divisions might voluntarily undertake. This section presents the cost estimates for a single, centrally developed, implemented, and sustained LCPM system for the Corps.

We constructed three possible scenarios for a completely centralized LCPM system Corps-wide, all based on the assumption that HQ USACE will direct all districts to use it and to use a single off-the-shelf PM system. The Headquarters command database with project-level information for division/HQ management reporting and analysis would be centralized but would use a distributed database with individual component pieces located at each district.

Since four current prototypes are nearing completion, and life-cycle costs, including the cost of the Headquarters command database, differ only slightly, we constructed the following three scenarios:

- Option 6A: All districts use the Sacramento system.
- Option 6B: All districts use the NCD/WES system.
- Option 6C: All districts use the LMVD system.

The Mobile prototype was not considered as a viable centralized option because it is the only one whose hardware does not include a PC network. The cost of the Mobile prototype and development costs for other unused prototypes for a given

scenario become sunk costs. The estimated life-cycle costs for the three centralized options are summarized in Table 4-8 and Figure 4-2.

TABLE 4-8

ESTIMATED COSTS FOR IMPLEMENTATION OPTIONS 6A, 6B, AND 6C

Prototype	Districts[a]	Estimated cost ($ millions)		
		Option 6A	Option 6B	Option 6C
Sacramento		8.6	0.3	0.3
NCD/WES		0.3	9.4	0.3
Mobile		0.3	0.3	0.3
LMVD		0.2	0.3	8.1
Other		0	0	0
PM system		9.4	10.3	9.0
Distributed database		2.9	2.9	2.9
Total		12.3	13.2	11.9

[a]Under Options 6A – 6C, all (40) districts choose a single prototype system; 6A = Sacramento, 6B = NCD/WES, 6C = LMVD.

The estimated life-cycle costs, excluding the district command database, are $9.4 million, $10.3 million, and $9.0 million for Options 6A, 6B, and 6C, respectively – a variation of only 14 percent. When the $2.9 million life-cycle costs of the database are added, the costs become $12.3 million, $13.2 million, and $11.9 million, respectively – a variation of only 11 percent.

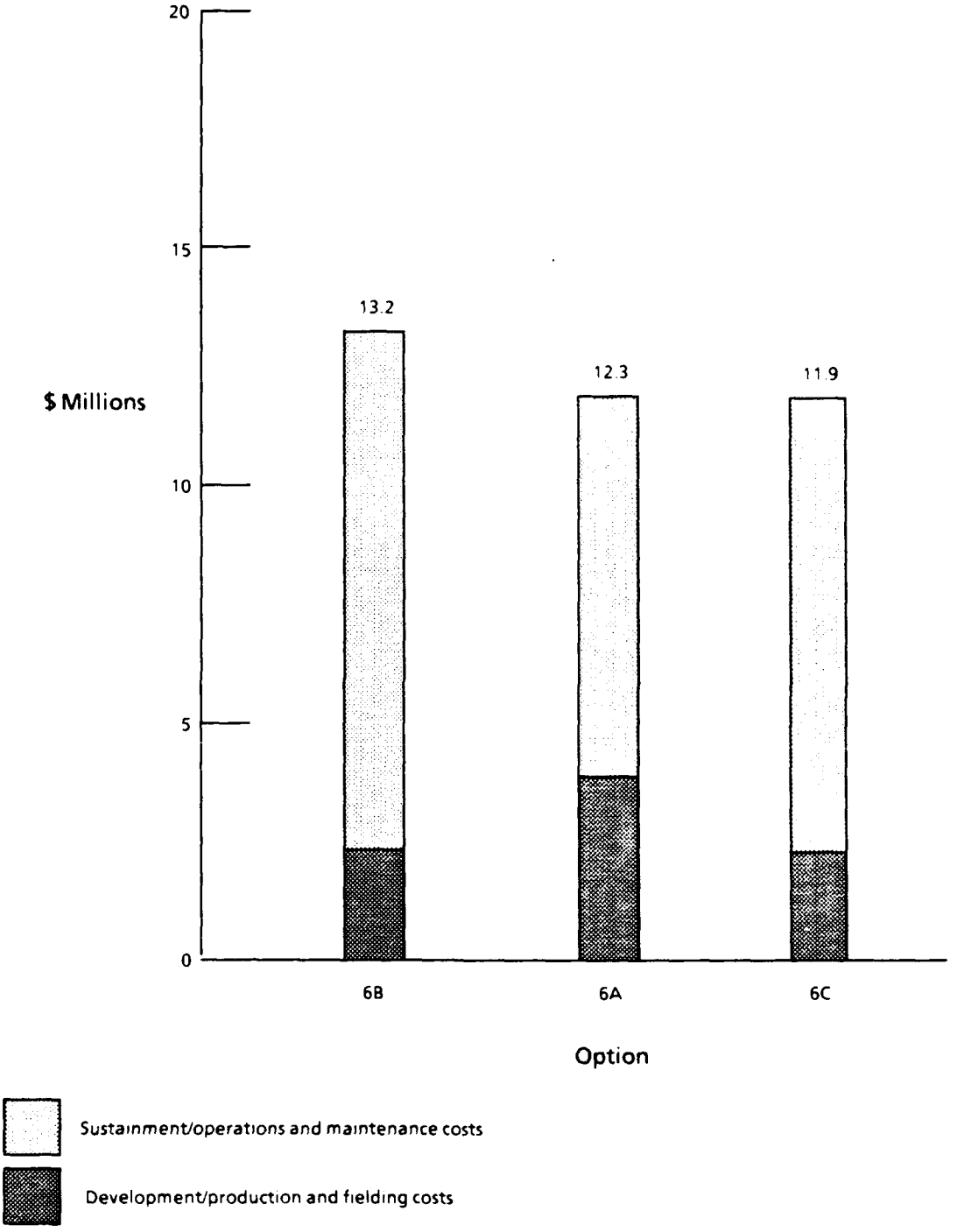


FIG. 4-2. COMPARISON OF COSTS FOR CORPS-WIDE IMPLEMENTATION OPTIONS 6A, 6B, AND 6C

CHAPTER 5

COST COMPARISON OF DECENTRALIZED AND CENTRALIZED LCPM SYSTEMS

Figure 5-1 presents a combined summary of the estimated life-cycle costs for both decentralized and centralized options of Corps-wide LCPM systems. Overall, the costs range from $11.9 million to $48.5 million. To date, sunk costs for prototype development are about $1.2 million. If no further actions are taken by HQ USACE to change the current decentralized course of LCPM, Option 5D is the most likely resultant scenario.

The centralized options cost 50 percent to 70 percent of the most optimistic (and most unlikely) decentralized options. Further, all centralized options cost only 28 percent to 31 percent of the most likely decentralized option of $42.9 million. The centralized options are significantly less expensive for two reasons. First, about 80 percent of the difference lies in centralized operations and maintenance costs. Under the decentralized options, each of the districts must individually perform maintenance on report generators, negotiate purchase agreements with PM software vendors, customize those off-the-shelf PM software packages, maintain customized interfaces with other ISMP and Corps databases, train new users, train old users with respect to upgrades, and perform all other tasks to keep its systems operating. The costs of performing those same functions at 20 to 30 different sites is significantly more expensive than at one site. Even the decentralized options that involve centralized maintenance (5B, 5E, and 5F) are much less expensive than those whose maintenance is decentralized.

The other 20 percent of the cost differential between centralized and decentralized options is the duplication in development and implementation activities.

The costs of the centralized options are all very close. Even though these systems were independently developed, their sunk development costs are quite similar, as are their estimated operations and maintenance costs. Even if one of the existing prototypes was not selected as the centralized system and an entirely new

LCPM system had to be developed, the life-cycle costs of that system would be expected to be comparable to other centralized options.

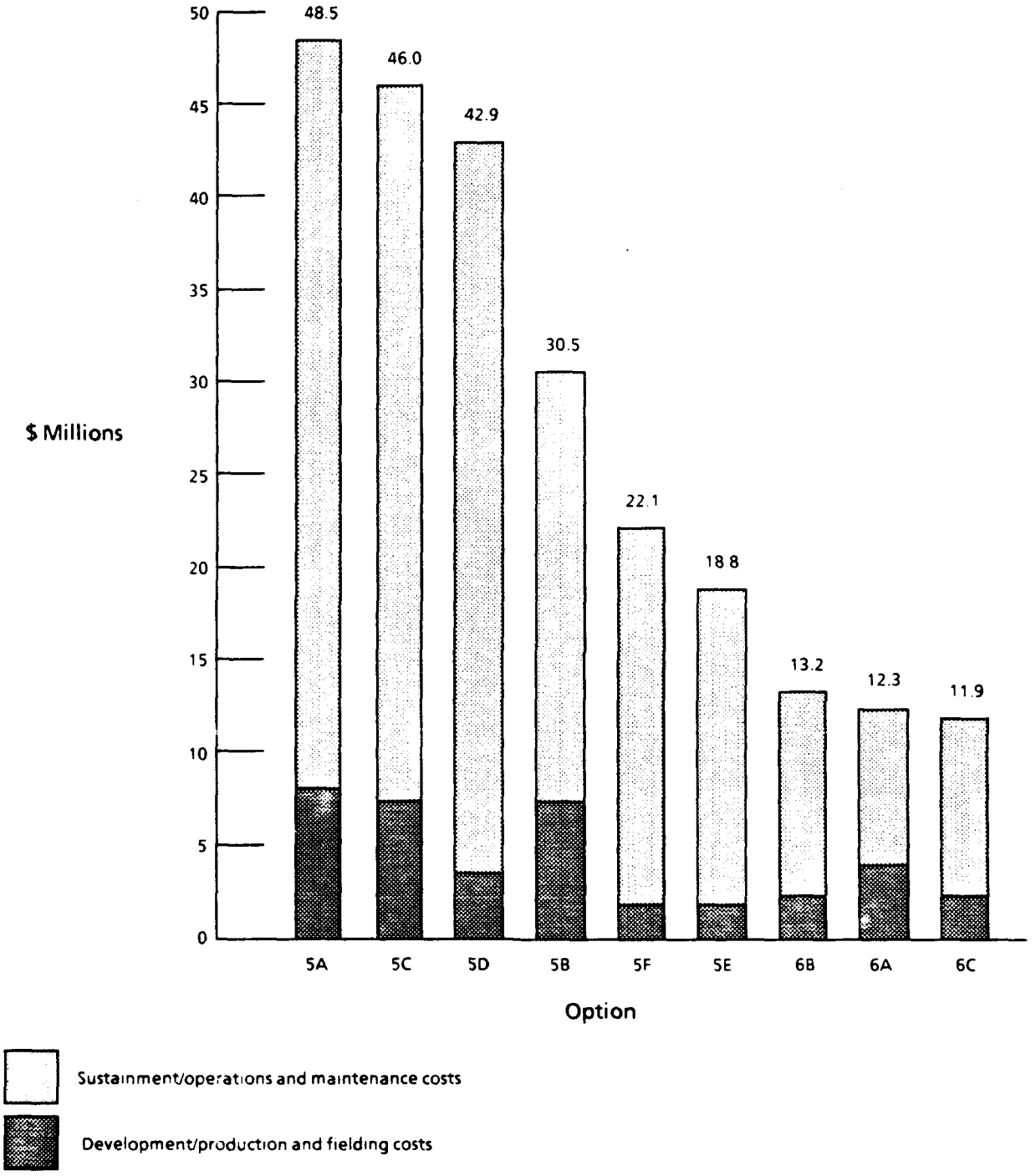


FIG. 5-1. COMPARISON OF COSTS FOR CORPS-WIDE IMPLEMENTATION OF OPTIONS 5 AND 6

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

LCPM Prototypes

Corps of Engineers activities that are currently developing prototype LCPM systems believe they are doing so out of necessity. They see modernizing the automation of management information at the district offices as a key ingredient in effective project management. Significant variation in how each activity defines the requirements for its prototype has led to variation in the design, configuration, and functions built into these systems. Some prototypes can be more easily modified and enhanced than others. All will require significant modifications before they can be fully integrated with ISMP systems and CEAP. The estimated life-cycle costs of the prototypes range between $1.4 million for the highest to $1.1 million for the lowest (for a single site), and all are scheduled to be at least partially operational by the end of FY90.

Implementation Options

The major cost factors associated with implementation of any LCPM system are systems operations and maintenance (i.e., sustainment) and systems design and development. The costs of developing and maintaining a single, centralized system are significantly lower than the costs of developing and maintaining multiple systems. Insofar as decentralized systems are concerned, their costs range from $18.8 million to $48.5 million, which contrasts starkly with the costs of centralized systems, which range from $11.9 million to $13.2 million. If no further HQ USACE decisions are made (i.e., the status quo is accepted), a decentralized system costing approximately $42.9 million will likely evolve. An optimal Corps-wide LCPM implementation would include the following conditions:

- Selection of a single LCPM prototype for full development combined with cancellation of the development and implementation efforts for the remaining prototypes

- Selection of a single LCPM system for implementation
- Centralized maintenance of LCPM software Corps-wide.

These decisions are time sensitive if USACE is to minimize sunk costs. Activities throughout the Corps are now formulating implementation plans based on the selection of current LCPM prototypes. Sunk costs will continue to accrue as the prototypes enter fielding and maintenance phases.

If HQ USACE delays a decision on LCPM implementation, a decentralized approach will surely become a fact. Under such an approach, the most likely scenario is the one that we have designated Option 5D, and it will cost an estimated $42.9 million. Option 5D would result in most districts choosing one of the current prototypes for implementation and a few choosing to develop their own systems. Under either condition, all districts would be faced with providing their own maintenance. The districts are currently choosing this path because they recognize their real need for effective automated LCPM systems and they believe implementation of ISMP is called well into the future.

RECOMMENDATIONS

For USACE to minimize the life-cycle costs of fielding LCPM systems Corps-wide, we recommend the following concepts be incorporated into the Corps of Engineers Information System Master Plan:

- Minimize the number of prototypes to be continued. In the best case, narrow the choice to a single prototype for further development.
- Select one of the LCPM systems that is built around commercial PM software. This approach offers a distinct advantage for periodic updating. Riding the coattails of a leading vendor is usually the least expensive way of keeping up with technological advances. The selected system should possess the following general characteristics:
  - Be capable of being custom designed
  - Be capable of supporting an internal or external relational database
  - Be capable of running in a network environment
  - Have commands available to call up custom-designed screens and generate custom-designed reports.

- Centralize systems management and maintenance for LCPM. This centralizing should include the activities for configuration management, software maintenance, and system upgrades and enhancements.

- Set priorities for LCPM development and implementation plans. These priorities should include establishing firm milestone schedules for completing Corps-wide implementation of LCPM within 18 months. Implementation should take place as soon as possible to support current project management needs of managers at the district offices.

We believe that the recommendations contained in this report provide the basis for a reevaluation and redirection of LCPM development and implementation plans which will ensure that LCPM needs are being met at the least cost.

APPENDIX A

LIST OF CONTACTS AND INDIVIDUALS INTERVIEWED

LIST OF CONTACTS AND INDIVIDUALS INTERVIEWED

USACE WATERWAYS EXPERIMENT STATION

Dr. N. Radhikrishnan
Mr. Warren Bennett

USACE LOWER MISSISSIPPI VALLEY DIVISION

Mr. Sam E. Bradley, Jr.

USACE SACRAMENTO DISTRICT

Mr. Larry Knoch

USACE CHICAGO DISTRICT

MAJ Rich Thompson, USA

USACE MOBILE DISTRICT

Ms. Lee Griffin

USACE HUNTSVILLE DIVISION

Mr. Bruce Johnson

U.S. ARMY ENGINEERING AUTOMATION SUPPORT ACTIVITY

Mr. Webb Smith
Ms. Kathy Sheridan
Mr. Raphael Pargas

LIST OF INDIVIDUALS PREVIOUSLY INTERVIEWED[1]

THE PORT AUTHORITY OF NY & NJ

Mr. Jon S. Weston
Manager
Capital Programs

Mr. Dennis J. Switaj
Capital Program Support
Management and Budget Department

FLUOR DANIEL, GREENVILLE, S.C.

Mr. R. J. Parker
Vice President, Construction

Mr. W. Keys Lewis III
Senior Director
Information Systems

Mr. Alan C. Waite
Principal Project Controls Engineer

Mr. Richard C. Forresster III
Business Development Manager
Defense

Mr. Harrell H. Waldrop
Director
Maintenance Consulting Services

Mr. Ronald J. De Pietro
Director
Estimating

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[1]LMI Report AR905R1. *Managing Engineering and Construction Information: An Industry Overview.* Moore, William B., and Robert A. Hutchinson. May 1989. As part of its earlier study, LMI interviewed industry trade associations, private-sector engineering and construction organizations, and software vendors to determine industry project management practices and commercial software capabilities.

EDWARDS KELCEY, LIVINGSTON, N.J.

Mr. Robert Marshall
Director
Information Systems

E. I. DU PONT DE NEMOURS & COMPANY, NEWARK, DEL.

Mr. J. R. Hanby
Engineering Department

Mr. James F. Collins
Manager
Computer Systems and Support

LUMMUS CREST, INC., HOUSTON, TEX

Mr. Robert K. McClammy
Vice President
Finance

Mr. Nick J. Lamonte
Vice President
Finance – USA

Mr. Mark Marlin
Manager
Project Controls and Estimating

Mr. Angus A. Morrison
Manager
Systems Support

MORRISON - KNUDSEN CORP., BOISE, IDAHO

Mr. Jim Lilly
Senior Deputy Consultant

Mr. Jim Colby
Assistant Corporation Comptroller

Dr. James M. Neil
Director
Management Systems

Mr. Dennis C. Hammond
Manager
Project Control

Mr. W. Kingery
Manager
Project Support

Mr. Pete Hedberg
Manager
Project Support

APPENDIX B

PROTOTYPE COST ESTIMATES AND COST CELL EXPLANATIONS

CONTENTS

LOWER MISSISSIPPI VALLEY DIVISION (LMVD)
(LCPM) SYSTEM PROTOTYPE

06-Jul 02:57 PM

U.S. ARMY CORPS OF ENGINEERS

LIFE-CYCLE PROJECT MANAGEMENT
COST ESTIMATES

NORMALIZED DISTRICT COSTS

1990 dollars INPUTS	LMVD
Supervisor, GS-12	$67,253
Lead Prog., GS-9	$46,377
Progmmrs., GS-9	$46,377
Progmmrs., GS-7	$37,912
Field PM, GS-12	$67,253
Avg. Trvl. & Per Diem	$173
PC File Server	$10,000
# of File Servers	2
PM applic. soft.	$3,000
Add. costs/user	$500
Commun. Soft.	$5,000
Network PC boards	$300
# PCs on network	25
# of Copies	25
# of PM users	25

MAISRC COST CELL	ISMP LIFE-CYCLE COST	LMVD
1.0	Development	
1.02	Documentation/Data	$12,986
1.04	System/Project Mgt.	$5,604
1.07	Other Dev. Costs	$0
2.0	Production	
2.013	PCs (micros)	$10,000
2.014	Communications Equip.	$3,750
2.022	Application Software	$180,000
2.023	Communications Soft.	$5,000
2.04	Documentation/Data	$9,826
2.06	Training Serv. & Equip.	$26,611
	SUNK COSTS:	$253,778
4.0	Fielding	
4.05	Site Activation	$12,510
4.06	Doc./Data (paper)	$150
5.0	Sustainment/Operations and Maint.	
5.03	Doc./Data (paper)	$613
5.041	Hardware	$10,000
5.0422	Applications Softare	$613,766
5.07	Replacement Tng.	$104,243
5.08	System/Project Mgt.	$168,134
	5.0 SUBTOTAL:	$896,755
	TOTAL:	$1,163,193

LOWER MISSISSIPPI VALLEY DIVISION (LMVD) (LCPM) SYSTEM PROTOTYPE

COST CELL EXPLANATIONS

1.0 DEVELOPMENT

1.02 *Documentation/Data:* The estimated effort for documentation is 1 man-month each for a GS-9 lead programmer and two GS-7 programmers plus 50 percent of a man-month for a GS-12 field project manager. All GS personnel are estimated at Step 5, with overhead and fringe benefit costs estimated at 65 percent of base salary at FY90 pay scales.

1.04 *System/Project Management:* The estimated effort is 1 man-month for a GS-12 supervisor.

1.07 *Other Development Costs:* None.

2.0 PRODUCTION

2.013 *Personal (Micro) Computers (PCs):* The LCPM system is not charged with the cost of PCs for project managers since multiple applications will take place on these PCs. The LCPM system will be one of the major, but not the only, application on the networked system. Therefore, 50 percent usage of each of the file servers is charged. Two file servers are required in the LMVD prototype configuration at a cost of $10,000 each.

2.014 *Communications Equipment:* This cost is calculated as 50 percent of the cost of network boards for each PC on a network (50 percent of $300 each).

2.022 *Application Software:* The cost of commercial project management software (Open Plan) at $3,000 per PC using the system. Added to this commercial software cost is the cost of customization. For LMVD, this cost is reflected in the actual contract cost for customization ($105,000).

2.023 *Communications Software:* Network communications software at a cost of $5,000.

2.04 *Documentation/Data:* The estimated effort is 1 man-month for each of the two GS-7 programmers and 50 percent for one project manager (GS-12).

2.06 *Training Services and Equipment:* The estimated effort is 3 man-days for each GS-12 user on the system and 3 man-days' effort of two GS-9 trainers.

4.0 FIELDING

4.05 *Site Activation:* The estimated effort is 2 man-days each for a GS-12 supervisor and GS-9 lead programmer, times the number of sites for loading software and systems testing. Conversion and data loading will require 3 man-months by a GS-7.

4.06 *Documentation/Data:* This is only the cost for reproduction of the user's guides for customized portions of the system. The preparation of all other documentation is included in the cost of production of the application software. For LMVD, documentation is assumed to be 100 pages at $.05 per page, times the number of users, plus five extra copies.

5.0 SUSTAINMENT/OPERATIONS AND MAINTENANCE

All recurring sustainment/operations and maintenance costs are accumulated for 10 years (the system's planned life cycle) and are given in FY90 dollars.

5.03 *Documentation/Data:* Only the costs of reproduction of customized portions of the system are included here. Man-days to revise the documentation are included in the applications software portion of sustainment costs (Item 5.0422). The 100-page manuals will be completely updated every other year, and 25 pages will be revised every year, at $.05 per page, times the number of users, plus five extra copies.

5.041 *Hardware:* The estimated cost is 50 percent of the cost for replacement of PC file servers on a network once during the 10-year life cycle.

5.0422 *Applications Software:* This cost is estimated as the total effort of programmers to maintain the system to make program modifications and upgrades. For LMVD, we estimate one full-time GS-9 programmer will be needed to maintain the customized portions. An addition is the cost of upgrades to the project management software. The project management software will be upgraded twice during the 10-year life cycle.

5.07 *Replacement Training:* This cost includes 3 man-days of yearly training for two GS-12 field project managers from each district.

5.08 *System/Project Management:* This cost is estimated as 25 percent of annual man-days for a GS-12 supervisor per year.

MOBILE DISTRICT
LCPM PROTOTYPE

06-Jul 02:57 PM

U.S. ARMY CORPS OF ENGINEERS

LIFE-CYCLE PROJECT MANAGEMENT
COST ESTIMATES

NORMALIZED DISTRICT COSTS

1990 dollars INPUTS	MOBILE
Supervisor, GS-12	$67,253
Lead Prog., GS-9	$46,377
Progmmrs., GS-9	$46,377
Progmmrs., GS-7	$37,912
Field PM, GS-12	$67,253
Avg. Trvl. & Per Diem	$519
PC File Server	$40,000
# of File Servers	5
PM applic. soft.	$8,000
Add. costs/user	$1,500
Commun. Soft.	$15,000
Network PC boards	$900
# PCs on network	75
# of Copies	75
# of PM users	75

MAISRC COST CELL	iSMP LIFE-CYCLE COST	MOBILE
1.0	Development	
1.02	Documentation/Data	$12,986
1.04	System/Project Mgt.	$4,676
1.07	Other Dev. Costs	$40,000
2.0	Production	
2.013	PCs (micros)	$40,000
2.014	Communications Equip.	$7,500
2.022	Application Software	$235,787
2.023	Communications Soft.	$5,000
2.04	Documentation/Data	$4,676
2.06	Training Serv. & Equip.	$26,611
	SUNK COSTS:	$309,736
4.0	Fielding	
4.05	Site Activation	$12,398
4.06	Doc./Data (paper)	$150
5.0	Sustainment/Operations and Maint.	
5.03	Doc./Data (paper)	$613
5.041	Hardware	$20,000
5.0422	Applications Softare	$463,766
5.07	Replacement Tng.	$104,243
5.08	System/Project Mgt.	$168,134
	5.0 SUBTOTAL:	$756,755
	TOTAL:	$1,079,039

MOBILE DISTRICT
LCPM PROTOTYPE

COST CELL EXPLANATIONS

1.0 DEVELOPMENT

1.02 *Documentation/Data:* The estimated effort for documentation is 1 man-month each for a GS-9 lead programmer and two GS-7 programmers plus 50 percent of a man-month for a GS-12 field project manager. All GS personnel are estimated at Step 5, with overhead and fringe benefit costs estimated at 65 percent of base salary at FY90 pay scales.

1.04 *System/Project Management:* The estimated effort is 1 man-month for a GS-11 supervisor.

1.07 *Other Development Costs:* None.

2.0 PRODUCTION

2.013 *Computer Hardware:* The Mobile LCPM system is charged with the allocated cost of running multiple applications. The LCPM system will be one of the major, but not the only, application on the networked system (Sperry 5000/95). The total allocated cost is estimated at $20,000.

2.014 *Communications Equipment:* None:

2.022 *Application Software:* The cost of commercial project management software (network version) at $4,000 per user, times the number of users. Added to this cost is the cost of customization. For Mobile, these costs are actual costs for a GS-12 supervisor and two GS-9 programmers to develop INFORMIX-SQL programs and a project management database.

2.023 *Communications Software:* Network communications software is estimated at a cost of $5,000.

2.04 *Documentation/Data:* The estimated effort is 1 man-month for a GS-11.

2.06 *Training Services and Equipment:* The estimated effort is 3 man-days for each GS-12 user on the system and 3 man-days' effort for two GS-9 trainers.

4.0 FIELDING

4.05 *Site Activation:* The estimated effort is 2 man-days each for a GS-11 supervisor and GS-9 lead programmer loading software and testing. Conversion and data loading will require 3 man-months by a GS-7.

4.06 *Documentation/Data:* This is only the cost for reproduction of the user's guides for customized portions of the system. The preparation of all other documentation is included in the cost of production of the application software. For Mobile, documentation is assumed to be 100 pages at $.05 per page, times the number of users, plus five extra copies.

5.0 SUSTAINMENT/OPERATIONS AND MAINTENANCE

All recurring sustainment/operations and maintenance costs are accumulated for 10 years (the system's planned life cycle) and are given in FY90 dollars.

5.03 *Documentation/Data:* Only the costs of reproduction of customized portions of the system are included here. Man-days to revise the documentation are included in the applications software portion of sustainment costs (Item 5.0422). The 100-page manuals will be completely updated every other year, and 25 pages will be revised every year, at $.05 per page times the number of users, plus five extra copies.

5.041 *Hardware:* The estimated cost is 50 percent of the cost for replacement of hardware on the network once during the 10-year life cycle.

5.0422 *Applications Software:* This cost is estimated as the total effort of programmers to maintain the system to make program modifications and upgrades. For Mobile, we estimate one full-time GS-7 programmer will be needed to maintain the customized portions. An addition is the cost of upgrades to the project management software. The project management software will be upgraded twice during the 10-year life cycle.

5.07 *Replacement Training:* This cost includes 3 man-days of yearly training for two GS-12 field project managers per district.

5.08 *System/Project Management:* This cost is estimated as 25 percent of annual man-days for a GS-12 supervisor per year.

SACRAMENTO DISTRICT
LCPM PROTOTYPE

06-Jul 02:57 PM

U.S. ARMY CORPS OF ENGINEERS

LIFE-CYCLE PROJECT MANAGEMENT
COST ESTIMATES

NORMALIZED DISTRICT COSTS

1990 dollars

INPUTS	SACRAMENTO
Supervisor, GS-12	$67,253
Lead Prog., GS-9	$46,377
Progmmrs., GS-9	$46,377
Progmmrs., GS-7	$37,912
Field PM, GS-12	$67,253
Avg. Trvl. & Per Diem	$173
PC File Server	$10,000
# of File Servers	2
PM applic. soft.	$2,000
Add. costs/user	$500
Commun. Soft.	$5,000
Network PC boards	$300
# PCs on network	25
# of Copies	25
# of PM users	25

MAISRC COST CELL	ISMP LIFE-CYCLE COST	SACRAMENTO
1.0	Development	
1.02	Documentation/Data	$19,795
1.04	System/Project Mgt.	$5,604
1.07	Other Dev. Costs	$20,000
2.0	Production	
2.013	PCs (micros)	$10,000
2.014	Communications Equip.	$3,750
2.022	Application Software	$164,392
2.023	Communications Soft.	$5,000
2.04	Documentation/Data	$18,732
2.06	Training Serv. & Equip.	$26,611
	SUNK COSTS:	$273,885
4.0	Fielding	
4.05	Site Activation	$12,510
4.06	Doc./Data (paper)	$150
5.0	Sustainment/Operations and Maint.	
5.03	Doc./Data (paper)	$613
5.041	Hardware	$10,000
5.0422	Applications Softare	$845,649
5.07	Replacement Trng.	$104,243
5.08	System/Project Mgt.	$168,134
	5.0 SUBTOTAL:	$1,128,638
	TOTAL:	$1,415,183

SACRAMENTO DISTRICT
LCPM PROTOTYPE

COST CELL EXPLANATIONS

1.0 DEVELOPMENT

1.02 *Documentation/Data:* The estimated effort is 1 man-month each for a GS-15 supervisor, a GS-12 lead programmer and two GS-9 programmers plus 50 percent of a man-month for a GS-12 field project manager. All GS personnel are estimated at Step 5, with overhead and fringe benefit costs estimated at 65 percent of base salary at FY90 pay scales.

1.04 *System/Project Management:* The estimated effort is 1 man-month for a GS-12 supervisor.

1.07 *Other Development Costs:* These costs ($20,000) are those for a consultant contract to evaluate commercial project management software.

2.0 PRODUCTION

2.013 *Personal (Micro) Computers (PCs):* The LCPM system is not charged with the cost of PCs for project managers since multiple applications will take place on these PCs. The LCPM system will be one of the major, but not the only, application on the networked system. Therefore, 50 percent usage of each of the file servers for the network is charged. Two file servers are required for the Sacramento prototype configuration at a cost of $10,000 each.

2.014 *Communications Equipment:* This cost is calculated as 50 percent of the cost of network boards for each PC on the network (50 percent of $300 each). Cabling costs for Sacramento were part of the building construction cost (pre-existing costs are not borne by LCPM).

2.022 *Application Software:* The cost of commercial project management software (network version) estimated at $2,000 per PC file server using DB_Vista III. Added to this commercial software is the cost of customization. For Sacramento, 10 man-months of the GS-12 senior programmer plus 9 man-months for two GS-9 programmers, to develop custom C programs.

2.023 *Communications Software:* This estimate is for network communications software at a cost of $5,000.

2.04 *Documentation/Data:* The estimated effort is 1 man-month for each, A 6515, 12 and 9.

2.06 *Training Services and Equipment:* The estimated effort is 3 man-days for each GS-12 user on the system and 3 man-days' effort of two GS-9 trainers.

4.0 **FIELDING**

4.05 *Site Activation:* The estimated effort is 2 man-days each for a GS-12 supervisor and GS-9 lead programmer, times the number of sites for loading software and testing the file servers. Sacramento has two PC network file servers, both at the Sacramento District Office and the cabling is part of the new building's wiring. This site is counted as one site for Sacramento. Conversion and data loading will require 3 man-months by a GS-7.

4.06 *Documentation/Data:* This is only the cost for reproduction of the user's guides for customized portions of the system. The preparation of all other documentation is included in the cost of production of the application software. For Sacramento, documentation is assumed to be 100 pages at $.05 per page, times the number of users, plus five extra copies.

5.0 **SUSTAINMENT/OPERATIONS AND MAINTENANCE**

All recurring sustainment/operations and maintenance costs are accumulated for 10 years (the system's planned life cycle) and are given in FY90 dollars.

5.03 *Documentation/Data:* Only the costs of reproduction of customized portions of the system are included here. Man-days to revise the documentation are included in the applications software portion of sustainment costs (Item 5.0422). The 100-page manuals will be completely updated every other year, and 25 pages will be revised every year, at $.05 per page, times the number of users, plus five extra copies.

5.041 *Hardware:* The estimated cost is 50 percent of the cost for replacement of PC file servers on the network once during the 10-year life cycle.

5.0422 *Applications Software:* This cost is estimated as the total effort of programmers to maintain the system to make program modifications and upgrades. For Sacramento, we estimate one-half time will be needed for a GS-9 lead programmer and one full-time

GS-7 programmer to maintain the customized portions. An addition is the cost of upgrades to the project management software. The project management software will be upgraded twice during the 10-year life cycle.

5.07 *Replacement Training:* This cost includes 3 man-days of yearly training for two GS-12 field project managers (for each district).

5.08 *System/Project Management:* This cost is estimated as 25 percent of annual man-days for a GS-12 supervisor per year.

CHICAGO DISTRICT WITH WATERWAYS EXPERIMENT STATION (WES) LCPM REPORTING SYSTEM (LRS) COMBINED LCPM SYSTEM PROTOTYPE

06-Jul 02:57 PM

U.S. ARMY CORPS OF ENGINEERS

LIFE-CYCLE PROJECT MANAGEMENT COST ESTIMATES

NORMALIZED DISTRICT COSTS

1990 dollars INPUTS	NCD/WES
Supervisor, GS-12	$67,253
Lead Prog., GS-9	$46,377
Progmmrs., GS-9	$46,377
Progmmrs., GS-7	$37,912
Field PM, GS-12	$67,253
Avg. Trvl. & Per Diem	$173
PC File Server	$10,000
# of File Servers	2
PM applic. soft.	$3,000
Add. costs/user	$500
Commun. Soft.	$5,000
Network PC boards	$300
# PCs on network	25
# of Copies	25
# of PM users	25

MAISRC COST CELL	ISMP LIFE-CYCLE COST	NCD/WES
1.0	Development	
1.02	Documentation/Data	$15,583
1.04	System/Project Mgt.	$12,547
1.07	Other Dev. Costs	$0
2.0	Production	
2.013	PCs (micros)	$10,000
2.014	Communications Equip.	$3,750
2.022	Application Software	$243,919
2.023	Communications Soft.	$5,000
2.04	Documentation/Data	$11,791
2.06	Training Serv. & Equip.	$31,934
	SUNK COSTS:	$334,524
4.0	Fielding	
4.05	Site Activation	$12,510
4.06	Doc./Data (paper)	$180
5.0	Sustainment/Operations and Maint.	
5.03	Doc./Data (paper)	$849
5.041	Hardware	$10,000
5.0422	Applications Softare	$674,896
5.07	Replacement Tng.	$125,091
5.08	System/Project Mgt.	$201,760
	5.0 SUBTOTAL:	$1,012,597
	TOTAL:	$1,359,811

CHICAGO DISTRICT WITH WATERWAYS EXPERIMENT STATION (WES) LCPM REPORTING SYSTEM (LRS) COMBINED LCPM SYSTEM PROTOTYPE

COST CELL EXPLANATIONS

This cost scenario combines the Chicago District LCPM prototype with the WES LRS. All cost cells are the combined total of configuring the two systems together with the following exceptions:

1.0 **DEVELOPMENT**

1.02 *Documentation/Data:* The estimated effort is 1 man-month each for a GS-9 lead programmer and two GS-7 programmers plus 50 percent of a man-month for a GS-12 field project manager. All GS personnel are estimated at Step 5, with overhead and fringe benefit costs estimated at 65 percent of base salary at FY90 pay scales. The total cost is adjusted upward by 20 percent to account for separate teams.

2.0 **PRODUCTION**

2.04 *Documentation/Data:* The estimated effort is 1 man-month for each of the two GS-9 programmers and 50 percent effort for one GS-12 project manager, the total cost is increased by 20 percent to account for separate teams.

2.06 *Training Services and Equipment:* The estimated effort is 3 man-days for each user on the system. The total cost is increased by 20 percent to account for the additional training required over a single integrated system.

5.0 **SUSTAINMENT/OPERATIONS AND MAINTENANCE**

5.03 *Documentation/Data:* Only the costs of reproduction of customized portions of the system are included here. Man-days to revise the documentation are included in the applications software portion of sustainment costs (Item 5.0422). The 100-page manuals will be completely updated every other year, and 25 pages will be revised every year, at $.05 per page times the number of users plus five extra copies. The total cost is adjusted upward by 20 percent to account for the additional documentation required over a single integrated system.

5.07 *Replacement Training:* The cost includes an average of 1 day of training per year, plus average travel and per diem costs, times the number of users on the system. The total cost is increased by 20 percent to account for additional training required over a single integrated system.

5.08 *System/Project Management:* This cost is estimated as 25 percent effort of a GS-12 supervisor per year.

CHICAGO DISTRICT
LCPM PROTOTYPE

COST CELL EXPLANATIONS

1.0 DEVELOPMENT

1.02 *Documentation/Data:* The estimated effort for documentation is 2 man-months for an O-4 and 1 man-month for a field project manager. All GS and military personnel are estimated at Step 5, or average in-grade rate, with overhead and fringe benefit costs estimated at 65 percent of base salary at FY90 pay scales.

1.04 *System/Project Management:* The estimated effort is 1 man-month for a GS-12 supervisor.

1.07 *Other Development Costs:* None.

2.0 PRODUCTION

2.013 *Personal (Micro) Computers (PCs):* The LCPM system is not charged with the cost of PCs for project managers since multiple applications take place on these PCs. The LCPM system will be a major, but not the only, application on the networked system. Therefore, 50 percent usage of each of the file servers for the network is charged. Two file servers are required for the Chicago prototype configuration installed at an average district at a cost of $10,000 each.

2.014 *Communications Equipment:* This cost is calculated as 50 percent of the cost of network boards for each PC on the network (50 percent of $300 each).

2.022 *Application Software:* The cost of commercial project management software (Open Plan) at $3,000 per PC using the system. Added to this commercial software cost is the cost of programming effort. For Chicago, this is 2 man-years of effort for an O-4 project supervisor/programmer, less the estimated effort captured in development.

2.023 *Communications Software:* Network communications software at a cost of $5,000.

2.04 *Documentation/Data:* The estimated effort is 2 man-months for a GS-7 programmer and 1/2 man-month for a project manager GS-12.

2.06 *Training Services and Equipment:* The estimated effort is 3 man-days for each GS-12 user on the system and 3 man-days effort of two GS-9 trainers.

4.0 FIELDING

4.05 *Site Activation:* The estimated effort is 2 man-days each for a GS-12 supervisor and GS-9 lead programmer, times the number of sites for loading software and testing the file servers. Conversion and data loading will require 3 man-months by a GS-7.

4.06 *Documentation/Data:* This is only the cost for reproduction of the user's guides for customized portions of the system. The preparation of all other documentation is included in the cost of production of the application software. For Chicago, documentation is assumed to be 100 pages at $.05 per page, times the number of users, plus five extra copies.

5.0 SUSTAINMENT/OPERATIONS AND MAINTENANCE

All recurring sustainment/operations and maintenance costs are accumulated for 10 years (the system's planned life cycle) and are given in FY90 dollars.

5.03 *Documentation/Data:* Only the costs of reproduction of customized portions of the system are included here. Man-days to revise the documentation are included in the applications software portion of sustainment costs (Item 5.0422). The 100-page manuals will be completely updated every other year, and 25 pages will be revised every year at $.05 per page, times the number of users, plus five extra copies.

5.041 *Hardware:* The estimated cost is 50 percent of the cost for replacement of PC file servers on the network once during the 10-year life cycle.

5.0422 *Applications Software:* This cost is estimated as the total effort of programmers to maintain the system to make program modifications and upgrades. For Chicago, we estimate it will require one-half time for a GS-9 lead programmer and one full-time GS-7 programmer to maintain the system portions. An addition is the cost of upgrades to the project management software. The project management software will be upgraded twice during the 10-year life cycle.

5.07 *Replacement Training:* This cost includes 3 man-days of yearly training for two GS-12 field project managers from each district. Training is performed by two GS-9 trainers.

5.08 *System/Project Management:* This cost is estimated as 25 percent of annual man-days for a GS-12 supervisor per year.

WATERWAYS EXPERIMENT STATION (WES)
LCPM REPORTING SYSTEM (LRS) PROTOTYPE

COST CELL EXPLANATIONS

1.0 **DEVELOPMENT**

1.02 *Documentation/Data:* The estimated effort for documentation is 1 man-month each for a GS-9 lead programmer and two GS-7 programmers plus 50 percent of a man-month for a GS-12 field project manager. All GS personnel are estimated at Step 5, with overhead and fringe benefit costs estimated at 65 percent of base salary at FY90 pay scales.

1.04 *System/Project Management:* The estimated effort is 1 man-month for a GS-12 supervisor.

1.07 *Other Development Costs:* None.

2.0 **PRODUCTION**

2.013 *Personal (Micro) Computers (PCs):* The LCPM system is not charged with the cost of PCs or hardware. This cost is included in the system/project management system estimates and not included as a separate cost for LRS.

2.014 *Communications Equipment:* This cost is included in the project management (PM) system estimates and not included as a separate cost for LRS.

2.022 *Application Software:* The estimated cost is based on actual manpower charges adjusted to include benefits and overhead costs.

2.023 *Communications Software:* The cost is included in the PM system estimates and not included as a separate cost for LRS.

2.04 *Documentation/Data:* This cost is included in the application software cost.

2.06 *Training Services and Equipment:* The estimated effort is 1 man-day for each GS-12 user on the system and 1 man-day effort of two GS-9 trainers.

4.0 FIELDING

4.05 *Site Activation:* The estimated effort is 2 man-days each for a GS-12 supervisor and GS-9 lead programmer, times the number of sites for loading software and testing. Conversion and data loading will require 3 man-months by a GS-7.

4.06 *Documentation/Data:* This is only the cost for reproduction of the user's guides for the LRS. For LRS, documentation is assumed to be 100 pages at $.05 per page, times the number of users, plus five extra copies.

5.0 SUSTAINMENT/OPERATIONS AND MAINTENANCE

All recurring sustainment/operations and maintenance costs are accumulated for 10 years (the system's planned life cycle) and are given in FY90 dollars.

5.03 *Documentation/Data:* Only the costs of reproduction of customized portions of the system are included here. Man-days to revise the documentation are included in the applications software portion of sustainment costs (Item 5.0422). The 100-page manuals will be completely updated every other year, and 25 pages will be revised every year, at $.05 per page, times the number of users, plus five extra copies.

5.041 *Hardware:* No hardware costs are associated with LRS.

5.0422 *Applications Software:* This cost is estimated as the total effort of programmers to maintain the system at the district level and does not include costs for headquarters or WES oversight or central maintenance. Such costs are captured in the scenario analysis costs estimates. District effort is estimated at 10 GS-9 programmer man-days per year.

5.07 *Replacement Training:* This cost is not included for LRS. It is included in the PM system costs.

5.08 *System/Project Management:* The estimated cost is based on 5 man-days of a GS-12 supervisor per year at the district level.

HEADQUARTERS LCPM DATABASE

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U.S. ARMY CORPS OF ENGINEERS

LIFE-CYCLE PROJECT MANAGEMENT
COST ESTIMATES

NORMALIZED DISTRICT COSTS

1990 dollars INPUTS	HQUSACE DATA BASE
GS-13	$79,974
GS-14	$94,504
GS-15	$111,159
Progmmrs., GS-7	$37,912
Field PM, GS-12	$67,253
Avg. Trvl. & Per Diem	$173
PC File Server	$40,000
# of File Servers	5
PM applic. soft.	$8,000
Add. costs/user	$1,500
Commun. Soft.	$15,000
Network PC boards	$900
# PCs on network	75
# of Copies	75
# of PM users	75

MAISRC COST CELL	ISMP LIFE-CYCLE COST	HQUSACE DATA BASE
1.0	Development	
1.02	Documentation/Data	$0
1.04	System/Project Mgt.	$104,433
1.07	Other Dev. Costs	$50,000
2.0	Production	
2.013	PCs (micros)	$0
2.014	Communications Equip.	$0
2.022	Application Software	$100,000
2.023	Communications Soft.	$0
2.04	Documentation/Data	$0
2.06	Training Serv. & Equip.	$19,272
	SUNK COSTS:	$273,705
4.0	Fielding	
4.05	Site Activation	$39,987
4.06	Doc./Data (paper)	$1,625
5.0	Sustainment/Operations and Maint.	
5.03	Doc./Data (paper)	$79,974
5.041	Hardware	$0
5.0422	Applications Softare	$863,637
5.07	Replacement Tng.	$270,618
5.08	System/Project Mgt.	$102,831
	5.0 SUBTOTAL:	$1,317,061
	TOTAL:	$1,632,378

HEADQUARTERS LCPM DATABASE

COST CELL EXPLANATIONS

1.0 DEVELOPMENT

1.02 *Documentation/Data:* These costs are included in system/project management costs (Item 1.04).

1.04 *System/Project Management:* The estimated in-house effort is one GS-13 for 1 man-year, one GS-14 at 20 percent of 1 man-year, and one GS-15 at 5 percent of 1 man-year.

1.07 *Other Development Costs:* Actual costs in this category are for contractor and programming support.

2.0 PRODUCTION

2.013 *Personal (Micro) Computers (PCs):* Costs in this category are not included but are assumed to be captured in Corps of Engineers Automation Plan (CEAP) cost estimates.

2.014 *Communications Equipment:* Costs in this category are not included but are assumed to be captured in CEAP cost estimates.

2.022 *Application Software:* The estimated cost is $100,000 for an application software production contract.

2.023 *Communications Software:* Costs in this category are not included but are assumed to be captured in CEAP cost estimates.

2.04 *Documentation/Data:* These costs are included in the cost estimates for application software (Item 2.022).

2.06 *Training Services and Equipment:* The estimated effort is three GS-12s at HQ level for 2 weeks' training, in addition to 40 people from the districts (GS-12) for 1 day.

4.0 FIELDING

4.05 *Site Activation:* The estimated effort is one GS-12 for 2 days at each district and 20 days' effort at HQ.

4.06 *Documentation/Data:* This is only the cost for reproduction of the user's guides for customized portions of the system. The preparation of all other documentation is included in the cost of production of the

application software. Documentation is estimated for five 50-page user manuals and two 200-page technical manuals for each district and 20 technical manuals and 50 user manuals at HQ.

5.0 SUSTAINMENT/OPERATIONS AND MAINTENANCE

All recurring sustainment/operations and maintenance costs are accumulated for 10 years (the system's planned life cycle) and are given in FY90 dollars.

5.03 *Documentation/Data:* Only the costs of reproduction of customized portions of the system are included here. Man-days to revise the documentation are included in the applications software portion of sustainment costs (Item 5.0422). It is assumed that the documentation will require 10 percent replacement each year, with two 50 percent replacements over the rest of the life cycle.

5.041 *Hardware:* Costs in this category are not included but are assumed to be captured in the CEAP cost estimates.

5.0422 *Applications Software:* This cost is estimated as the total effort of programmers to maintain the system to make program modifications and upgrades. It is estimated it will require 50 percent of a GS-13 lead programmer's time and one full-time GS-9 programmer to maintain the system. (No full upgrade costs are assumed here.)

5.07 *Replacement Training:* This cost includes an average of 3 man-days of training per year at a division site for two GS-12 field project managers from each district. Training is performed by two GS-9 trainers. This includes travel and average per diem costs.

5.08 *System/Project Management:* The estimated cost is for one GS-14 and one GS-15 at 5 percent effort per year at HQ.

DISTRICT COMMAND LCPM DATABASE

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U.S. ARMY CORPS OF ENGINEERS

LIFE-CYCLE PROJECT MANAGEMENT
COST ESTIMATES

NORMALIZED DISTRICT COSTS

	1990 dollars INPUTS	DISTRICT COMND. DB.
	GS-13	$79,974
	GS-14	$94,504
	GS-15	$111,159
	Progmmrs., GS-7	$37,912
	Field PM, GS-12	$67,253
	Avg. Trvl. & Per Diem	$173
	PC File Server	
	# of File Servers	
	PM applic. soft.	$8,000
	Add. costs/user	$1,500
	Commun. Soft.	$15,000
	Network PC boards	$900
	# PCs on network	40
	# of Copies	40
	# of PM users	40

MAISRC COST CELL		ISMP LIFE-CYCLE COST	DISTRICT COMND. DB.
1.0	Development		
1.02	Documentation/Data		
1.04	System/Project Mgt.		$178,849
1.07	Other Dev. Costs		$194,250
2.0	Production		
2.013	PCs (micros)		
2.014	Communications Equip.		
2.022	Application Software		$187,500
2.023	Communications Soft.		
2.04	Documentation/Data		
2.06	Training Serv. & Equip.		$47,272
	SUNK COSTS:		$607,871
4.0	Fielding		
4.05	Site Activation		$39,987
4.06	Doc./Data (paper)		$1,625
5.0	Sustainment/Operations and Maint.		
5.03	Doc./Data (paper)		$79,974
5.041	Hardware		$0
5.0422	Applications Softare		$1,788,491
5.07	Replacement Tng.		$270,618
5.08	System/Project Mgt.		$111,159
	5.0 SUBTOTAL:		$2,250,242
	TOTAL:		$2,899,725

DISTRICT COMMAND LCPM DATABASE

COST CELL EXPLANATIONS

1.0 **DEVELOPMENT**

1.02 *Documentation/Data:* The estimated cost is included in system/ project management costs, below.

1.04 *System/Project Management:* The estimated effort is one GS-13 for 1 man-year of effort, one GS-14 at 20 percent of 1 man-year. and one GS-15 at 5 percent of 1 man-year.

1.07 *Other Development Costs:* The estimated costs in this category are for contractor and programming support.

2.0 **PRODUCTION**

2.013 *Personal (Micro) Computers (PCs):* Costs in this category are not included but are assumed to be captured in CEAP cost estimates.

2.014 *Communications Equipment:* Costs in this category are not included but are assumed to be captured in CEAP cost estimates.

2.022 *Application Software:* The estimated cost is $250,000 for an application software production contract.

2.023 *Communications Software:* Costs in this category are not included but are assumed to be captured in CEAP cost estimates.

2.04 *Documentation/Data:* These costs are included in the cost estimates for application software (Item 2.022).

2.06 *Training Services and Equipment:* The estimated effort is 3 man-days for each GS-12 user on the system (40 users) in addition to average travel and per diem during training.

4.0 **FIELDING**

4.05 *Site Activation:* The estimated effort is one GS-12 for 1 man-day at each district with 20 man-days of effort at HQ.

4.06 *Documentation/Data:* This is only the cost for reproduction of the user's guides for customized portions of the system. The preparation of all other documentation is included in the cost of production of the application software. Documentation is estimated for five 50-page

user's manuals for each district in addition to two 200-page technical manuals with 20 technical manuals and 50 user manuals at HQ.

5.0 SUSTAINMENT/OPERATIONS AND MAINTENANCE

All recurring sustainment/operations and maintenance costs are accumulated for 10 years (the system's planned life cycle) and are given in FY90 dollars.

5.03 *Documentation/Data:* Only the costs of reproduction of customized portions of the system are included here. Man-days to revise the documentation are included in the applications software portion of sustainment costs (Item 5.0422). It is assumed that the documentation will require 10 percent replacement each year, with two 50 percent replacements over the rest of the life cycle.

5.041 *Hardware:* Costs in this category are not included but are assumed to be captured in the CEAP cost estimates.

5.0422 *Applications Software:* This cost is estimated as the total effort of programmers to maintain the system to make program modifications and upgrades. It is estimated it will require one GS-14 supervisor at 20 percent effort and two full-time GS-13 programmers to maintain the system over the life cycle.

5.07 *Replacement Training:* This cost includes an average of 3 man-days of training per year for two GS-12 field project managers from each district. Training is performed by two GS-9 trainers. This includes travel and average per diem costs.

5.08 *System/Project Management:* The estimated cost is for one GS-14 and one GS-15 at 5 percent effort per year at HQ.

APPENDIX C

MAISRC INFORMATION SYSTEM COST STRUCTURE AND BUDGET ELEMENTS

MAISRC INFORMATION SYSTEM COST STRUCTURE AND BUDGET ELEMENTS

MAISRC COST CELL	TITLE
1.0	Development/CONCEP DESIGN
1.01	Dev Eng, Acq & Mod
1.011	Hardware
1.012	Software
1.02	Documentation
1.03	System Integr & Test
1.04	System/Project Mgt
1.05	Trng Serv & Equip
1.06	Facilities
1.07	Other Dev Costs
2.0	Production/APPL DEV
2.01	Hardware
2.011	Central Process Unit
2.012	Peripheral Devices
2.013	PCs
2.02	Software
2.021	Operating Software
2.022	Application Software
2.03	Engineering Changes
2.04	Documentation/Data
2.05	Sys Integ/Test & Eval
2.06	Trng Serv & Equip
2.07	Initial Spares
2.08	Other Prod Costs
3.0	Military Contruction
4.0	Fielding/DEPLOYMENT
4.01	System Test & Eval
4.02	Trng Serv & Equip
4.03	Transportation
4.04	Init Repairs & Consum
4.041	Intial Repair Parts
4.042	Init Supplies/Consum
4.05	Site Activation
4.06	Documentation/Data
4.07	Other Fielding Costs

MAISRC COST CELL	TITLE
5.0	Sustainment/O&M
5.01	Replenishment
5.011	Replen Repair Parts
5.012	Replen Spares
5.013	Replen Supplies/Consum
5.014	War Reserve Spares
5.015	War Res Repair Parts
5.02	POL Utilities
5.021	POL
5.022	Utilities
5.03	Documentation/Data
5.04	Central Maint & Rep
5.041	Cent Maint & Rep HW
5.042	Cent Maint & Rep SW
5.05	Field Op & Maint
5.051	Field Op & Maint HW
5.052	Field Op & Maint SW
5.06	Transportation
5.07	Repl Training
5.08	System/Project Mgt
5.09	Facilities Mod
5.10	Leases
5.11	Other Sustainment

REPORT DOCUMENTATION PAGE

Form Approved
OMB No 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	August 1990	Final

4. TITLE AND SUBTITLE
The Cost of Information Systems Modernization: A Comparison of Options for Life-Cycle Project Management Systems

5. FUNDING NUMBERS
Contract
MDA903-90-C-0006

6. AUTHOR(S)
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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Logistics Management Institute
6400 Goldsboro Rd.,
Bethesda, MD 20817-5886

8. PERFORMING ORGANIZATION REPORT NUMBER
CE002R1

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Director of Information Management
U.S. Army Corps of Engineers
Rm. 5116, Pulaski Building
Washington, DC 20314

10. SPONSORING/MONITORING AGENCY REPORT NUMBER
N/A

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
A

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

The U.S. Army Corps of Engineers (USACE) has undertaken a systems modernization program that will govern its information management for the next decade. One of the major systems being developed under this plan is the Life-Cycle Project Management (LCPM) system.

We found that the current LCPM prototypes not only differ significantly in design and configuration but also in the functions they perform and their flexibility for further modification and enhancement. The costs associated with the options for Corps-wide implementation of LCPM at multiple sites vary widely – ranging from $12 million for a centralized system to $49 million for a totally decentralized system.

Under current plans, a relatively expensive decentralized system will likely be implemented. We identify implementation options that can meet LCPM needs at significantly lower cost.

We also recommend that USACE minimize the number of prototypes to be continued, recommend selection of an LCPM system that is built around existing commercial project management software, and centralize systems management and maintenance.

14. SUBJECT TERMS	15. NUMBER OF PAGES
Life-Cycle Project Management, Project Management Systems, Corps of Engineers Information Systems; ISMP, LCPM	94
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLAS	UNCLAS	UNCLAS	UL