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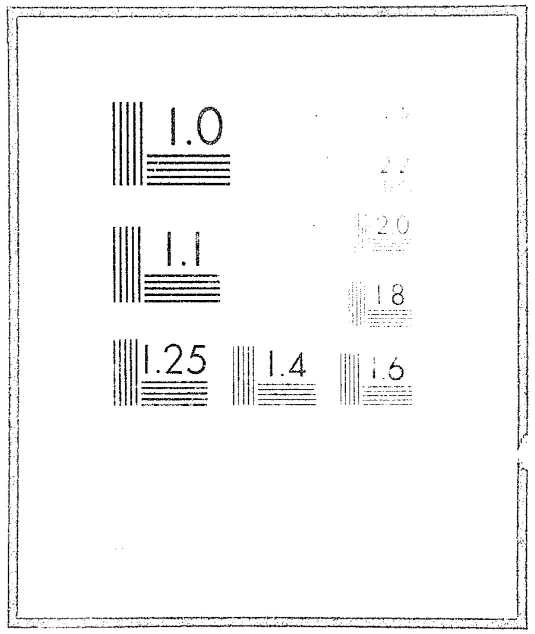

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Supplement to
TECHNICAL REPORT NO. 11

CLIS
CRIMINALISTICS LABORATORY INFORMATION SYSTEM

VOLUME 4
IMPLEMENTATION PLAN

SEARCH GROUP Inc.
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SGI 1620 35th AVENUE / SUITE 200 / SACRAMENTO, CALIFORNIA 95822 / (916) 392-2550

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Supplement to
TECHNICAL REPORT NO. 11
MAY 1975

CLIS
CRIMINALISTICS LABORATORY INFORMATION SYSTEM

VOLUME 4
IMPLEMENTATION PLAN

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PREFACE

The model for a criminalistics laboratory information system described in this report was developed by Project SEARCH (now SEARCH Group, Inc.) as part of its ongoing program of facilitating the application of advanced technology to the administration of criminal justice. The project, funded by the Law Enforcement Assistance Administration, addressed itself to three topics:

- definition of the information needs of criminalistics laboratories throughout the nation
- conceptual design of an automated information storage and retrieval system
- creation of a plan for implementing the system

Future efforts will include the detailed design, implementation, and evaluation of a pilot system and, eventually, full system implementation.

SEARCH Group, Inc. (Project SEARCH) is a private, non-profit justice research organization owned and operated by the fifty states, the District of Columbia, Puerto Rico, and the Virgin Islands, which fosters research of greater magnitude than can normally be undertaken by individual states.

Thomas M. Muller served as CLIS Project Chairman and Fred Wynbrandt as Vice-Chairman. Subcommittee Chairmen were Edward Bigler, Richard Fox, and Frank Madrazo. Administrative staff services for the project were provided by the California Crime Technological Research Foundation; technical support was provided under contract by PRC Public Management Services, Inc.

Four volumes providing detailed information about specific aspects of the project are being published.

- Volume 1 — *Identification of User Needs*
- Volume 2 — *Systems Design For a Conceptual Model*
- Volume 3 — *System and Organizational Impact*
- Volume 4 — *Implementation Plan*

Copies of these volumes are available from SEARCH Group, Inc.

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GLOSSARY

DATA PROCESSING TERMS

baud Number of bits transmitted per second. (It usually requires eight bits to transmit one character.)

byte That portion of a computer word capable of containing a single character. Used synonymously with "character" in this report.

CPU Central processing unit. A computer without its data storage and other peripherals.

CRT Cathode ray tube.

hardwired Accomplished by electronics rather than programming.

I/O Input and output.

modem Device which connects a terminal or computer to a telephone line.

peripheral Device with which a computer stores data or communicates with the outside world, such as a disk drive, card reader, or teletypewriter.

INSTITUTIONAL ABBREVIATIONS

ASTM American Society for Testing and Materials (Philadelphia, Pennsylvania).

FCIC Florida Crime Information Center (Tallahassee, Florida).

HOCRE Home Office Central Research Establishment (Aldermaston, United Kingdom).

WRAIR Walter Reed Army Institute for Research (Washington, D.C.)

GEOGRAPHIC ABBREVIATIONS

NE = NEW ENGLAND
- Connecticut
- Maine
- Massachusetts
- New Hampshire
- Rhode Island
- Vermont

MA = MIDDLE ATLANTIC
- New Jersey
- New York
- Pennsylvania

ENC = EAST NORTH CENTRAL
- Illinois
- Indiana
- Michigan
- Ohio
- Wisconsin

WNC = WEST NORTH CENTRAL
- Iowa
- Kansas
- Minnesota
- Missouri
- Nebraska
- North Dakota
- South Dakota

SA = SOUTH ATLANTIC
- Delaware
- District of Columbia
- Florida
- Georgia
- Maryland
- North Carolina
- South Carolina
- Virginia
- West Virginia

ESC = EAST SOUTH CENTRAL
- Alabama
- Kentucky
- Mississippi
- Tennessee

WSC = WEST SOUTH CENTRAL
- Arkansas
- Louisiana
- Oklahoma
- Texas

M = MOUNTAIN
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- New Mexico
- Utah
- Wyoming

P = PACIFIC
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SECTION A
INTRODUCTION

CHAPTER 1. BACKGROUND AND OBJECTIVES

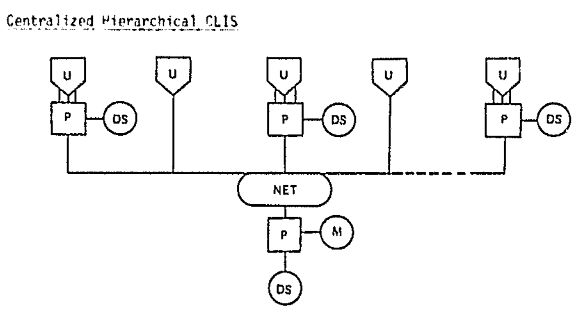
BACKGROUND

This document represents the fourth in a series of reports describing the activities, findings and recommendations of a total effort to conceptually design a Criminalistics Laboratory Information System. Earlier volumes discussed system requirements (Volume 1), conceptual design (Volume 2), equipment alternatives and organizational impact (Volume 3).

Requirements. CLIS requirements were analyzed in Volume 1 and were based on the return of laboratory information forms. A brief review of system priorities is presented in Chapter 3 of this document.

Conceptual Design. Volume 2 included a detailed discussion of conceptual design alternatives. A total of six basic design configurations were presented along with the principal advantages and disadvantages of each. Figure 1 shows the recommended configuration. This configuration is capable of more than adequately handling the processing functions shown in Figure 1.

Figure 1
CLIS Configuration



Centralized Hierarchial CLIS

This configuration is similar to the hierarchical CLIS, but it combines the advantages of a central-processor complex with those of local processing capability.

Advantages

- Flexibility.
- Centralized control.
- Easy coordination of file maintenance.
- Local processors can handle specialized non-CLIS data peculiar to each laboratory.
- Multiple terminal capability for high-volume users.
- Potential of acquiring/reducing data directly from instrument.
- Allows for distributed data bases.

Disadvantages

- Possible peak-period competition for system resources, resulting in response delays.
- Increased complexity results from communication between local and main processors.
- Potential increased cost of local processors and data storage.
- Local systems and programming support must be provided.

Both the network and system configurations were developed from the system requirements by application area (See Figure 2) which were also presented in Volume 2. Figure 3 shows proposed CLIS application areas.

Equipment Alternatives. Volume 3 presented a comprehensive discussion of the reasonable equipment alternatives which would satisfy the conceptual system requirements of CLIS. A comparative analysis of equipment required for each of three major network environments is reproduced here in Figure 4 to illustrate important cost considerations for the conceptual design. Network and equipment costs have been further detailed in Chapters 10 and 12 of this report.

Organizational Impact. A major conclusion expressed in Volume 3 report was that the organization structure and process of individual user laboratories would probably not have a significant impact upon the ability of CLIS to provide required laboratory information support services. On the other hand, it was definitely concluded that the organization structure and process of both the CLIS policy board and its administrative and operational staff would impact greatly upon the level and quality of user services. Correspondingly, the organization of both groups must be structured with care to ensure that the interests of CLIS and its users are met in an equitable manner. It is equally important that the requirements and qualifications of policy board members and administrative and operational staff be carefully established and enforced. Figure 5 shows a suggested CLIS organization structure as developed in Volume 3.

GOALS AND OBJECTIVES OF IMPLEMENTATION PLANNING

The overall goal in the development of an Implementation Plan is to prepare detailed and accurate plans which will lead to the establishment of a Criminalistics Laboratory Information System as conceptualized in preceding reports. Specific objectives of this task are the following:

- The identification of activities and performance milestones which must occur for the successful implementation of CLIS
- The development of a schedule showing the relation of activity and performance milestones to each other and the established time schedule
- The identification of personnel requirements for each of the major activities defined in the implementation process
- The development of budget requirements of the implementation process
- The identification and scheduling of important decision points at which progress may be reviewed and subsequent activities reevaluated.

The planning process which addresses these goals and objectives is presented in Section B, Implementation Plan.

Figure 2

System Requirements by Application Area

Application Area		Data Storage in Characters: Initial	Data Storage in Characters: Growth Per Year	Communications* Characters/Day	File Maintenance Record Updates	Processing Capability
Analytical I/D Support	Small IR File	4.0 M	60.0 K	1.4 M	Annually and as available	On-line Files
	All Known Data Bases	385.0 M	50.0 M	5.4 M 5.4 M		Interactive Access
	All Data Except M.S.	31.0 M	2.6 M	2.7 M		Extensive File Searching and Matching
Rifling Specifications		2.3 M	123.0 K	400.0 K	Weekly	Interactive Access
Bibliography & Abstracts		9.0 M	1.8 M	600.0 K	Bi-weekly or as Citations are Developed	Language Interpreter On-Line Tutorial
Sources of Standard Samples		3.4 M	2.0 M Avg. 2 yrs.	3.5 K	Semi-annual, As available	Inquiry/ Response
Sources of Specialized Reagents		100.0 K	5.0 K	500	As available	Inquiry/ Response
Summation		401.4 M	53.9 M	6.4 M		

*Ten-fold usage increase after implementation.

M=Million
K=Thousand

Figure 3

Criminalistics Laboratory Information System (CLIS)

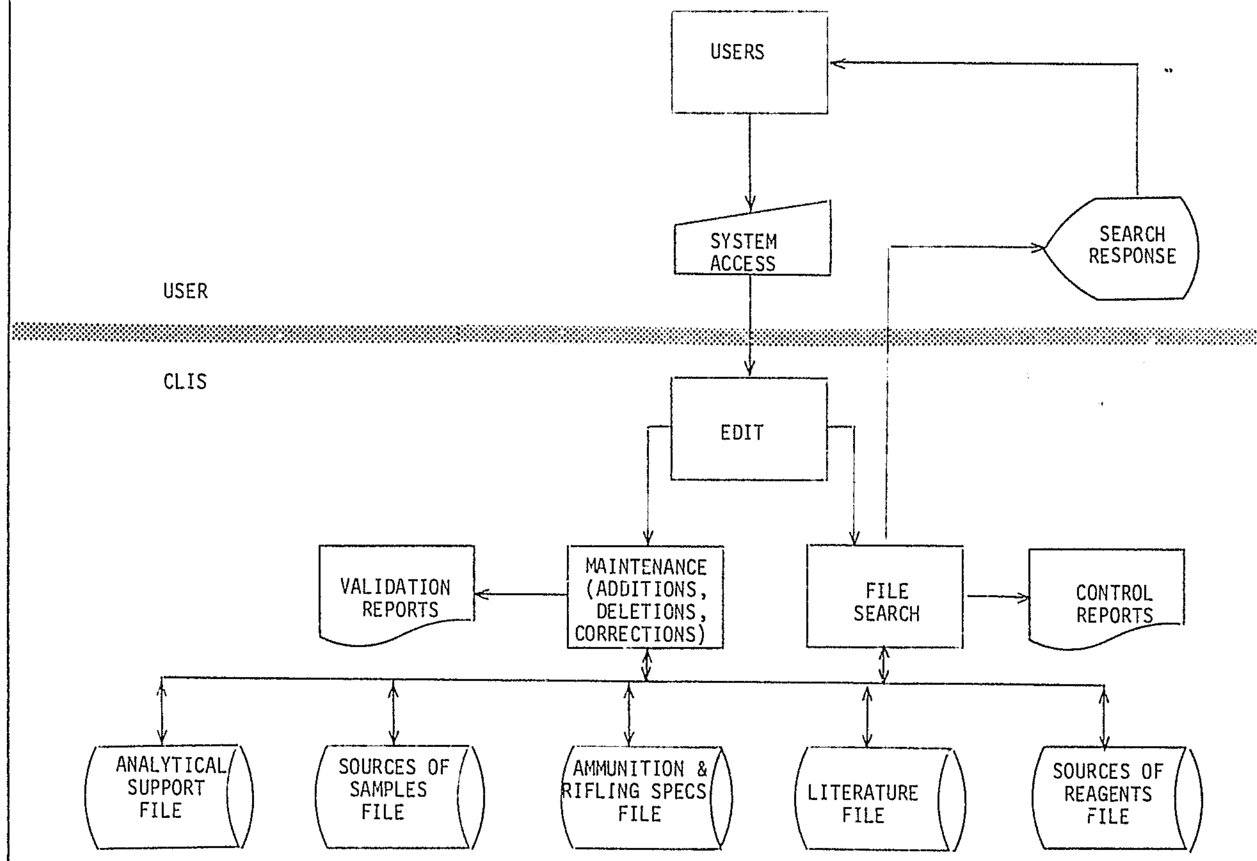


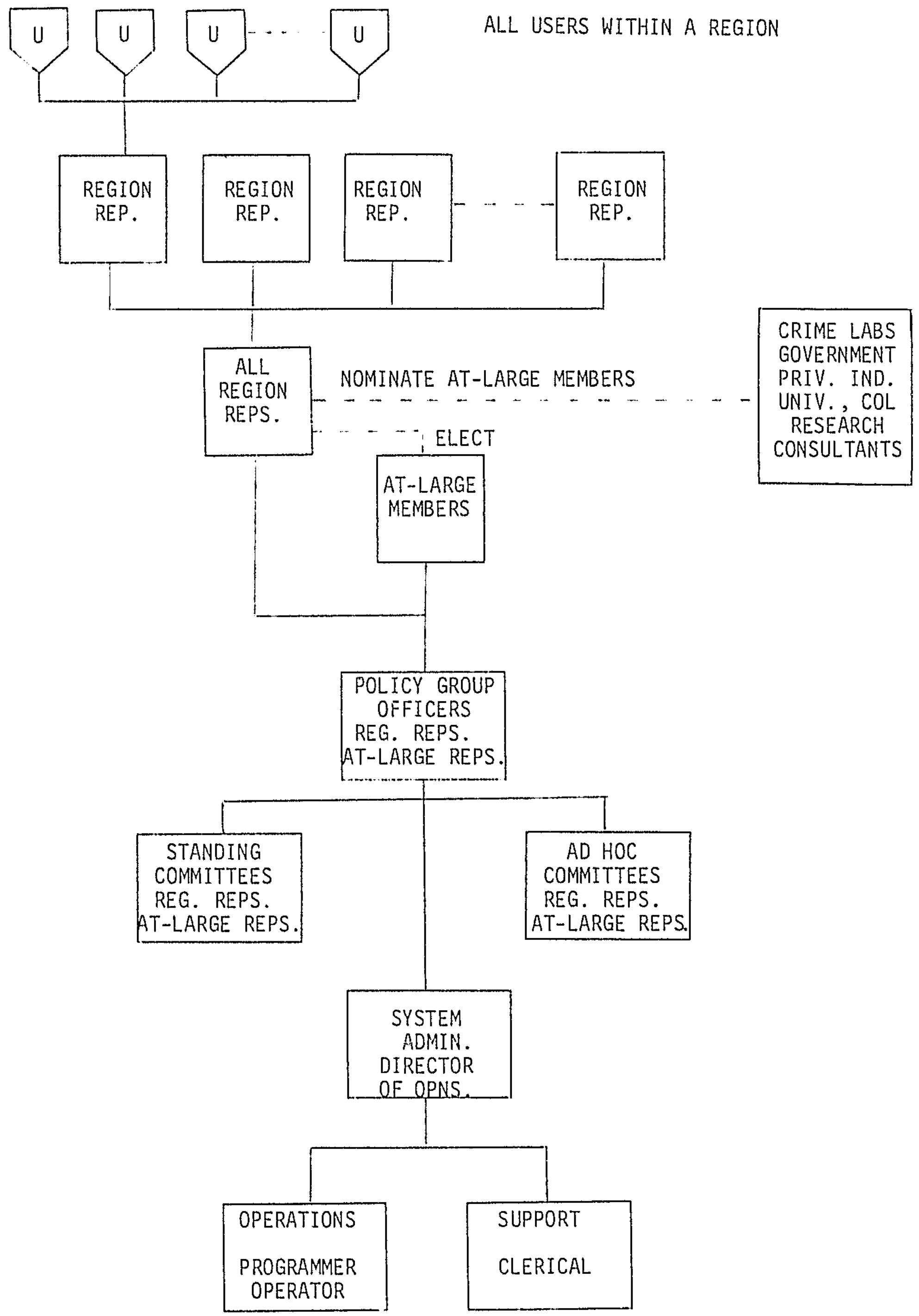
Figure 4

CLIS Network Alternatives

Item	Commercial: Basic Terminals	Commercial: Intelligent Terminals	Independent: Basic Terminals	Independent: Intelligent Terminals	State or Federal Government – National Network Not Available – Some Costs Assumed by Host Agency: Basic Terminals	Intelligent Terminals	National Network Not Available – Costs Not Assumed: Basic Terminals	Intelligent Terminals	National Network Available – Some Costs Assumed by Host Agency: Basic Terminals	Intelligent Terminals	National Network Available – Costs Not Assumed: Basic Terminals	Intelligent Terminals
Terminals	108.3	116.1	108.3	116.1	108.3	116.1	108.3	116.1	108.3	116.1	108.3	116.1
Communications	52.0	52.0	20.0	20.0	20.0	20.0	20.0	20.0	24.5	24.5	24.5	24.5
Central Processing	23.0	23.0	23.0	23.0	–	–	23.0	23.0	–	–	23.0	23.0
Hardware Total	183.3 High	191.1 High	151.3 Medium	159.1 Medium	128.3 Low	136.1 Low	151.3 Medium	159.1 Medium	132.8 Low	140.6 Low	155.8 Medium	163.6 Medium
Implementation Costs	Low	Low	High	High	High	High	High	High	Low	Low	Low	Low
Operating Costs	High	High	High	High	Low	Low	Low	Low	Low	Low	Low	Low
Overall System Costs	High	High	Highest	Highest	Low	Low	Medium	Medium	Lowest	Lowest	Low	Low

Note: All figures are median monthly lease costs (including maintenance) in thousands of dollars.

Figure 5
Suggested CLIS Organization



CHAPTER 2. DEFINITIONS OF TERMS AND CONCEPTS

RESOURCE FACTORS

Manpower Categories. Four major personnel categories applicable to this project can be identified. They are the following:

- Administrative staff
- Implementation staff
- Data entry staff
- Operations staff

The administration staff would consist of two persons, a director or manager and a secretary. The director/manager could also perform the functions of the director of operations described in Chapter 7 of Volume 3.

The implementation staff category can be subdivided as follows:

- Systems Analyst. An individual who understands the systems application areas to be computerized, and who can define systems solutions for these areas, and direct system documentation
- Programmer/Analyst. A person who can convert an analyst's systems solutions into computer programs and who can define less complex computerized solutions on his own
- Junior Programmer. An individual who can translate simpler systems specifications into computer programs and assist in system documentation.

Data entry staff would consist of data preparation clerks and keypunch operators. Their major function is in the establishment of data bases. They would assist with certain repetitive parts of system development, such as the implementation of system tables, and of course, keying operation as would be required in programming and debugging. After implementation, there will be a continuing need for this type of personnel for maintaining the data base.

The operations staff will initially consist only of a computer operator whose responsibility it will be to coordinate the use of the computer for program debugging, trial compilation runs and obtaining program listings. This person will also maintain inventories of computer expendables such as paper, ribbons, tapes, disk packs, etc.

Support Facilities. In this category are such items as office and storage space. It is not possible to be very specific about their nature or costs until the organization and geographic location of CLIS are specified. At present, they are included as overhead in the manpower cost constants explained under "Cost Constants" below.

TIME FACTORS

From the viewpoint of the individual participant, implementation will divide itself into the phases discussed below. Of course, some of the personnel also will be involved in the planning stage preceding these phases.

Training. The project will presumably be staffed with persons experienced in the types of work required. However, it is probably too much to hope that all will have exposure to the specific hardware used for CLIS. Consequently, some will require training courses in the languages and techniques to be used. Time and funds will need to be allocated for this purpose. It is estimated that three-quarters of the personnel will each need up to four weeks of training.

Analysis. The overall shape of the system will be largely determined in the planning stage in advance of the implementation stage. Nevertheless, the first part of the development of each program module must be an analysis phase wherein data processing solutions are devised for the problem areas to be solved. Usually, this does not take as long as the actual programming, but some functions may be analysis-intensive, such as the search algorithm for matching IR spectra. The level of expertise necessary for analysis (or for that matter, programming) of various functions will vary; hence, individuals of varying degrees of seniority can work in parallel. Moreover, an analyst can begin work on module B after turning over module A to another individual for programming.

Programming. This is the actual rendering of the design of a system function into computer-utilizable language. Here again, it will be possible for individuals of differing levels of expertise to work simultaneously.

Operating Phase. At some point, each programming task will be turned over to the working system as operational. When the major portion of the system is operational, the implementation staff can be reduced. Some may stay on as, or be replaced by, operating personnel.

COST FACTORS

Manpower Costs. The salary figures in Table 1 are taken from the Federal General Schedule which went into effect on October 1, 1974. The new schedule was meant to provide comparability with 1974 private enterprise pay.

Table 1

Salary Levels and Manpower Constants For CLIS Implementation

LEVELS OF EXPERTISE	GS Rating	Salary Annual	Salary Monthly	Salary Weekly	Weekly Manpower Constant
Overall Coordinator	15	$29,818	$2,484	$573	$1,146
Systems Analyst	13	21,816	1,818	420	840
Programmer/Analyst	12	18,463	1,539	355	710
Junior Programmer	9	12,841	1,070	247	494
Computer Operator	7	10,520	877	202	404
Keypunch Operator	5	8,500	708	163	326
Clerk, Administrative and Data Preparation	5	8,500	708	163	326

The "manpower constants" in the last column of the table are meant to include, in addition to salary for each expertise level, the weekly costs of administrative overhead, working space and facilities, travel, etc.

Data Preparation Costs. Data preparation includes the preparation of original documents, forms, machine-readable transactions, and other types of paper handling. It is especially significant in the creation and maintenance of data bases. After the requisite procedures have been developed data preparation could be done by project clerical staff at about 50 records per hour, for about $4.00 per hour (not including overhead), or it could be contracted out to data preparation service organizations at a cost of about $6.00 per hour for the same production rate. Probably a mixture of the two approaches would be employed, with outside data preparation being used during large-scale data conversion periods, such as the integration of a new data base.

Other Costs. The major item not included in the above categories is the cost of a computer and its associated hardware. This cost has two components:

- the purchase price of equipment that is to be owned
- a monthly cost consisting of the monthly rental on leased hardware plus monthly fees for the maintenance of all equipment.

Another cost factor would be for the purchase of standard data bases such as those of Sadtler or the ASTM.

Still another cost is the cost of training implementation personnel in the use of particular computer systems and programming languages. This may be estimated at $300/week if the training is available local to the CLIS site, or $650/week if travel and away-from-home living expenses must be included.

OTHER TERMS AND CONCEPTS

Manning Levels. The personnel complement needed during the implementation phase will be greater than that required after the system is operational. The number of individuals at work on the project at any given point in time can be said to be the manning level at that point. The greatest number of computer professionals will be required during the period of most intensive systems and applications programming. The greatest number of clerical personnel will be required during the original implementation of the data bases. In general, the more personnel assigned to the project, the faster it can be implemented because more operations can be completed in parallel. However, because of limiting factors of communication, administration, and contention for facilities (such as keypunching or computer time for program debugging), the project staff must not be allowed to become too large. By staggering the implementation of the various tasks, a fairly small staff can complete the project without sacrificing efficiency of personnel utilization.

Site Preparation and Hardware. In general, site preparation should be the responsibility of the host agency. Integration of the required CLIS hardware will have to be carefully planned with respect to floor plan layout and utility requirements such as electric power and air conditioning. The CLIS staff, including private contractors, must work closely with the host staff in determining the configuration details, acquisition of hardware and development of hardware delivery schedule. This schedule must also take into account any upgrades or additional hardware that the host site is planning for its own purposes. The detailed implementation plan will need to include the site preparation schedule and hardware delivery, installation, and integration schedules for the entire site.

Program Development. CLIS may utilize its own processor, or it may share one with the host agency. In the latter case the CLIS staff must apprise the host agency of their computer resource requirements for compilation and testing. It is anticipated that before the pilot CLIS is implemented, a significant amount of computer time will be required for program development. This will consist of compilation and testing of individual program modules as they are coded. Procedures must be developed to ensure adequate turnaround time for CLIS jobs without interference with the operations of the host site.

Communication Link. The CLIS will involve a large number of remote terminals. Initially, the pilot system will require two or three inhouse terminals for testing and then addition of other remote terminals. The communication links will be built up gradually, and the detailed system design must incorporate all of the specifications necessary to define the terminal hardware, line protocol and message formatting. These data communication links must also make provisions for remote testing and local testing of terminal hardware and basic message transfers.

Data File Conversion. The data file conversion task will be an ongoing effort in the initial stages of CLIS implementation. After the data files are finalized, the data must be converted to CLIS formats. If this data is already in machine-readable form, programs for conversion and data-base generation must be written and tested. For those files that are to be converted by manual means, detailed procedures must be developed that will define data elements, editing, and error-checking. As this data is converted, it can then be built into the nucleus of the data base.

Budget Requirements. Throughout this report monetary requirements will be estimated for each major activity. These figures will include estimates for necessary hardware and personnel costs. These costs will be arranged to show the monthly and cumulative fiscal impact of the pilot project during its implementation and of the completed system.

Technical Monitors. In addition to the actual CLIS implementation staff, it is anticipated that some specialized application areas will be technically governed by a specific subcommittee (see Chapter 5 on organizational structures). Each subcommittee will appoint technical monitors to review and suggest the basic policies (to be approved by a policy board) for data content and format. The CLIS staff will obtain technical approval for detailed application area operations from the appropriate technical monitors.

CHAPTER 3. REVIEW OF SYSTEM PRIORITIES

INITIAL REQUIREMENTS

Volume 1, Chapter 5, "Priorities," summarized the responses to the questionnaires regarding the priorities of various possible CLIS applications. A table of the composite of all the priorities assigned by respondents is reproduced below.

Application	Composite Priority
A. Analytical/Identification Support	1
J. Compilation of Statistics	2
C. Sources of Standard Samples	3
E. Literature Abstract Information	4
I. Rifling Specifications	5
D. Bibliographic Information	6
B. Sources of Specialized Knowledge	7
G. Sources of Specialized Reagents	8
F. Computation Data and Capability	9
H. Explosive Tagging	10

In order to propose a rational implementation sequence, a number of factors were taken into account:

- The above priority list established by the potential users
- The need to initially concentrate on highly visible and easily implementable functions that are useful to a number of laboratories
- The strategy of using available data bases that can be incorporated into CLIS with little or no modification
- The concept of showing preference to applications that are useful to the greatest number of laboratories
- The delaying of functions that are highly sophisticated or difficult to implement
- Consideration of the time that must elapse for the implementation of each application.

Using these criteria, the following implementation sequence was suggested:

- Sources of standard samples
- Rifling specifications
- Analytical and identification support for IR spectrophotometry of drugs
- Bibliographic and abstracting services
- Sources of specialized reagents and knowledge
- Analytical and identification support for UV spectrophotometry, gas chromatography/mass spectroscopy, X-ray diffraction, and IR spectrophotometry for nondrugs.

The compilation of statistics to determine specimen uniqueness was not included in the priorities list because the concept is not as yet well-defined, and considerable time would undoubtedly be required to accumulate the requisite data.

REVISED REQUIREMENTS

Detailed review of questionnaire data resulted in the recommendation (Volume 2, "General Design Considerations") of a modified sequence of priorities for analytical and identification support:

- IR spectrophotometry for drugs
- UV spectrophotometry for drugs
- GC, MS and GC/MS
- IR and UV for nondrugs
- Electrophoresis.

It was further recommended that the initial IR data base consist of the Sadtler Research Laboratories collection of IR spectra for pharmaceuticals plus the British Home Office Central Research Establishment forensic and alkaloid files of IR spectra.

At the CLIS committee's request electrophoresis was dropped from, and X-ray diffraction was reinstated into, the analytical and identification support implementation priorities. Also at their request, sources of standard samples, specialized reagents, and specialized knowledge have been combined into a single "sources" function and given a lower priority. In addition, atomic absorption support was dropped as an application area.

SUGGESTED IMPLEMENTATION SEQUENCE

Taking into account the requests by the committee, and applying the same criteria as was used in the Volume 1 report to suggest an order of implementation, the following is the recommended implementation sequence:

- Rifling specifications
- Analytical and ID support for IR for drugs, using the Sadtler pharmaceutical and HOCRE files as the data base
- Bibliographic and abstracting services
- UV analytical and ID support for drugs
- Expansion of IR data base to support analyses of nondrug samples
- Sources of standard samples, reagents and knowledge[1]

[1]After reviewing the Task 5, Implementation Plan draft report, the CLIS Special Project Committee voted to postpone indefinitely any further consideration of a source of specialized knowledge file in the implementation process.

- Implementation of the remaining analytical/ID support functions:
  - GC, MS and GC/MS
  - UV for nondrugs
  - X-ray diffraction and flourescence spectroscopy.

It is believed that this sequence (subject to modifications suggested by further experience) will result in an orderly implementation and a realistic system structure.

SECTION B
IMPLEMENTATION PLAN

CHAPTER 4. EXECUTIVE SUMMARY OF THE IMPLEMENTATION PLAN

The implementation plan for Phase II of CLIS development is presented in detail in the remaining chapters of this section. This chapter summarizes the major points of each implementation task in an effort to provide a concise overview of the entire process. It is expected that some readers will not get into the details of the implementation chapters. However, no reader should read this summary without also reading Chapter 3, "Implementation Guidelines." A caution for those who read on — there is a considerable amount of detail in many of the implementation chapters, so that in some cases passages do not read like an implementation plan but, rather, a detailed design document. However, it was felt that such detail was essential to supplement the specific steps of the implementation process.

Chapter 5 — Task 1, Organization for Policy Control

Responsibility — Current CLIS Committee

Time Frame — November-December 1974

Cost — Part of Overall Administrative Costs (see Figure 6)

Prior to December 31, 1974, the current CLIS committee should complete the following activities which relate to Phase II, CLIS implementation:

- Adopt a definition of potential CLIS "users"[1]
- Select laboratories to participate in the pilot system[1]
- Establish liaison with agencies which could be involved in CLIS operations (NLETS, DEA, FBI)

[1]These items have been accomplished by the CLIS committee and are detailed on page 51 and in Figure 8 of this Volume.

Figure 6

Phase II Cost and Time Schedule

TASK	RESP.	COST K NATL. AVE.	COST K G.S. (GOV'T)	MONTHS -3 0 5 10 15 20 25 30 35 40
1 - ORG FOR POLICY CONTROL		(A) 250	(A) 250	
USER ID	PC			
LIAISON	PC			
TRADE-OFF PREP	IC			
2 - SYSTEM TRADE-OFF STUDY	CON	(C) 35	(C) 35	
HARDWARE				
SOFTWARE				
APPLICATIONS				
NETWORK				
HOST AGENCY				
3 - PROGRESS ASSESSMENT	PS	(A)	(A)	
ESTABLISH PROCEDURES	LEAA			
REVIEW & ANALYSIS				
4 - ORG FOR POLICY & ADMIN CNTRL		(A)	(A)	
POLICY - AUTH & RESD.	PB			
SUPPORT REQUIREMENTS	PB			
ADMIN ORGANIZATION	HA			
5 - SYSTEM USERS	CON	(C) 20	(C) 20	
ORIENTATION				
USERS MANUAL				
TRAINING GUIDELINES				
6 - PILOT SYSTEM	HA	835.8	976.7	
DEFINITION	CON			
HARDWARE				
SOFTWARE				
APPLICATIONS				
7 - PROGRESS ASSESSMENT	PS	(A)	(A)	
ORGANIZATION	LEAA			
TRAINING				
PILOT SYSTEM				
8 - FULL SYSTEM	HA	4,120.5	4,4[illegible]1.0	
HARDWARE	CON			
SOFTWARE				
APPLICATIONS				
TOTAL		5,261.3	5,772.7	

LEGEND: RESP. - PC = PRESENT COMMITTEE; IC = INTERIM COMMITTEE; PB = FINAL POLICY BOARD; HA = HOST AGENCY; CON = CONSULTANT; PS = PROJECT SEARCH; LEAA

COST: (A) = PART OF TOTAL ADMIN. COST LISTED FOR TASK 1; (C) = CONSULTANT

NATL. AVE. = PRIVATE INDUSTRY; G.S. = FED. GOV'T PAY SCALE

TIME SCHEDULE: ——— = 1 EA TECHNICAL STAFF CATEGORIES; ······ = 2 EA TECHNICAL STAFF CATEGORIES

- Establish an interim committee to handle Phase I, Phase II transition and early Phase II activities
- Ensure that funding for implementing activities is not unnecessarily delayed.

Responsibility — Interim Policy Committee
Time Frame — First three months of Phase II
Cost — Part of Overall Administrative Costs (see Figure 6)

- The interim CLIS committee should prepare and distribute a request for proposal (based on the contents of Chapter 6) for a system trade-off study
- Select a contractor to conduct a system trade-off study
- Monitor the progress of the trade-off study.

Chapter 6 — Task 2, System Trade-off Study

Responsibility — Contractor
Time Frame — Two months
Cost — $35,000

There are an infinite number of ways to develop and assemble the various components of CLIS. Many alternatives have already been presented and some decisions and assumptions have been made. There are, however, still many critical decisions which must be made. The system trade-off study will facilitate the decisionmaking process. The general areas of the study include:

- Determination of hardware specifications and selection of a vendor
- Definition of the pilot system
- Selection of a telecommunications network and a host agency for CLIS
- Further definition of selected data bases (bibliographic/abstract, rifling specifications, mass spec)
- Determination of installation strategies.

Chapter 7 — Task 3, Progress Assessment

Responsibility — Project SEARCH, LEAA
Time Frame — During first four months of implementation
Cost — Part of Overall Administrative Costs (see Figure 6)

It is reasonable at this stage of project development (immediately after the trade-off study) for the funding and sponsoring agencies to conduct a detailed assessment of progress. This review process should be designed to supplement, not replace, the ongoing review and monitoring activities of the CLIS policy group and should address two major objectives:

- The development of an effective assessment process which provides realistic and timely feedback to the long-range planning function
- The identification of needed changes in the direction and scope of implementation activities, the incorporation of such changes into the planning process, and the commitment of the funds necessary to continue the development of CLIS.

Chapter 8 — Task 4, Organization for Policy and Administrative Control

Responsibility — Interim Policy Committee, Host Agency
Time Frame — Within 45 days after the completion of Task 2
Cost — Part of Overall Administrative Costs (see Figure 6)

The trade-off study conducted during Task 2 will necessitate many critical decisions not previously required, particularly those relating to final hardware and hardware vendor choices, sources and locations of data bases, and the identification of those agencies which will house the processing for CLIS and the necessary telecommunications link. The interim policy committee, therefore, should have all data needed to undertake the establishment of a permanent policy and review group. An equally important factor is that the interim policy committee can draw on its actual experience under implementation conditions in developing the best organization structure for the permanent policy group. Considerable input will be required from the host agency and those agencies housing distributed data bases (those not centralized in the host agency). The major activities of this task will include the following:

- The establishment of an organization structure for the permanent CLIS policy group
- The documentation of the duties, responsibilities, and authority of the policy group
- The identification of administrative support to be provided by the host agency and Project SEARCH to the policy group
- The organization and staffing by the host agency of administrative and operational responsibilities in a manner most compatible with existing policies and procedures and the specific requirements of CLIS.

Chapter 9 — Task 5, Involvement of System Users

Responsibility — Contractor
Time Frame — Four months
Cost — $20,000

It is important that CLIS provide a valuable service to its users. It is more important that the service require a minimum of effort by the users. Several products can be developed which will make the total system easy for laboratories to understand and use.

- An audio-visual presentation should be prepared in a highly professional manner to be used to introduce CLIS to potential users and other interested parties. This presentation would be the initial step in the training, education, and PR process.
- The development of a comprehensive, yet simple, user's manual should be developed. First, the manual will describe how the system is activated and used (sign-off and -on, error routines, user messages, etc.). Second, the manual will describe the special user interfaces with specific data bases (formatting of requests, reductions of input data, inquiry/response samples, error messages, etc.).
- The user's manual will be one of the tools used in the training of users. A set of training guidelines should also be developed to ensure the adequacy of user training, both initial and ongoing.

The criteria for selecting user laboratories for the pilot system and a listing of laboratories selected by the committee are also presented in this chapter.

Chapter 10 — Task 6, Development of Pilot System

Responsibility — CLIS Administrative and Operational Staffs (Host), Contractor
Time Frame — 6-12 months (depending upon personnel resources applied)
Cost — $976,700

The development of the pilot system is one of the most critical implementation tasks. It will provide an effective test of user participation, system response, and hardware and network efficiency. The following are the major steps involved in the development of a pilot system:

- Definition of a pilot system to include system facilities, application areas, data bases, and number of terminals
- Identification of hardware requirements to include type of terminals, central-processing equipment and data storage requirements
- Identification of software requirements to include both system and applications software, and a software implementation sequence with appropriate manning level requirements
- Identification of the sources of pilot-system data bases for the rifling and IR drug application areas.

Chapter 11 — Task 7, Progress Assessment

Responsibility — Project SEARCH, LEAA
Time Frame — 60 days
Cost — Part of Overall Administrative Costs (see Figure 6)

This is the second of the major policy/planning/funding assessment points suggested during the implementation process. This will be the first opportunity at this level for an objective assessment of actual performance as it relates to organization, user involvement and the provision of services. The process will include assessments of:

- CLIS policy group organization and activities
- CLIS audio-visual presentation
- CLIS user's manual
- CLIS user training guidelines
- CLIS pilot system.

The decisions formed after the assessment should address the following:

- Should the organization structure or process of the CLIS policy group be modified to increase effectiveness?
- Are changes required in the user's orientation and training process before they are supplied in a total system environment?
- Does the experience of the pilot system suggest changes to the plan for full system implementation?
- How can any needed changes best be incorporated into the planning process?

Chapter 12 — Task 8, Development of Full System

Responsibility — CLIS Administrative and Operational Staffs (Host), Contractor
Time Frame — 21-42 months (depending upon personnel resources applied)
Cost — $4,491,000

The term "full system" describes a near maximum number of users being provided a full range of services initially defined in the Phase I, Volume 2 report on the conceptual design of CLIS. Because of their complexity, some of the application areas assigned for implementation during this phase will have to have been already under development in parallel with the pilot system.

The procedures to be followed for the implementation of a full system are basically those that were suggested for the development of the pilot system. The scope and sophistication, however, will be considerably greater.

- *Hardware Requirements.* A total of 31 terminals will be utilized in the pilot system. It is estimated that 169 additional terminals will be required for the full system. The only incremental equipment needed to expand central-processing hardware to full-system capability will be an input/output channel controller. Three additional tape drives will be required to supplement the one drive suggested for the pilot system.
- *Software Requirements.* Most of the system software will be completed in implementing the pilot system, and full system modifications will be minor. Applications software programming will be considerably more extensive, since seven additional data bases will be added, and the two pilot system data bases may be upgraded.
- *Sources of Full-System Data Bases.* A detailed study of sources of data bases, their availability in machine-readable form, costs and data conversion problems must be completed prior to the inclusion of any new applications in the full system.

CHAPTER 5. TASK 1 — ORGANIZATION FOR POLICY CONTROL

THE CLIS SPECIAL PROJECT COMMITTEE

The current CLIS Special Project Committee has been very much in evidence during the activities of Phase I conducted during the past nine months. The involvement of the committee has been extremely productive, and committee members have collectively and effectively represented the varied interest of the criminalistics laboratory community and Project SEARCH. As a review, advisory and policy group, the committee has exercised consistent project quality control and has been instrumental in the success achieved during Phase I. As in the case many times with volunteer groups, the CLIS Special Project Committee by no means performed in a token manner. It is this type of conscientious dedication which must be continued without interruption during the time remaining in Phase I and through the transition from Phase I (conceptual design) to Phase II (implementation).

The Special Committee, in its present form, will continue through December 1974, when the grant funding and project period expire. During the time remaining the committee must, of course, perform the administrative duties required by Project SEARCH and LEAA. At the same time, however, the committee can also undertake some activities which can facilitate the transition to the implementation tasks suggested in this report.

The following are some specific steps which the CLIS Special Project Committee should perform before December 31, 1974.

Step 1. User Identification

The committee should adopt a definition of potential CLIS "users." The access and dissemination subcommittee has drafted such a definition.

Step 2. Select Pilot Labs

This report suggests criteria to be used in selecting laboratories to participate in the pilot system. A list of laboratories meeting these criteria has also been compiled. The present committee should select 30 pilot system laboratories before December 31, 1974. The selection process would naturally include confirming the interest and commitment of potential pilot labs.[1]

Step 3. CLIS Liaison

The material in this and earlier reports suggests the possible involvement of specific government and private groups in the implementation and operation of CLIS; e.g., NLETS, DEA and FBI. During the next several months the committee should open formal liaison channels with these groups to determine the resources and commitments which may be exercised during Phase II.

Step 4. Establish an Interim CLIS Committee

In order to ensure a continuity of control and policy formulation, the present committee should establish an organization structure for an interim committee which will operate during the early months of implementation involving the system trade-off study. The membership of the interim committee can be quite appropriately suggested by the current committee.

Step 5. Continuing Funding

The present committee should undertake whatever actions are necessary to ensure that the funding for Phase II is not unnecessarily delayed. At a minimum, at least partial funding of Phase II, to cover the operational costs of the interim committee and Task 2 (System Trade-off Study), should be secured by Project SEARCH as soon after the expiration of the current grant as is practical.

AN INTERIM POLICY COMMITTEE

The interim policy committee suggested in Step 4 will be an important force during the early stages of implementation. The principal contributions of the interim committee should closely follow the example set by the current committee, particularly regarding review and monitoring activities.

Step 6. Preparation for Trade-off Study

The system trade-off study is presented as the second task in the implementation process. It is the

[1] Figure 8 lists 47 labs selected by the committee.

first major technical task, and the importance of the study's results upon subsequent implementation tasks is obvious. The interim committee, with the help of Project SEARCH administrative staff, should prepare and distribute a request for proposal for the conduct of the trade-off study.

Step 7. Selection of a Contractor to Conduct a Trade-off Study

The interim committee should review and evaluate the proposals submitted and select the contractor to perform the trade-off study.

Step 8. Monitor the Progress of the Trade-off Study

At reasonable intervals during the trade-off study, the interim committee should monitor project activities and assess deliverable products produced as a requirement of the agreement with the contractor.

CHAPTER 6. TASK 2 — SYSTEM TRADE-OFF STUDY

In most cases there will be more than one way of providing each CLIS application. Many detailed alternatives will have to be weighed in determining the most appropriate course of action at numerous decision points. Such a determination of the most efficient course of action through a set of complex circumstances can be called a trade-off study. It is recommended that parts or probably all of this study be performed under contract by a reputable and qualified consulting company with experience and expertise in the information systems and criminal justice fields. Such an organization could commit highly qualified personnel to a concentrated effort and thus avoid the dangers of delay or insufficient depth of investigation that might otherwise result. It is doubtful that the CLIS or Project SEARCH staffs would be able to devote sufficient time or manpower to accomplish this task with the necessary thoroughness.

The decision to use a contractor for this task and the selection of such contractor should rest with the CLIS Policy Board.

Following is a detailed discussion of some of the major alternatives which may be encountered and a description of how a trade-off study might be organized to address such considerations.

IMPLEMENTATION ALTERNATIVES

Unfortunately, there are many paths that may be used to arrive at a system such as the one being proposed. Not all the information is yet available which would make it possible to predict the best path with absolute certainty.

General Hardware

The implementation of CLIS will involve significant time, effort and money. This fact alone mandates that the initial selection of the system configuration must be one that will serve the current needs of crime laboratories and be capable of expanding to meet their future needs and instrumentation requirements. For this reason it is recommended that an early task of Phase II implementation be a study to determine the proper system configuration at a detailed level.

Volume 3 of this Phase I project presented several alternatives to the design of a CLIS that would be responsive to user demands. System functions were broken down into terminals, communications, computer processing, and data storage. Each of these functions was further defined as to capability and cost. The six basic CLIS configurations were thus presented along with median cost criteria to indicate the various approaches that could be taken and the advantages and disadvantages of each. In Volume 3 the project staff recommended that a centralized hierarchical configuration be used to implement CLIS. This recommendation and subsequent justifications were based upon general design and costing criteria and did not unnecessarily delve into detailed design parameters.

Now that the generalized configuration has been decided upon by the committee, such detailed system definition is needed to identify and qualify all operational and maintenance components. This work should occur near the beginning of Phase II and will provide the basic, detailed system-definition document for all future CLIS specifications.

Input to this detailed system will come from many areas:

- Phase I conceptual design
  - User requirements
  - General configuration
  - Anticipated volumes
- System user identification
- Communications system selected
- Organization selected to host and maintain CLIS
- Hardware specifications
- System software specifications

The study staff will take all pertinent information and generate a document that will define in detail all operational aspects of the system, including, but not necessarily limited to: specific terminal hardware, communications net and schedule requirements, system operations protocol, data elements, record and message formats, and interfaces to the application areas. Careful evaluation must be made of terminal hardware and communications equipment so as to define the hardware configuration that will adequately service the pilot system as well as contain the capabilities for expansion to the full system. The system operating protocol will largely be a function of the host computer system. However, if this system has multiple responsibilities, CLIS operations should be separate and distinct from host operations whenever possible so that the the administration of CLIS can be kept independent and not merged into and confused with other host operations. Interface to the applications must be carefully defined so as to provide the application area designers and programmers information on exactly what features and capabilities he system will provide. The general structure that the application and programs must take and all communication message formats and sequencing will be defined in detail for the systems analysts and programmers. The study will also define the basic terminal opertaions for communicating with the system which will form the base for generation of the terminal operator user's manual. Of course this manual will be supplemented by the operations necessary to use each application area.

A major decision is that of determining at what point in the development process the computer hardware can most cost-effectively be installed. If it is installed before programming begins, it will sit idle a large portion of the time until a significant amount of software is operational. If, on the other hand, installation is postponed, other similar systems will have to be found for the debugging of earlier programs along with the resultant associated costs. The ease of finding such other equipment will be subject to the nature of the hardware chosen. It is also subject to the uniqueness of the applications. CLIS will be a highly unique system, and it is doubtful that comparable equipment configurations can be found easily. For these reasons it is recommended that the hardware be installed first and its initial idleness be accepted as a cost of most efficient implementation.

In a summary, the study will produce a detailed system specification that will be used to define all of the technical functions of system operation. Appropriate sections of the specification will be suitable for use in procurement of terminals, communications equipment and computer hardware. Other sections will define the system interface to application areas and basic terminal operations. It is estimated that it will take six man-months to accomplish this task.

Data Storage Acquisition Strategy. This report, for purposes of discussion only, assumes that a DECsystem 10 will be selected for the processing hardware. It is also assumed that DEC's yet-to-be-announced, 3330-type disk drives will be used for all data storage. This is initially inefficient because the total storage requirement for the pilot system would use up only a fraction of even a single one of these drives. An alternative strategy would be to store both system software and pilot data bases on DEC's smaller, faster and cheaper disks and to add the larger devices only as needed for larger data bases. The smaller disks could eventually be reserved for software, and all data moved to the larger disks. This tactic should significantly delay the onset of large data storage expenses. If some other hardware is selected, there would doubtless be an analogous but different decision process for data storage implementation.

System Facilities. The types and amount of programming that will be required to enable interactive communication between users and data bases cannot be defined until the communications network is known, and the terminals have been selected. However, capabilities required can be functionally defined, and this is done under "Software" in the "Pilot System" chapter. Some of these may already be characteristic of the terminals or network chosen and will not need to be implemented separately.

Application Programs — General

A major decision will be whether or not to include user data bases in the pilot system. This will constitute a separable subtask which could be deferred to become part of the main system implementation. Following is a brief discussion of presently viable, alternate means of implementing some of the more important application areas. Most of the identification support categories have presently identifiable alternatives, notably the mass spec and X-ray diffraction functions discussed in another chapter under "Sources of Full-System Data Bases."

Rifling Specifications Application. In Volume 2 it was proposed that this function consists of two parts: first, an ammunition file to be used in the identification of a fired cartridge, and second, a rifling specifications file to be used in determining what firearms might have fired the cartridge. Since questions have been raised as to the usefulness of automating the cartridge identification, preference should be given to the second step, the rifling-specification data base itself. The ammunition file could be added in a later phase if its usefulness becomes established.

The rifling-specification file is relatively straightforward, but the establishment of its data base will initially require the encoding of a great deal of firearms information that is not currently available in machine-readable form.

The Jet Propulsion Laboratory is studying the feasibility of an automated firearms identifications system (Reference 2). The system is considerably more ambitious than the one being proposed. When and if it becomes operational, the possibility of integration with CLIS should be investigated.

Infrared Drug Identification Support Application

The computerized search of infrared spectra is a relatively well-known application; a number of such systems have been implemented, and several are available commercially (Table 2).

A number of governmental organizations have also developed infrared search systems. These have included the computerized infrared data file of the New York State Division of Criminal Justice Services (Reference 5), the toxicology data bank (currently being developed) of the Walter Reed Army Institute of Research (WRAIR), and the British Home Office Central Research Establishment (HOCRE, Reference 4).

The latter project — which also includes ultraviolet spectra, mass spectra, computerized literature tetrieval, and other functions — is being designed to run on small laboratory computers and "could be made available to any laboratory equipped with such a computer on a basis of participation in the information exchange network" (Reference 4). Such a system might have utility either at CLIS' central or distributed processing sites; the CLIS developers should stay in communication with the WRAIR-HOCRE project.

In implementing an infrared spectral search as a CLIS function, questions such as the following will have to be answered:

- Is an existing search algorithm to be used?
- If not, will a new search algorithm be developed by CLIS operational personnel or by an outside contractor?
- If by CLIS personnel, will it be designed from scratch or adapted from an existing algorithm?
- Are the available existing file formats acceptable, or should a new one be developed?

Figure 7 represents the relationships between these decision points. In Phase II of the CLIS proj-

Table 2

Commercially Available Computerized Infrared Search Systems

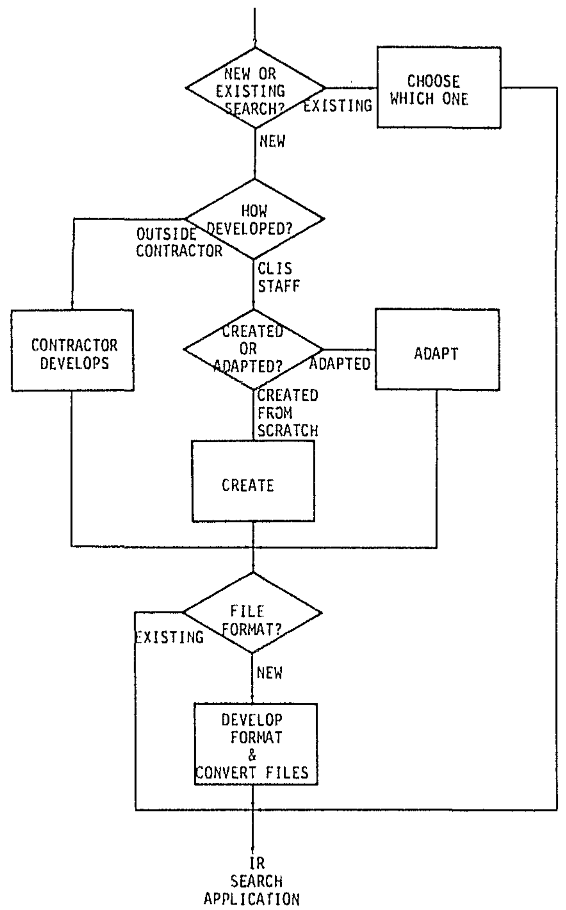
NAME OF SERVICE	PURVEYOR	AVAILABILITY OF SERVICE: BY MAIL	RUNS OF USER'S EQUIPMENT	VIA TIMESHARING SERVICE	NOTES
FIRST - 1	DNA SYSTEMS, INC., Saginaw, Michigan	X	X		(1)
FIRST - 2	DNA SYSTEMS, INC., Saginaw, Michigan	X	X	X	(1)
Infrared Spectral Retrieval Service	EASTMAN KODAK COMPANY, Rochester, New York	X			(2)
IRGO	CHEMIR LABORATORIES, Glendale, Missouri			X	
IRIS	SADTLER RESEARCH LABORATORIES, INC., Phil., Pa.			X	
ISIS	TRIANGLE UNIVERSITIES COMPUTATION CENTER, Research Triangle Park, N.C.			X	
SIRCH-III	AMERICAN SOCIETY FOR TESTING AND MATERIALS, Philadelphia, Pa.		X		(1)

(1) See Reference 3

(2) See Reference 1

Figure 7

Decisions Involved in Implementing the Infrared Search Application



ect, the trade-offs among the existing algorithms will have to be weighed against the development of new algorithms.

Bibliographic and Abstracting Services. This will be the most difficult and time-consuming of the CLIS functions to implement. Consequently, any other means of providing similar services should be investigated thoroughly.

The National Library of Medicine's TOXLINE (a subset of their MEDLINE) provides such a service for part of the criminalistic area of interest. Even though it is disseminated through a commercial network service, it could communicate via an online link with the CLIS system. Users could also subscribe to TOXLINE separately through terminals connected to the TMYSHARE net.

The Royal Canadian Mounted Police currently maintains a microfiche system for the dissemination of forensic information throughout its laboratory system. It is anticipated that this could serve as a valuable source in the development of a bibliographic lexicon and as a source of abstracts.

The forensic science Computerized Literature Retrieval system under development by HOCRE and WRAIR (Reference 4) also bears watching. Perhaps there is the possibility of either online access to the system or of acquisition of some ready-made software or machine-readable data bases.

Manual retrieval systems, either of a centralized or a distributed nature (such as the optical coincidence system demonstrated by Remac Corporation at the San Francisco CLIS meeting of July 24, 1974), could be considered at least as a temporary or partial solution.

STEPS IN PERFORMING THE TRADE-OFF STUDY

The following steps indicate what should be done and in what sequence in the process of performing a trade-off study. Most of these steps are discussed in greater detail in the "Pilot" and "Full System" chapters or under "Implementation Alternatives" above.

Step 1. Determination of Hardware Specifications. In defining the detailed capabilities and configuration of terminals, processors and other hardware, many considerations will need to be traded off. Recommendations in regard to numerous details will have to be presented to and decided upon by the proper policy-setting body.

Step 2. Definition of the Pilot System. At this point the pilot system will need to be specified more fully. Below are some of the considerations which must be examined:

- In light of the operating system and utilities supplied by the vendor, how much specialized systems software will have to be added?
- How will an infrared search algorithm be achieved, and what file format will be used?
- Should user-generated data bases be a part of the pilot system?

Step 3. Selection of a Host Agency. The Volume 3 report discusses the rationale for a government network and host agency for CLIS. During this step a host agency must be selected which satisfies the following requirements:

- Centralized quality control
- Maintenance of some national data bases by a functional crime laboratory with wide forensic experience and operations
- Obtain and sustain ongoing funding
- Provide laboratory and data-processing personnel with the skill levels necessary to operate and maintain CLIS.

Step 4. Development of a Bibliographic and Abstract Information Capability. Should this be a manual or computerized facility, and if computerized, should access to an existing system be recommended? Are any similar capabilities being developed by other organizations at such a stage as to merit consideration of their integration with CLIS?

Step 5. Vendor Selection. Following the specification of the hardware, vendors must be contacted, their proposals evaluated, and a selection of the most responsive and cost-effective vendor made.

Step 6. Determination of Installation Strategies. The most appropriate time for installation of the major processing hardware must be identified, taking into consideration such factors as convenience of software development and any shortages or other conditions which might delay delivery. The incremental addition of terminals and data storage hardware will have to be defined in terms of when such additional capability can be supported by the developing software and in light of the projected evolution from a pilot to a full system.

Step 7. Rifling Specifications Application. Should an ammunition file be included? Is there usable existing software?

Step 8. Network Requirements. All system requirements should be presented and explained to the alternative network agencies, NLETS and NCIC. Each agency should be allowed a reasonable time to respond to each requirement including:

- Terminals — type and hookup
- Usage — applications, message volume, usage rates
- Response time
- Operational procedures
- Security
- Interfaces — speed, mode.

Step 9. Network Evaluation Criteria. Network evaluation criteria should allow for the realistic assessment of each potential network agency's capability to satisfy CLIS requirements. The criteria should include the following:

- Costs — operation and installation
- Maintenance capability — speed, accuracy
- Flexibility — upgrade services, add users, expand services
- Network personnel — numbers and skill levels
- Past performances — reliability, credibility, efficiency, effectiveness
- Compliance — level of responsiveness to requirements.

Step 10. Comparative Analysis. A comparative analysis of each network agency's responsiveness should be conducted on an item-by-item basis.

Step 11. Mass Spec Decisions. What is the availability, applicability and cost of data for this application? How should such a data base be implemented, and how should it be searched?

Step 12. Expansion from Pilot to Full System. How should this be accomplished in terms of hardware, software, and data base acquisition?

Step 13. Local Processors. Are small computers in individual laboratories appropriate, and if so, what should they be and how should they be funded?

Step 14. Other Identification Support Facilities. What considerations need be addressed in the implementation and searching of other data bases, such as ultraviolet spectra or X-ray diffraction patterns?

Trade-off Study Report. The conduct of this study will require the continual documentation of alternatives and recommendations. The compilation of these documents will comprise the Trade-off Study Report.

MANPOWER REQUIREMENTS AND SCHEDULE

Responsibility for a trade-off study could be divided among the following three competence levels:

- Top technician. An individual with the judgment and computer system specification experience necessary to make well-reasoned hardware and software recommendations.
- Senior technician. A person who can make similar judgments after thorough research into

the factors involved.

- Clerical. A person to do the compilations and computations required in a trade-off investigation.

COST OF A TRADE-OFF STUDY

Using the steps, levels of expertise, and schedule as specified above, the cost of performing a competent trade-off study for this system can be estimated at $35,000.

CHAPTER 7. TASK 3 — PROGRESS ASSESSMENT

THE NEED FOR REVIEW

The periodic review and assessment of CLIS implementation activities, conducted in a formal, structured manner, will be an important control in ensuring that the system satisfies the needs of its users. This process is also a requirement of the RFP. Several levels of review will be required. The responsibility for exercising two levels of review (subcommittee and committee) rests with the CLIS policy control group in both its interim and final forms. The subcommittees and full committee review requirements have been referenced in Chapters 5 and 8. The third level of review should be performed jointly by Project SEARCH and LEAA personnel not directly involved with the CLIS policy group on either a permanent or ad hoc basis. It is obvious, however, that the broad direction and funding decision inherent in this final level of the review process be based upon the ongoing control activities of the CLIS policy group and its subcommittees and committees.

The implementation plan presented in this document represents a suggestion for the best approach in establishing CLIS based upon what is now known. Any implementation plan must be flexible enough to allow for necessary changes in direction resulting from actual implementation experience. The review process is the key to providing that flexibility. The process can best be performed by the combined personnel resources (crime laboratory, data processing, fiscal) of the CLIS policy group, Project SEARCH and LEAA.

THE REVIEW PROCESS

The following steps are suggested for the establishment and conduct of the overall joint policy and funding review process for CLIS implementation:

Step 1. Recommend to Project SEARCH and LEAA the structure of the joint review group.

Responsibility: CLIS Interim Policy Committee
Time Frame: During first month of implementation.

Step 2. Establish the joint review group, including the assignment of personnel.

Responsibility: Project SEARCH, LEAA
Time Frame: During first month of implementation.

Step 3. Establish review criteria, procedures and meeting schedules.

Responsibility: Joint Review Group
Time Frame: During second month of implementation.

Step 4. Perform a progress assessment of Task 2, System Trade-off to include reports prepared for and recommendations of the CLIS policy group.

Responsibility: Joint Review Group
Time Frame: During 45 days following completion of Task 2.

Step 5. Recommend future actions for implementation and funding.

Responsibility: Joint Review Group
Time Frame: Within 45 days of completion of Task 2.

DELIVERABLES

Two principal deliverables should result from the activities of this task. The first is the actual establishment of the review process itself. If it is determined not to be feasible for Project SEARCH and LEAA to undertake this as a joint venture, then the respective responsibilities can be performed by both groups independently and the end results compiled for consideration in the decisionmaking process. The second deliverable is the decision whether to continue with implementation based upon the trade-off study conducted during Task 2. Major changes in direction and scope, if appropriate, should be identified and incorporated into the planning process, and the necessary funding should be committed.

CHAPTER 8. TASK 4 — ORGANIZATION FOR POLICY AND ADMINISTRATIVE CONTROL

THE CLIS POLICY BOARD

After the trade-off study (Task 2) is completed, many of the final CLIS design alternatives will have been selected, such as:

- Hardware — make, model, etc.
- Data bases — sources, location
- Host agency — location of central processing, administrative and operational responsibilities
- System network — communication between users, central processing and data bases.

Armed with this information, the interim policy committee can establish the permanent CLIS policy board. The ultimate decision, however, cannot be made without positive interaction with individuals or groups that will be intimately involved with the administration and operation of CLIS. The liaison contacts that were suggested in Task 1 should prove to be very productive at this point. It is *imperative* that the CLIS host agency, network agency, and agencies housing data bases be positively represented on the CLIS policy board with full voting powers. The mix of other members representing the interests of criminalistics laboratories can be at the discretion of the board.

Step 1. Organization

Several organizational alternatives were suggested in the Phase 1, Volume 3 (Organizational Impact) reports for the CLIS policy board. Using those suggestions as a guideline, the board members should establish an organization structure to include all necessary organization entities (committees, subcommittees, regional groups, ad hoc groups, etc.).

Step 2. Duties and Responsibilities

The duties and responsibilities of the policy board should be described, officers elected, procedures established and necessary agreements and/or contracts completed.

Step 3. Authority

The role, authority and responsibility of the policy board should be clearly defined in an appropriate charter and/or set of bylaws. Any such document must obviously be compatible with the policies and procedures of the host agency.

Step 4. Administrative Support

The administrative support required from Project SEARCH and the host agency should also be detailed, personnel requirements established and commitments obtained.

Step 5. Administrative Organization

The host agency will be selected in large part on the basis of its ability to satisfy the requirements for CLIS. Therefore, at this stage of system development, it can be assumed that the host agency will not only be sensitive but totally responsive to these requirements. It is suggested that the host agency organize and staff its administrative and operational responsibilities in the manner most compatible with existing policies and procedures and the specific requirements of CLIS.

CHAPTER 9. TASK 5 — INVOLVEMENT OF SYSTEM USERS

IDENTIFICATION OF USERS

The term "users" as used in this chapter refers to those laboratories that plan to make use of the entire CLIS system or at least a part of it. "Users" may or may not include the various committee or subcommittee members. The term involves collectively the laboratory technicians, clerks and examiners who may have access to the system. From the aspect of determining system policies and procedures, "users" is understood to mean the responsible laboratory directors forming the users' committee.

There is currently established a subcommittee recommendation on user identification as part of the Phase 1 effort. A list of laboratories identified as potential CLIS users and a set of criteria by which they were selected is presented in this chapter. This list was used to identify the laboratories that have been selected to be part of the pilot system (see Figure 8) All of this information will be particularly important in determining loading and volume estimations for development of the system specifications (see Chapter 2).

DEVELOPMENT OF AN AUDIO VISUAL PRESENTATION

One very important aspect of user involvement in the goals and benefits of CLIS is that he thoroughly understand exactly what CLIS is and what it can do for him. There will be a great number of people who must understand the basic objectives and capabilities of CLIS. They can vary from laboratory technicians to state SPA directors to court prosecutors to criminal investigators who will find it necessary to know what the system will and will not do and exactly what services it will provide and generalities concerning the sources and accuracy of resident data

For this reason it is recommended that a formal functional level presentation that will portray the capabilities and benefits of CLIS be developed by a qualified private contractor. This presentation should exist in audio-video form and be oriented as an introduction to the functional aspects of the system. This will be extremely beneficial not only in introducing the system concept to potential users, but also as education of those high-level personnel who will be responsible for funding the project.

- *Time schedule — 60 calendar days*
- *Cost estimate — $10,000.*

PREPARATION OF A USER'S MANUAL

The next step in the development of user involvement is the production of the system user manual. Preparation of this document will be organized in two phases: system functions and application functions. The system functions will describe in basic terms to the operator just how he is to communicate with the system. This will include sign-on and sign-off procedures, how to communicate with the system control and how to resolve erroneous entries. There will be available a sequence of instructions automatically operated by the system to guide or prompt inexperienced operators through the basic procedures. The user manual will also describe the system test routines that will be provided by the system for equipment checkout. A comprehensive list of error messages along with their respective corrective actions to be taken will be included in the manual.

The second phase of the manual will define the operations of the application areas. Operations for each application will be defined in a separate subsection and will be the responsibility of the technical monitors of that area. Each subsection will contain detailed step-by-step procedures on how to enter data and what to expect in return from the system. Any necessary formatting and/or reduction of the input data will be defined for each function that the application is to support. A sample inquiry and response will be delineated step by step (and also supported by the system as a test run) to enable the terminal operator to become fully acquainted with all aspects of each application area function. All error messages will be defined along with a description of what corrective action is to be taken.

The number of laboratory personnel who are expected to be capable of using at least some portion of the system is expected to be at least 500. Geographic distances and workload conditions indicate that it may be expensive to attempt to arrange formal training courses on a nationwide or even regional basis, but at the same time the expense would be justified in the long run. In addition, it is anticipated that a typical laboratory examiner may only use the system a few hours per week. This means that the operational procedures for using the system must be simple and straightforward. It is not appropriate to demand that every terminal operator spend weeks in training just so that he may use the system for a very small percentage of his working day.

- *Time schedule — 30 calendar days*
- *Cost estimate — $5,000*

DEVELOPMENT OF USER TRAINING GUIDELINES

In addition to the functional presentation and the system user manual, a training manual must be prepared to provide each laboratory a means for training its personnel on a formal and OJT basis. Simplified operator interaction for each application area will not only reduce the time necessary for training, but will also enable a user to refresh his knowledge of operator functions merely by quickly scanning a training manual. This manual should be designed to include on-the-job training for each application area. Each section of the manual will describe in detail all of the functions that will be supported for the application. It will include very detailed step-by-step procedures and define all possible combinations of data input. It will also contain examples for all major functions performed by each application area along with descriptions of when and for what reason each step was taken. It will be written at such a level that a laboratory examiner with no knowledge of computer systems can become proficient in use of the capabilities of the system within a short period of time with a minimum of guidance.

- *Time schedule — 20 calendar days*
- *Cost estimate — $5,000.*

Criteria for Laboratories Participating in the Pilot System. Two major criteria should be borne in mind in selecting laboratories for the pilot system:

- They should be varied.
- The applications to be implemented in the pilot system should be useful to them.

Balancing the more detailed criteria in the following list should result in an appropriate mixture of participants:

Interest. Inclusion of many of the laboratories represented on the CLIS committees and of others that have expressed a particular desire to participate.

Geographic representation. Two strategies are possible here — the laboratories could be limited to a particular area, to minimize problems of travel and communication during the development phase; however, it would be more indicative of the future shape and success of the system and probably more satisfactory from most other aspects not to apply such a limitation.

Size. "Size" can be defined as the resultant of two attributes — number of employees and workload. Here again there are two approaches. It could be postulated that only the largest laboratories could support or adequately utilize a CLIS terminal. However, one of the goals of CLIS is to bring to smaller laboratories via a computer terminal capabilities which are currently available only in the large ones. Perhaps there is still a minimum size for a participating laboratory, but the smallest laboratories that have adequate interest and workload should be represented in the pilot system.

Jurisdiction. The pilot system should include terminals located in federal, state, county and municipal laboratories.

Activity and/or instrumentation. The applications proposed for the pilot system are rifling specification and the identification of drugs by infrared spectometry. Hence, the laboratories chosen should have an infrared spectrometer or a heavy commitment to firearms identification, or both.

Function. Besides general criminalistics laboratories, it would be desirable to include laboratories dedicated to firearms identification, drug examinations, toxicology, etc.

Figure 8 is a listing of the laboratories that have been selected by the project committee.

In addition, the committee adopted a definition of a "user" of CLIS; i.e., the "user definition" as originally developed is subject to the constraints of pending legislation potentially governing criminal justice data systems and the policies of the organization housing the system. A "need to know" determination and the specific mechanism for a potential user to either obtain CLIS-generated data or the adding of data to the CLIS data base are a function of the CLIS "policy and decisionmaking establishment." These matters will be resolved in the general policies promulgated by the "establishment" or on an ad hoc basis as specific needs occur.

Figure 8

Potential Pilot Laboratories

Questionnaire	Location	Jurisdiction	No. of Employees	Function	Workload: Drugs	Workload: Firearms	IR Spectrometer now planned		Interest	Remarks
8	S. Charleston, W.V.	S	13		4,230	852	3		C	
16	Los Angeles, CA.	C	12	TOX			1		C	
18	Kansas City, Mo.	M	18		7,630	2,500	1		C	
24	Denver, Col.	S	9		15,400	1,640	2		P	
25	Dallas, Tex.	S	5		3,070		1	X		
34	Dayton, Ohio	C	17		1,190	876	1			
36	St. Louis, Mo.	M	43		4,670	5,070	1			
41	Washington, D.C.	F	438		4,640	10,150	4		P,C	FBI Lab
44	Springfield, Ill.	S	8		3,860	1,060	2	X		
47	Joliet, Ill.	S	22		4,660	1,390	2	X	C	
48	Detroit, Michigan	M	30		11,600	22,500	1			
50	Highland Park, Ill.	C	6		1,640	147	1			
51	Austin, Texas	S	83		74,500	3,320	3		P	
52	Cape May, N. J.	C	1		753		1			
55	Phoenix, Ariz.	S	25		4,520	161	1		C	
56	Plymouth, Mi.	S	23		5,780	1,780	2			
58	Pekin, Ill.	S	5		2,210	287	1			
64	San Bernardino, Ca.	C	13		3,610	408	1			
69	Martinez, Ca.	C	14		2,200	194	1			
70	Albany, N. Y.	S	42		6,280	777	2			
72	Tallahasee, Fla.	S	34		1,437	345	1	X	C	
79	Laramie, Wyo.	S	13		1,300		1		P	
80	E. Lansing, Mi.	S	48		7,410	2,820	1			
84	Washington, D.C.	F	35	Drg.	16,000		1		P,C	DEA Lab
85	Auburn, Ala.	S	70				1		P	
90	Seattle, Wash.	M	14		26,600	245	1			
96	Wichita, Ks.	M	17		17,138	831	1		C	
97	Reno, Nev.	S	3	Drg.	4,620		1		P	
102	Frankfort, Ky.	S	23		6,040	1,320	1			
108	Portland, Ore.	S	4		18,700	272		X	P	
112	London, Oh.	S	44		7,000		3		C	
119	Baltimore, Md.	PC M	76		4,950	3,930	1		C	
120	Ft. Worth, Tx.	M	22		4,540	162	1			
148	Warren, Mi.	S	15		4,000	800	1		P	
160	Madison, Wi.	S	36		21,000	4,640	2			
167	Los Angeles, Ca.	M	33		16,000	2,240	1			
168	Miami, Fl.	C	80		4,530	4,720	1		P	
170	San Francisco, Ca.	C	6		4,050	458	1			
176	Levittown, Pa.	C	3		9,470		1			
147	Riverside, Ca.	S	11		676		?	0		
62	Sante Fe, N.M.	S	7				1	?		
86	NYC, N.Y.	M	320		20,000	16,850	4	0		
49	Allegheny Co., Pa.	C	18		3,141	1,065	3	0		
76	Charlotte, N.C.	C	30				1	0		
118	KBI, Topeka, Ks.	S	9				1	0		
None	Chicago, Ill.									
None	Eastern Ohio Forensic Lab									

CHAPTER 10. TASK 6 — DEVELOPMENT OF PILOT SYSTEM

The need was suggested, early in this project, to concentrate first on parts of the system that are easy to implement, useful, visible, and at the same time are high on the list of potential users' desires. The criteria for implementation priorities are discussed more fully in Chapter 3 of this report. At the San Francisco meeting on July 23, 1974 the organizational alternatives subcommittee suggested that a prototype system servicing 30 laboratories be described, costed, and scheduled for first implementation. This chapter proposes such a system, herein referred to as a "pilot" system and describes how it might be implemented.

DEFINITION OF PILOT SYSTEM

A pilot system would consist of the application functions highest on the implementation priority list serving a number of terminals smaller than that proposed for the final full system.

System Facilities. Certain basic capabilities would need to be designed into the pilot system; these should not have to be repeated in expanding to the full system:

- Data base entry capability
- Data base updating capabilities, both at the data base site and remotely from the terminals (for the users' own data bases)
- Formatting and editing facilities for inputs and outputs from the terminals
- A "driver" program to allow terminals to be interactive with the application processing and data bases.

Applications. It is suggested that the pilot system support the first two applications in the revised priorities list presented at the end of Chapter 3, namely:

- Rifling specifications
- Analytical and identification support for infrared spectroscopy of drugs only.

Data Bases. These data bases are recommended for this level of implementation:

- A rifling specifications file
- The collection of IR spectra for pharmaceuticals from Sadtler Research Laboratories, Inc.
- The files of forensic and alkaloid IR spectra from the United Kingdom's Home Office Central Research Establishment
- File space for users' collections of drug IR spectra.

Terminals. The number of 30 terminals is arbitrarily accepted as a reasonable number to be implemented first, one in each of 30 laboratories. An additional terminal will be needed at the central processing site.

HARDWARE REQUIRED

Terminals. The worst case assumption is made that terminals will have to be supplied to all of the 30 laboratories chosen for the pilot system, even though some of them may already have applicable terminals. No in-laboratory processors are assumed for the pilot system. Using the median price for intelligent terminals developed in the Volume 3 Report, the monthly cost of 31 terminals can be calculated to be about $7100 (30 laboratories plus one terminal at the central site).

Actually, the specific types of terminals available or appropriate for use will depend on the details of the communications hookup employed; this will vary from state to state. Part of Phase II of CLIS will have to be an investigation of (1) where the potential user sites are, (2) which ones of them will need to be supplied with terminals, (3) what interfaces are available for the terminals, and (4) which model or models of terminals should be specified and installed.

In the Volume 3 Report a series of assumptions was made which allowed the estimation of the additional cost required to connect laboratory terminals to NCIC or NLETS. This cost prorates to about $100 per terminal per month or about $3100 per month for 31 terminals. Additionally, there would be a one-time connection fee of about $100 per terminal (not included in the Volume 3 estimate).

Cost of a Central Processor. Summarizing figures developed in Chapter 2 of the Task 3 Report, we can postulate the following costs:

CPU with 64,000 words of memory	$269,000
Communications hardware	19,000
TOTAL PRICE FOR THIS CONFIGURATON	$288,000
Additional peripherals	106,000
TOTAL	$394,000

Additional peripherals include tape and small disk drives, a card reader, and a line printer. These devices were not included in the Volume 3 configuration.

This equipment configuration is based on a Digital Equipment Corporation DECsystem 10. This would be a very good choice for the CLIS system because of its network communication capability and its expandibility. It is also intermediate in the cost range of system possibilities — comparable hardware from any other manufacturer would be more expensive, and smaller systems from various manufacturers, such as DEC itself, would be less expensive.

Data Storage

Using the record and file size estimates developed in Volume 3, the following is an estimate of storage requirements:

Rifling specifications file	600,000 chars.
Sadtler Pharmaceuticals file	295,000 chars.
HOCRE forensic and alkaloids file	566,000 chars.
Users' file area	540,000 chars.
TOTAL DATA STORAGE	2,001,000 chars.

A single DEC 3330-type disk pack system for the DECsystem 10 will hold about 100 million characters of storage, or plenty of room for the initial CLIS data base, system software, and a great deal of space for expansion. The cost of a controller and one of these units will be about $55,000.[1]

Hardware Tasks and Decisions

Step 1. Specify Terminals. The selection of the laboratory sites that are to be part of the pilot system was discussed previously under "User Involvement." After the selection has been made, the following can be determined:

- Whether appropriate terminals are already present or whether new ones must be provided
- What various interfacing specifications, if any, must be considered if the tie-in for a given terminal is to be through an existing state network.

When these factors have been defined, terminal hardware can be specified. The same type of terminal will not necessarily be appropriate in all locations.

Decisions which must be made in the terminal selection process include those below:

- Should a keyboard/printer or a cathode ray tube (CRT) terminal be used?
- If a keyboard/printer is selected, should it be slow or a fast type?
- If a CRT is specified, should it be a basic or an intelligent terminal?
- If an inteligent type, what intelligent capabilities should it have?
- If the terminal is a nonprinting type, should a hardcopy device be associated with it?

Step 2. Define Specifications of Processing Hardware. It is desirable, but not mandatory, that this step follow that of specifying terminals.

Step 3. Select Vendor. Once a hardware specifications document is produced, it can be transmitted to vendors, their responses evaluated, and the most suitable system can be chosen.

Step 4. Determine Installation Data. As discussed under "trade-offs," it is possible, but not recommended, to delay purchase of the hardware until the software is partly developed.

Step 5. Develop Data Storage Acquisition Strategy. It is possible to assume a strategy whereby only a small disk is needed at first and larger drives are added only as needed for data base implementation. This is also discussed under "trade-offs."

Hardware Cost Summary	Purchase Price	Monthly Charge
Terminal Rental		$7100
Terminal Maintenance		1450
CPU, Memory, and Communications Hardware	$394,000	
Maintenance for CPU, Memory, and Communications Hardware		1412
Disk Pack System	55,0000[1]	
Maintenance for Disk Pack System		362
TOTAL HARDWARE COSTS	$449,000	$10,324

[1]Estimated. These products have not yet been announced.

SOFTWARE REQUIRED

The intelligent design of a multiple-application system such as CLIS is a series of modules which perform such tasks as managing communications to and from multiple terminals (regardless of the type of message traffic) or updating data bases (regardless of which data base). Differences between applications are for the most part handled by entries in tables (such as a record definition table or an editing criteria table). Relatively little programming has to be done that is specific to each application. Such a system is said to be table-driven. Table-driven systems have the great advantage of allowing additional applications to be added with a small additional effort.

Systems Software

Terminal handler. This module will provide the necessary switching logic between all terminals and the nonapplication-specific interactive driver. Some or all of this capability may be provided by the communications network used, thus reducing the amount of implementation programming required.

Interactive driver. This program provides the logic to react to whatever action the operator at the terminal has taken, thus linking the terminal handler to various applications and systems programs.

File Manager. This is a utility to interact with the data base somewhat analogously to the way the terminal handler interacts with the terminals. Some of the capability may be covered by manufacturer-provided software.

Formatter. This module arranges information in a meaningful manner whether it be for disk storage, hard copy, or CRT display. It may include editing and range-checking criteria. It is used both by the interactive driver and the file manager. Some of the function may be provided by intelligent terminals.

Data base entry and updating facilities. These are used at the data storage location to increase ar modify the data base. They do not involve the terminals, but they do use the file manager.

Data base updating from terminals. This function is similar to the centrally located updating facility but allows the user to update his own data base from his terminal. As such, it also interacts with the interactive driver, formatter, and terminal handler.

Applications Software. (both Rifling Specifications and Infrared Identification Support)

Application-specific interactive logic. The programming required by the unique characteristics of each application area. For example, for infrared searching it might include the interactive encoding necessary to render spectra into machine-understandable form.

Search logic. This includes algorithms and matching logic required to find filed records according to various criteria. It interrelates between application-specific modules and the file manager.

Tables. These contain all the application-related entries that drive the generalized modules. Examples would be terminal specifications, formats, editing criteria, error checking criteria, record definitions, specifications for data base managers, etc.

Figure 9 diagrams the interactions between these modules. Table 3 predicts the levels of expertise and time required to implement the programming tasks.

Software Implementation Sequence

Figure 10 shows how manpower might be most efficiently allocated to achieve the linear sequence presented in Table 3.

Manning Level. (Refer to Figure 10). The professional complement would vary from one to three persons on the project. The clerical need would continue to involve a single individual. Each horizontal bar in the figure represents a level of expertise in the computer profession. As indicated, systems analysis and clerical functions would be needed initially and a programmer/analyst would be needed shortly thereafter. A junior programmer would not be needed for three and a half months but would remain assigned to the task for some months after the others had completed their parts. The clerical function could be converted to "operational" status after implementation of the system tables.

SOURCES OF PILOT DATA BASES

As specified under "Definition of Pilot System" above, data bases are to be included in this phase of the system: (1) Rifling specifications; (2) Sadtler IR spectra for pharmaceuticals; (3) HOCRE (British Home Office) forensic and alkaloid IR spectra; and (4) user-generated IR spectra for drugs.

The rifling specifications file apparently will have to be generated from scratch.

The Sadtler file is available as hard copy for $504; it is not available in computer-readable form. An approach which is more economical in the long run is to pay $1,000 to $3,000 (depending on form and completeness) for the entire ASTM IR data base in machine-readable form. The ASTM file contains the Sadtler pharmaceuticals file as a subfile. The rest of the data base would be required for later phases of CLIS.

The HOCRE file is available on microfilm from the Central Research Establishment in Aldermaston, England. Since the file is part of the Toxicology Data Bank being developed jointly by HOCRE and the Walter Reed Army Research Institute, it is possible that it could be obtained in machine-readable form. The HOCRE files are presumably available free of cost to the law enforcement community.

Contributions to users' files should be entered at their terminals. However, users may have large data bases extant at the time of CLIS inception which they may wish to include in the automated data base. In these cases there would need to be encoding and conversion to machine-readable form at the central facility.

Some of the following operations will be required to get each of the data bases into the system:

- Obtaining available information
- Making measurements to gain information not yet available
- Design of an encoding procedure
- Compilation of the data onto standard forms
- Conversion of the forms to machine-readable state (e.g., via keypunching or key-to-disk)
- "Putting up the data base" or the actual feeding of the machine-readable material to the computer for transfer to its data storage devices
- Computer conversion of machine-readable information into a different format for internal storage.

Those steps which might be invoked for each data base are shown in Table 4.

Cost of Initial Establishment of Data Bases. In estimating a data base establishment cost the following assumptions are made:

- The rifling specifications file must be built from scratch, from manual encoding to conversion to machine-readable form.
- The Sadtler pharmaceuticals file is obtained from the ASTM data base in machine-readable form. The ASTM data base is purchased for $2,000.
- The HOCRE files are not obtained in machine-readable form and must be manually converted.
- The establishment of user-generated data bases is not part of the initial implementation.
- Encoding of these records onto data forms can proceed at an average rate of 30 per hour.
- Keypunching, or other conversion to machine-readable form can be done at an average rate of 50 records per hour.
- The manpower constant (see Chapter 3 for clerical activities is $200 for a 40-hour week.

Table 5 shows the calculations based on these assumptions which can be used to arrive at the cost to set up these data bases. It would be less expensive ($824) to purchase and manually convert the 1200-record Sadtler pharmaceuticals file, but purchase of the ASTM data base in machine-readable form becomes cost-effective when the final system is implemented.

TIME AND COST SUMMARY

Figure 10 and Table 6 depict how manpower, implementation priorities, elapsed time, and costs interrelate for the pilot system. Aspects of these interrelationships are discussed below:

COSTS

Table 6 lists the individual and cumulative costs during the implementation phase of the project. A major alternative would be to delay installation of the hardware until the first program modules were nearly ready; say, until month four (instead of month one) of the implementation phase. See the "Implementation Alternatives" section for a discussion of why this delay is not recommended.

Training costs were estimated using the time and cost factors for training described in the "Definitions" chapter. Figure 11 shows the schedule used to estimate the training costs for Table 6.

Table 6 reflects manpower costs based on national industry averages taken from a survey conducted by Datamation magazines. The figures include an overhead factor of 100 percent. If typical federal government GS ratings were used, the bottom line total would equal $976,700 (see Figure 6).

Figure 9

Interrelations of Prototype CLIS Software Modules

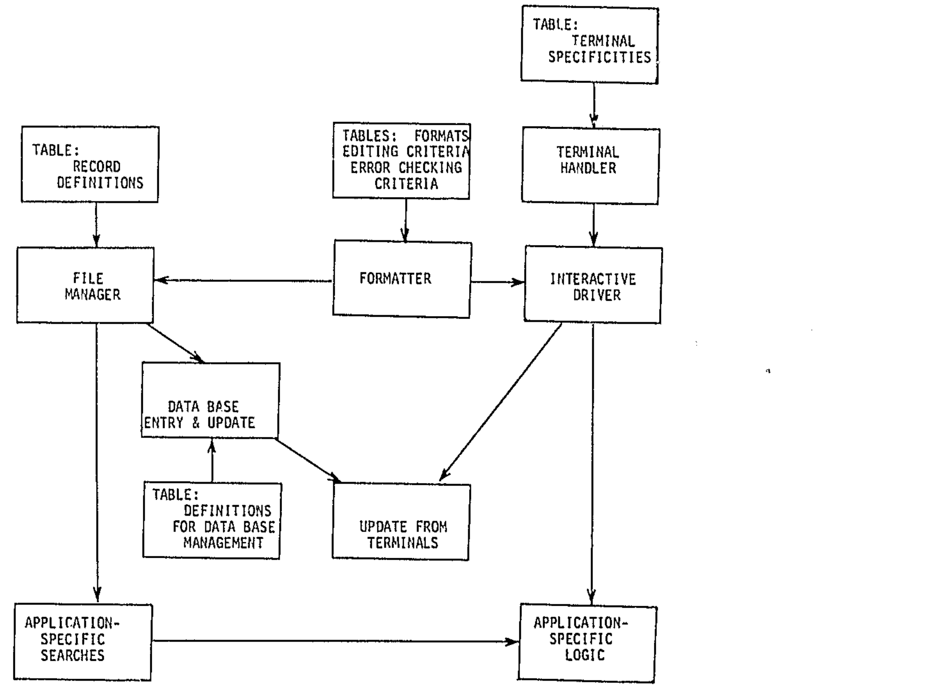
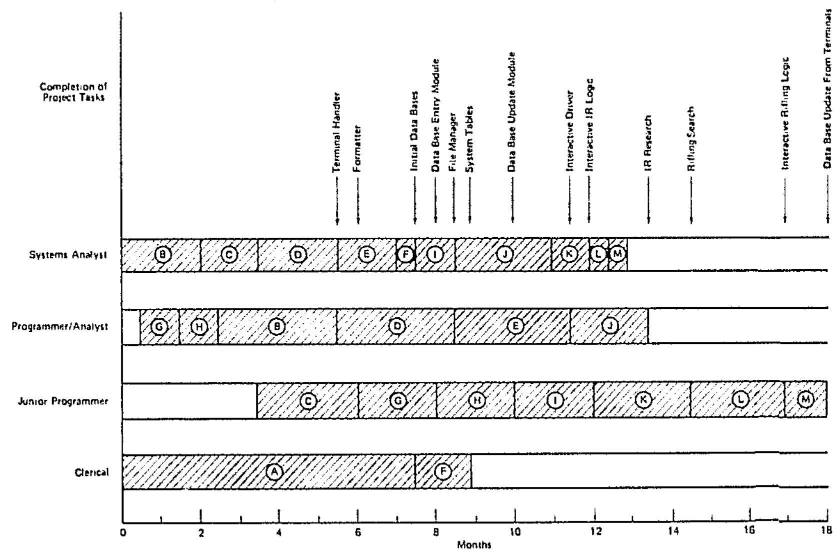


Figure 10

Manpower Allocation for Implementation Phase of CLIS Prototype System



Circled letters refer to the tasks listed in Table III. Task A represents initial data base implementation and is not included in Table III.

Figure 11

Schedule Assumed in Estimating Training Costs

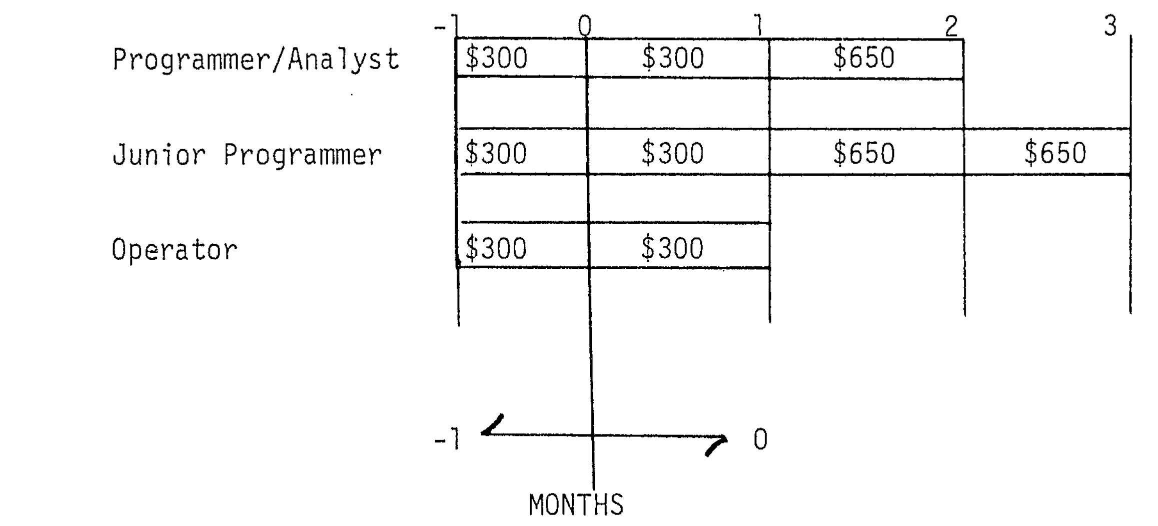


Table 3

Implementation Sequence, Times, and Required Levels of Expertise for Prototype CLIS Software Modules

(Time in man-months)

Task	Priority	Systems Analyst	Programmer/ Analyst	Junior Programmer	Clerk
B. Terminal handler	1	2	3		
C. Formatter	1	1.5		2.5	
D. File Manager	1	2	3		
E. Interactive Driver	1	1.5	3		
F. System Tables	1	0.5			1.5
G. Data Base Entry	2		1	2	
H. Data Base Update	2		1	2	
I. IR interactive	3	1		2	
J. IR search	3	2.5	2		
K. Rifling search	3	1		2.5	
L. Rifling interactive	3	0.5		2	
M. Update from terminals	4	0.5	—	1.5	—
TOTAL		13	13	14.5	1.5

Task A is reserved for data base implementation and is not included in this table.

Table 4

STEPS REQUIRED TO PUT UP PILOT DATA BASES

	Rifling	Sadtler	HOCRE	User
1. Obtain information	X(A),(B)	X(C)	X	X(B)
2. New measurements	X			X(D)
3. Define encoding	X	(X)(E)	(X)(E)	X
4. Fill out forms	X	(X)(F)	(X)(F)	(X)(G)
5. Key-to-machine-readable	X	(X)(F)	(X)(F)	(X)(G)
6. Feed computer	X	X	X	(X)(G)
7. Computer conversion		(X)(E)	(X)(E)	

Notes:

(A) Obtained from published sources
(B) Obtained from users
(C) Purchased
(D) An ongoing process
(E) Only if existing format is not used
(F) Only if not obtained in machine-readable form
(G) Only if a large data base is put up at one time; otherwise, entry is via terminals.

Table 5

Computation of Data Base Implementation Costs — Pilot System

	Rifling	HOCRE
Number of records	3,000	2,300
Number of hours required for entry onto forms @ 30 records/hour	100	76.7
Number of hours required for conversion to machine-readable form @ 30 records/hour	60	46
Total hours	160	123
Number of weeks required @ 40 hours/week	4	3.08
Manpower cost @ $200/week	$800	$620
Total clerical cost		$1,420
Purchase of ASTM data base		2,000
Total Data Base Implementation cost		$3,420

Table 6

Summary of CLIS Prototype Implementation Costs

	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3	[illegible]	[illegible]	[illegible]	[illegible]
One-Time Costs:																			
Hardware Purchase																			
Computer	$394,000	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Data Storage	55,000	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Terminal Hookup	---	---	---	---	---	---	$3,100	---	---	---	---	---	---	---	---	---	---	---	---
Data Base Purchase	---	---	---	---	---	---	---	[illegible]	---	---	---	---	---	---	---	---	---	---	---
Training	900	$2,850	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Monthly Hardware Costs:																			
Terminal Rental	---	---	---	---	---	---	7,100	7,100	$7,100	$7,100	$7,100	$7,100	$7,100	$7,100	$7,100	[illegible]	[illegible]	[illegible]	[illegible]
Communications Fees	---	---	---	---	---	---	3,100	3,100	3,100	3,100	3,100	3,100	3,100	3,100	3,100	[illegible]	[illegible]	[illegible]	[illegible]
Maintenance																			
Terminals	---	---	---	---	---	---	---	1,450	1,450	1,450	1,450	1,450	1,450	1,450	1,450	[illegible]	[illegible]	[illegible]	[illegible]
CPU & Data Storage	1,784	1,784	1,784	1,784	1,784	1,784	1,784	1,784	1,784	1,784	1,784	1,784	1,784	1,784	1,784	[illegible]	[illegible]	[illegible]	[illegible]
Manpower:																			
Coordinator	2,580	2,580	2,580	2,580	2,580	2,580	2,580	2,580	2,580	2,580	2,580	2,580	2,580	2,580	2,580	[illegible]	[illegible]	[illegible]	[illegible]
Secretary	860	860	860	860	860	860	860	860	860	860	860	860	860	860	860	[illegible]	[illegible]	[illegible]	[illegible]
Systems Analyst	2,580	2,580	2,580	2,580	2,580	2,580	2,580	2,580	2,580	2,580	2,580	2,580	2,580	2,580	2,580	---	---	---	---
Programmer/Analyst	[illegible]	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	[illegible]	---	---	---
Junior Programmer	430	1,200	---	---	860	1,720	1,720	1,720	1,720	1,720	1,720	1,720	1,720	1,720	1,720	[illegible]	[illegible]	[illegible]	[illegible]
Computer Operator	860	860	860	860	860	860	860	860	860	860	860	860	860	860	860	[illegible]	[illegible]	[illegible]	[illegible]
Keypunch Operator	---	860	860	860	860	860	860	860	860	860	860	860	860	860	860	[illegible]	[illegible]	[illegible]	[illegible]
MONTHLY TOTAL	$459,464	$15,724	$11,674	$11,674	$12,534	$13,394	[illegible]	$27,[illegible]	$25,044	$25,044	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CUMULATIVE TOTAL	$459,464	$475,188	$486,862	$498,536	$511,070	$524,464	$551,[illegible]	$578,[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

CHAPTER 11. TASK 7 — PROGRESS ASSESSMENT

THE IMPORTANCE OF IMPACT ASSESSMENT

This particular task will be extremely important in that it is the first major opportunity to assess the actual impact of several of the key implementation tasks. Previous project review and assessment activities will have been concerned almost exclusively with the quality of project planning. The three tasks which will come under the joint review of Project SEARCH and LEAA at this point in the implementation process are critical to the success of CLIS and should give the first objective assessment of actual performance as it relates to organization, user involvement and the provision of services.

THE REVIEW PROCESS

The following steps are suggested for the review and assessment of Task 4 — Organization for Policy and Administrative Control; Task 5 — Involvement of System Users; and Task 6 — Development of a Pilot System. All are the responsibility of the Joint Review Group (Project SEARCH and LEAA).

Step 1. Assess CLIS policy group organization and activities.

- Membership selection and participation
- Representation of user interests
- Structure of working committees and subcommittees
- Number of meetings, purpose, accomplishments
- Impact of the policy group upon implementation

Time Frame: 30 days, beginning one month after the completion of Task 4.

Step 2. Assess CLIS audio-visual presentation.

- Effectiveness in explaining CLIS to prospective users
- Versatility in use with other interested groups.

Time Frame: one month after completion of Task 5, done concurrently with Steps 3 and 4.

Step 3. Assess CLIS User's Manual.

- Comprehensiveness and clarity of content
- Simplicity of use
- As an aid to users
- Printing and distribution.

Time Frame: one month after completion of Task 5, done concurrently with Steps 2 and 4.

Step 4. Assess CLIS User Training Guidelines.

- Effectiveness and comprehensiveness
- Versatility and flexibility based upon the "need to know" of user personnel.

Time Frame: one month after completion of Task 5, done concurrently with Steps 2 and 3.

Step 5. Assess CLIS Pilot System.

- Hardware
- Software
- Administrative and operational organization
- Data base development
- Adherence to schedules
- Usage rates.

Time Frame: Hardware and Software — 12 months after start of Task 6; Data bases — 18 to 24 months after start of Task 6.

DECISIONS OF REVIEW GROUP

Several key decisions affecting the implementation of a full CLIS system can be made after a careful review of these three important tasks.

- Should the organization structure or process of the CLIS policy group be modified to increase effectiveness?
- Are changes required in the user's orientation and training process before they are applied in a total system environment?
- Does the experience of the pilot system suggest changes to the plan for full system implementation?
- How can any needed changes be best incorporated into the planning process?

It is possible that the joint review group will not be able to resolve some of these questions without the assistance of some outside resources. The joint review group should then delegate specific authority to an individual or group capable of successfully completing the assigned tasks on behalf of the review group.

CHAPTER 12. TASK 8 — DEVELOPMENT OF FULL SYSTEM

The previous chapter described the implementation of a pilot system, with reduced data bases and a reduced number of terminals. Assuming that this system successfully passes its evaluation period, it will then be necessary to expand it to the full CLIS system. This chapter describes the operations necessary to accomplish this. However, as explained below, it will be necessary that some applications already be under development in parallel with the pilot system. Certain costs, incurred in the development of a pilot system, were described in the last chapter. The costs presented in this chapter are the incremental cost required to bring the pilot up to a full system.

HARDWARE REQUIRED

Terminals. In Phase II the distribution of, the necessity for, and the nature of terminals will need to be investigated in detail. For the present the assumptions of Volume 3 are maintained; i.e., that there will be 200 terminals of which 60 are local processors installed in the laboratories. If it is decided to use medium-priced intelligent terminals, then from the cost figures developed in Volume 3, and the "Development of a Pilot System" chapter of this report, the following monthly costs may be computed:

140 intelligent local terminals	$ 32,100
60 local CPU's and data storage	84,000
Modem and line costs for 200 terminals	20,000
Total for 200 terminals	$136,100
Less 31 terminals installed in pilot phase	7,100
Less modem and line costs for 31 terminals	3,100
Total for 169 terminals	$125,900
Maintenance for 109 local terminals*	5,120
Total monthly costs for terminals	$131,020

*The maintenance charge for the local CPU's is assumed to be included in the lease price.

Assuming an average connection charge of $100 per terminal for 169 terminals, there would be an additional one-time charge of $16,900.

Central Processing Hardware. For the DEC system 10 configuration specified for the pilot system, the only incremental hardware necessary in expending to a full system would be an input/output channel controller needed for communication with the increased number of data storage disk drives. The purchase price for this piece of equipment is $14,000. The monthly maintenance charge is $67.

Data Storage. Three additional 3330-type disk drives would be required to hold the full CLIS data base. These units have not yet been put on the market by the Digital Equipment Corporation, so price estimates are only approximate. Three drives (the controller was already included in the pilot system) would cost about $75,000. Monthly maintenance would be about $765.

Hardware Decisions and Tasks — Full System. The identification of user-sites to be included in a pilot system will be part of a larger effort to identify all potential CLIS terminal locations.

As with the pilot system, each site must be considered regarding:

- Whether a terminal exists, must be provided by CLIS, or will be obtained through some other means.
- How many terminals are appropriate to the site.
- Whether there are any peculiar interfacing conditions.
- What kind of terminal should be provided, in terms of speed, intelligence, whether keyboard/printer or CRT, etc.

Terminals will no doubt be added incrementally to the system, so that any terminal costs borne by the CLIS project will also be added incrementally.

The implementation and funding of local processors in some laboratories should be looked at very carefully, since they constitute such an expensive part of the system.

The hardware items that need to be added in expanding from a pilot to a full system are as follows:

- an additional I/O Channel
- more terminals
- more data storage.

The best strategy for adding data storage hardware would be to add hardware only as fast as necessary for the data bases as they go up.

Hardware Cost Summary	Purchase/ One Time Costs	Monthly/ Lease and/or Maint. Cost
Cost to expand from pilot to full system		
Terminals	$16,900*	$131,000**
Central Processing	14,000	67***
Data Storage	75,000	765***
Total Expansion Cost	$106,000	$131,832
Cost of Pilot System	449,000	10,324
Total System Cost	$555,000	$142,156

* One Time Terminal Connection Cost
** Lease and Maintenance
*** Maintenance Average

SOFTWARE REQUIRED

Most of the systems software will be completed in implementing the pilot system. Updating the system tables to accommodate additional applications should be only a minor chore. Most of the new programming for the added functions will be involved with the interactive logic and search modules.

Systems Software. For expansion to the full system, this category resolves into only two subtasks:

- additions to system tables
- maintenance and improvement to existing systems software modules, based on experience gained from the pilot system.

Applications Software. Expansion of the infrared search for a much larger data base will no doubt require modification of the existing interactive logic and search modules. Experience gained from the pilot system will probably lead to some reworking and improvement of these programs.

Programs similar to the IR Modules will be needed for support of UV searches. This will also proceed in two stages — first, for drugs, and second for nondrugs. Experience gained from the IR programming should make the ultraviolet implementation less formidable.

Interactive logic and search modules will also be needed for the GC, mass spectrography, fluorescence spectrography, and X-ray diffraction identification support applications to be implemented in this stage.

The bibliographic/abstracting services function will be one of the most complex and time-consuming applications to design and program. The interactive logic required will be extremely involved. In addition to this and to the search mechanism, there will be a requirement for a unique module to allow entry of literature abstracts at the central CLIS site.

Implementation Sequence. Table 7 presents the amount of manpower required at each level of expertise for programming the various applications.

SOURCES OF FULL SYSTEM DATA BASES

Chemical Identification Support Files. Sadtler Research Laboratories, Inc., markets a collection of 2,000 pharmaceuticals ultraviolet spectra at $700, which would be an appropriate constituent of a drugs-only data base. However, this collection is presumably a subset of their larger standard UV spectra collection which would be needed eventually for a nondrugs UV data base. A trade-off analysis should be conducted during Phase II to determine whether or not the larger 36,000-entry collection should be purchased initially for $5,470.

HOCRE supplies a 700-spectrum collection of alkaloids, which should also be included in the initial drugs-only data base. It is supplied free on microfilm to the law enforcement community.

Table 7
Implementation Sequence, Man-Months, and
Implementation for Full CLIS System
Levels of Expertise Required for Software

Application	Systems Analyst	Programmer/ Analyst	Junior Programmer	Total
UV-Drugs	1.5	0.5	0.5	2.5
Bibliographic/Abstract	7		20	27
IR-nondrugs	4	5.5	5.5	15
Sources	3		9	12
GC, MS	10	5	5	20
UV-nondrugs	4	4	4.5	12.5
Fluorescence Spectography and X-ray diffraction	7.5	4.0	4	15.5
Total	37.0	19.0	48.5	104.5

It was suggested in Chapter 7 that the entire ASTM infrared data base be purchased and a subset of it be used for a drugs-only file in the pilot system. No additional data base would then need to be acquired for the full system.

For gas chromatography support the only publicly available data base is the ASTM Gas Chromatographic Data Compilation which is sold in machine-readable form at $500.

The most complete mass spec data base is the 37,000-entry file used for the Mass Spectral Search System maintained by the Environmental Protection Agency. Since it is a government-developed system, the data are in the public domain and may be available free of charge and in machine-readable form.

The Sadtler Research Laboratories collection of 1,000 excitation and emission fluorescence spectra is available at $250.

The Florida Crime Information Center has a computerized X-ray diffraction support program. It is available from the Joint Commission on Powder Diffraction Standards in machine-readable form for $2,500.

In areas other than IR, UV, and mass spec, the major thrust of CLIS implementation should be in support of the users' own data bases for analytical support. User files are also an important addition to standard UV, IR, and MS data bases.

Other Files. Data bases for applications other than identification support may be largely CLIS-generated in the manner of the rifling specification file developed for the pilot system. The largest of these will be a bibliographic/abstracting services file which may require an outside contractor to do the actual abstracting and will involve considerable ongoing support in order to keep it up to date.

The two categories of the "sources" file — reagents and samples — will probably be compiled largely from contributions from CLIS users.

These will also require ongoing support, but on a much smaller scale than the bibliographic function.

Operations Involved in Data Base Implementation and Maintenance. Table 8 shows which operations would be required to get each of the data bases into the system.

Costs of Establishing Data Bases. The assumptions listed below have been invoked in order to estimate the costs of establishing the data bases:

- The Sadtler UV pharmaceuticals file is obtained from the complete file of Sadtler Standard UV Spectra which is purchased for $5,470.
- The HOCRE file, the Sadtler fluorescence spec file and portions of other files that are not available in machine-readable form must be manually converted.
- The bibliographic/abstract file is built from scratch, from manual encoding to machine-readable form; the actual abstracting, however, is contracted outside.
- The IR file for nondrugs is taken from the ASTM data base which was purchased for the pilot system and is in machine-readable form.

Table 8

Operations Required to Expand from Pilot to Full System Data Bases

	UV-DRUGS SADTLER	UV-DRUGS HOCRE	BIBLP/ ABST	IR NONDRUGS	SOURCES REAGENTS	SOURCES SAMPLES	GC	MASS SPEC.	UV NONDRUGS	FLOR. SPEC.	X-RAY DIFF	USER
Obtain information	X(A)	X	X(B),(C)	(D)	X(E)	X(E)	X(A)	X	X(F)	X(A)	X(A)	X(E)
Make new entries			X(G)		X(G)	X(G)						X(G)
Define encloding process	X(H)	X(H)	X	(D)	X	X	X(H)	X(H)	X(F)	X(H)	X(H)	X
Fill out forms	X	X(I)	X	X(I)	X(J)	X(J)	X	X	X	X	X(I)	X(J)
Convert to machine-readable				X(I)	X(J)	X(J)	X	X	X	X	X(I)	X(J)
Feed computer	X	X	X	X	X(J)	X(J)	X	X	X	X	X	X(J)
Computered conversion	X(H)	X(H)		X(H)			X(H)	X(H)	X(H)	X(H)	X(H)	

NOTES:
(A) Purchased
(B) Obtained from published sources
(C) An ongoing process
(D) Already obtained for pilot system
(E) Obtained from users
(F) Already obtained from drug UV file
(G) An ongoing process
(H) Only if existing format is not used
(I) Only if not obtained in machine-readable form
(J) Only if a large data base is put up at one time; otherwise, entry is from terminals.

- The "Reagents," "Evidence," and users' files are built up over a period of time and do not involve an initial implementation effort.
- The ASTM Gas Chromatographic Data Compilation is purchased at $500 in machine-readable form.
- The Sadtler fluorescence spec file is purchased for $250.
- The MSS mass spec data base is obtained in machine-readable form, but the format must be converted to a more compact form via program.
- No additional purchase is necessary for a UV file for non-drugs, but the data must be converted to machine-readable form.
- An X-ray diffraction data base is procured for $2,500 in machine-readable form.

The following manpower constants are also assumed:

- Encoding of records onto data forms proceeds at an average rate of 30 per hour.
- Conversion to machine-readable form is done at an average rate of 50 records per hour.
- The clerical manpower constant (see Chapter 2) is $200 for a 40-hour week.

Using these assumptions the calculations shown in Table 9 can be used to determine estimated base establishment costs.

TIME AND COST SUMMARY

Figure 12 depicts the approximate time-phasing for the full system. After implementation of the pilot system, a three-month lag is allowed for evaluation of the parts of the system then in existence. Even so, work on the bibliographic/abstract, IR for nondrugs, and GC and MS must overlap all or part of the pilot system implementation. Otherwise, completion of the system would be inordinately delayed and the application areas could not be implemented in the desired sequence.

Manning Level. To maintain the implementation schedule shown in Figure 12 it is estimated that the following personnel would be needed in addition to those required for the pilot system:

- One systems analyst
- One programmer/analyst
- One junior programmer
- Two clerks

The system analyst and one of the clerks would be needed in parallel with the pilot system to begin work on the bibliographic/abstracts, GC, mass spec, and IR for nondrugs applications program design and data base implementation. Assignment of the others could wait until completion of the pilot system when the personnel assigned to those tasks would also be available.

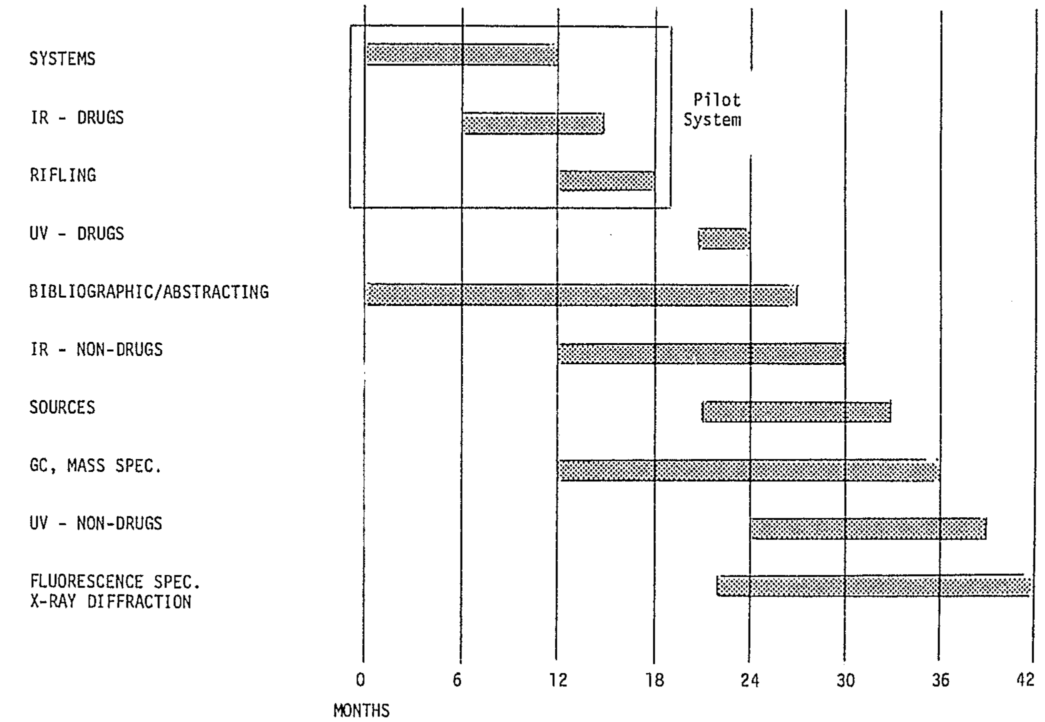
Table 9

Computation of Data Base Implementation Costs — Full System

	UV-SADTLER	UV-HOCRE	UV-NONDRUG	FLUORESCENCE SPEC.	BIBLIO/ ABSTRACT
No. of Records	2,000	700	34,000	1,000	6,000
No. hours required for entry on forms at 30 records/hour	66.7	23.3	1,130	33.3	200
No. hours required for conversion to machine-readable form at 50/records hr.	40	14	680	20	120
Total hours	107	37.3	1,810	53.3	320
No. weeks required at 40 hours/week	2.68	.942	45.2	1.44	8
Manhour cost at $200/week	$540	$190	$9,000	$290	$1,600
Total clerical cost					$11,620
Purchase of data bases					
UV-Sadtler $5,470					
FS-Sadtler $ 250					
GC-ASTM $ 500					
XRD-JCPDS $2,500					
Total DB Purchase					$ 8,720
Total data base implementation cost					$20,340

Figure 12

Time Phasing for Full CLIS System



Cost Summary. Table 10 roughly tabulates the estimated costs required to implement a CLIS system over the first three and one half years. Circumstances which might significantly affect these costs are discussed below:

- The largest single item is the lease cost for terminal equipment, including local processors. Some terminals, and especially the local processors, might be acquired individually by laboratories and funded outside this project.
- The eventual number of terminals may be less than the 200 we are estimating. At any rate, many of them may be deferred so that charges for 200 terminals would not start immediately after implementation of the pilot system as assumed in these figures.
- Full data storage is also assumed immediately after the pilot system. Because the data bases will not all be ready at the same time, purchase of part of this capability could be deferred and maintenance charges would not start until it was installed.
- Detailed study of personnel allocation will probably result in more efficient assignments than shown, and this major item could be reduced somewhat.

Cost of Contracting Specific Items. Rather than the entire implementation being accomplished by a single agency, parts of the project could be contracted out modularly to various contractors or subcontractors. Table 11 shows the costs of converting the various data bases to machine-readable form at $66 an hour. Table 12 shows analysis and programming costs for the various application areas. A monthly cost of $17,500 is used. This assumes that several persons with varying levels of systems analysis, programming, and perhaps clerical expertise are assigned to the project.

The incremental cost of clerical personnel for implementation of the full system is $73,960. Were the contracting of data preparation to allow a reduction in clerical staff, there might be a cost savings realizable through this approach. However, the clerical personnel will have many other duties, so that any such savings would be illusory.

In contrast, the contract cost ($682,500) for programming and analysis is considerably higher than the CLIS manpower costs for the same functions ($338,100).

REFERENCES

Anderson, Don H. and Covert, G. L. "Computer Search System for Retrieval of Infrared Data," *Analytical Chemistry*, Vol. 39 (1967), 1288-1293.

Blackwell, R. J. and Framan. E. P. *Automated Firearms Identification System (AFIDS): Phase I.* Report prepared for the Application Technology Office, National Aeronautics and Space Administration by the Jet Propulsion Laboratory, California Institute of Technology, 1974.

Erley, Duncan S. "A Quantitative Evaluation of Several Infrared Searching Systems," *Applied Spectroscopy,* Vol. 25 (1971), 200.

Kazyak, Leo. "Information Exchange and Computerized Data Retrieval for Toxicology," *Journal of Forensic Sciences,* Vol. 19, No. 1 (1974), 147-154.

Madrazo, Frank G. *Pilot Computerized Infrared Data File.* Report prepared for the National Institute of Law Enforcement and Criminal Justice, Law Enforcement Assistance Administration by the Criminalistics Research Bureau, New York State Division of Criminal Justice Services, 1972.

McLaughlin, Richard A. "EDP Salary Survey," *Datamation,* Vol. 20, No. 5 (May 1974), 50-56.

Table 10

Estimated Costs for a Full CLIS System

One-time Costs	
Hardware (data storage)	$75,000
Hardware (channel controller)	14,000
Terminal connection	16,900
Data base purchase	8,720
Training	3,750
Monthly Hardware Costs	
Terminals - 24 months @ $136,100	3,266,400
Terminal maintenance - 24 months @ $6,570	157,680
Computer and data storage maintenance - 24 months @ $2,616	62,784
Monthly Manpower Costs	
Coordinator - 24 months @ $2,580	61,920
Secretary - 24 months @ $860	20,640
Systems Analyst - 42 months @ $2,580	108,360
Systems Analyst - 23 months @ $2,580	59,340
Two Programmer/Analysts - 24 months @ $4,300	115,200
Two Junior Programmers - 23 months @ $2,400	55,200
Computer Operator - 24 months @ $860	20,640
Clerks - 42 months @ $860	36,120
Two Clerks - 22 months @ $1,720	37,840
Total costs incremental over pilot system (Task 8)	$4,120,494
Cost of pilot system (Task 6)	835,841
Cost of implementing CLIS system (Tasks 6 and 8)	$4,956,335
Cost of planning and administration Tasks 1, 2, 3, 4, 5 and 7)	305,000
Total cost of planning, administering, and implementing full CLIS system	$5,261,335

Table 11

Costs of Data Preparation by Outside Contractor

File	Hours	Cost
UV-Sadtler	107	$ 642
UV-HOCRE	37.3	224
UV-Nondrug	1,810	10,860
Fluorescence Spec	53.3	320
Bibliog/Abstract	320	1,920
Total		$ 13,966

Table 12
Costs of Analysis & Programming by Outside Contractor

APPLICATION	MONTHS	AVERAGE COST PER MONTH	DATA PREPARATION
UV-Drugs	1	$ 17,500	866
Bibliog/Abstract	9	157,500	1,920
IR-Nondrugs	6	105,000	
"Sources"	4	70,000	
G.C. Mass Spec	8	140,000	
UV-Nondrugs	5	87,500	10,860
Fluorescence Spectography and X-ray Diffraction	6	105,000	320
Total		$682,500	13,966

SECTION C
IMPLEMENTATION GUIDELINES

CHAPTER 13. IMPLEMENTATION GUIDELINES

Certain objectives and philosophies are important for a successful interactive system. CLIS will become an efficient, resourceful and responsive system if the following directives are adhered to through-out the implementation process:

- The system must be easy for the laboratory examiner to use, and
- System implementation must be planned very carefully, begun, small, tested thoroughly, and only then allowed to expand.

SIMPLICITY

Ease of use by laboratory examiners must be a prime consideration because it is they, and subsequently the criminal justice community, who will benefit from this application of technology to social problems.

Insofar as possible, the computer should be invisible to the user — he should talk to a terminal, not to a computer professional. To do this, his turnaround time must be minimized. Users are usually discouraged from asking questions of many computer systems because they know that by the time they get their answers, the need will have passed. In the CLIS system response will be via interactive terminal wherever possible, and wherever possible, hard copy will be produced on call rather than at scheduled times.

Far too often has a highly complex sophisticated system been thrust upon people who cannot easily understand its operation without spending a signficant amount of time (which they don't have) and effort attempting to master intricacies proposed by specialists who may not be aware of all problems. CLIS will exist as a laboratory tool; this will be its entire *raison d'etre*.

INTERACTION WITH USERS AND PLANNING

The operator should have great flexibility during use. In accomplishing this, intense interaction will be required with future users during the design stages.

CLIS will be a complex undertaking. It will involve a large communication network and many users, and it must be integrated within the operational constraints of the host agency. The keynote here is to start small and expand carefully. The pilot system approach is an excellent means for accomplishing this. The basic system control programs and data base interactions are to be implemented on a piecemeal basis, with each function and program module thoroughly tested before proceeding to the next function. If this procedure is not followed, one can expect chaos at full system implementation time when it is discovered that a critical program module was not tested completely.

DOCUMENTATION

The next key factor in CLIS implementation is that of documentation. A lot of words have been generated about documentation. In a system such as CLIS good documentation must exist to make the system responsive to change and to guard against coding details being forgotten. It is highly unlikely that the same personnel that initiate Phase II will still be part of the staff at full implementation. For this reason, it will be very important to establish documentation guidelines that will apply through the project.

Good documentation does not mean beautifully drafted flowcharts and daily program listings in quintuplicate; rather, it means complete and up to date listings and flowcharts even to the last midnight program punch. System specifications, logical flow of control, program module functions, data-base and message formats, program narrative, and test results must all be written in such a manner that the knowledge gained is readily transferrable and not lost.

END