Management Systems Development at the Department of Highways

MARCH 1983

Department of Administration
Division of Management Services

STATE OF COLORADO

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March 1, 1983

Mr. Joe Dolan
Executive Director
Department of Highways
4201 E. Arkansas Avenue
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Dear Mr. Dolan:

We are pleased to report that we have completed our study on the management systems of the Department of Highways. The study addresses the macro aspects of your Department's data processing and system development needs for the foreseeable future, based on the numerous records, studies, and audits on related subjects. There has been no effort to reiterate in detail the complaints, problems, and difficulties formerly documented, except in summary form, where necessary to support the text. We have remained objective in the development of proposed long term recommendations for your consideration. We hope that these will be beneficially implemented under your leadership, and that your Department will emerge from the present situation in four to five years with a well integrated systems capability and clear direction for future development.

We greatly appreciate the support received from the Internal Auditor's Office of your Department. Mr. Philip E. Seymour and Mr. Alan Boisvert have materially participated in this study by providing records, introductions, working space, clerical support and especially in gathering and analyzing data on the Automated Data Processing Development Survey. Ms. Mary Williams and Mr. Don Peterson have been very helpful in providing information regarding the accounting and data processing capabilities of your Department. Many other members of your Department have been helpful as well. We are sure that they are as hopeful for a beneficial outcome from this study as we are.

Thank you for this brief opportunity to assist with your important work. We remain available and enthusiastic to work with you again either to implement the recommendations made, or to consult with you on other management matters. We are prepared to discuss any aspect of this report with you or your staff at any convenient time.

Sincerely,

John R. Kennedy
Director, Management Services

JRK/pp

PROJECT TASK FORCE

The project was directed by Mr. Robert M. Roberts, Management Consultant from the Division of Management Services. Mr. William W. Graham, Management Consultant from the Division of Management Services studied and analyzed the Financial Management System and accounting operations. Mr. Robert W. Yackel of the State Division of ADP provided advice and assistance on the technical aspects of data processing hardware and systems. Mr. Alan Boisvert, EDP Auditor for the Internal Audit Branch of the Department of Highways, lead the ADP development survey and analysis, and provided considerable information and assistance throughout the project.

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I. EXECUTIVE SUMMARY

A. This study provides recommendations developed for the improved organization and operation of systems development and computer services, management information systems in general, and the financial management system in particular. The project resulted from complaints, unfavorable audit findings and a resolve by the Department's leaders to determine and correct the basic problems that have caused repeated criticism of computer and financial services.

The Findings of the study center on the past development of the Financial Management System, which has been developed over the last seven years. Recently, the system was closely scrutinized by the State Auditors, and it was found that some of their previous recommendations pertaining to system deficiencies had not been implemented.

Through interviews, and an examination of records and current operations, it was found that:

1. The accounting system upon which the FMS was based was a unique, manual system that had not been properly prepared for automation using rigorous evaluation and redesign,

2. Departmentwide emphasis and support for the FMS development was insufficient - primarily due to compartmentalized Division operations and lack of Departmental planning and direction.

3. Original system design was incomplete in that a thorough requirements analysis involving all requirements of users, suppliers, and recipients of data were not documented or satisfied,

4. Users were not sufficiently involved or trained,

5. Subsequent activities depending on the foregoing were suboptimal (eg, software search, projection of future impact), and

6. Remedies for improvement were applied as necessary under time constraints imposed by growing demands for service, lack of control, and limited qualified staff.

As a result of constraints during the approach to FMS development, combined with numerous other demands, Divisions needing, but not receiving computer services, developed computer related capabilities that do not purposefully implement or contribute to total Department needs. Continuing in this direction will be uneconomical, divisive, and less productive than a combined effort could be.

At present, over 50 significant administrative systems are in operation on at least 15 large and small computers. Two of the four major mainframes providing significant support are operating near capacity in some respect, and all of these mainframes are under the control of other agencies. This threatens not only day-to-day control over DOH reaction time, but also DOH decisions regarding the application of

staff personnel time. The main computer of the Department is a midrange computer that is operating near capacity and uneconomically.

The problems presented have become too significant to continue to be addressed in a piecemeal fashion. Department level impetus and effort should be directed toward these problems for an extended period of time. The approach suggested is embodied in the following recommendations.

B. Recommendations:

1. Develop a plan for the Department, with supporting plans and policies for staff functions to include computer services and accounting. (p.38)

2. Realign the organization to provide for an Office for Systems Development, reporting to the Executive Director for an interim period to redirect Departmental emphasis on systems development. (p.38)

3. Obtain/assign a Systems Development Director and a qualified staff. As an initial step, develop a systems development and data processing plan to implement the Department's plan. (p.40)

4. Designate a computer services/data processing staff reporting to the Director of Systems Development. (p.40)

5. Involve Division Directors in strategic systems development planning. (p.41)

6. Involve the Internal Auditor in planning, design, and development stages of systems. (p.41)

7. Maintain a current, comprehensive plan for systems development, data processing, and hardware and applications software acquisition. (p.42)

8. Delay studies and acquisition of hardware and software throughout the Department until these efforts can be pursued under a departmentwide approach. (p.42)

9. Retitle the present Steering Committee as "User" Committee, and continue this function at the request of the Director of Systems Development. (p.43)

10. Create a Steering Committee of Division Directors (who may be represented by knowledgeable members of their Divisions, authorized to commit resources and make decisions for their Divisions). (p.43)

11. Adopt the organization and procedures recommended for new system developments and changes. (p.44)

12. Initiate the Systems Development operation by considering the configuration projected in this report. (p.52)

13. Develop a systems architecture that will support distributed data processing and data bases as envisioned. (p.52-57)

14. Remove the CRTs from Districts I and VI. (p.52)

15. Bring MAPPER and Microcomputer studies to a close and publish the results. (p.52)

16. Purchase recommended software for the HP 3000. (p.53)

17. Discontinue adding new systems to the CU Computer. (p.53)

18. Continue the distribution of word processing within the Department. (p.53-54)

19. Install and link microcomputers in the Districts to FMS and provide a budget control application. (p.54)

20. Proceed with distributed data processing for the State Patrol and link the Patrol to FMS. (p.54)

21. Begin the steps necessary for purchase of a Department mainframe computer. (p.54-55)

22. Obtain systems development and distributed data processing expertise. (p.55)

23. Employ the CAS as the general ledger of accounting for the Department. Design an FMS-2 system to function as an ABL. (p.32)

24. Obtain the services of a highly qualified professional, knowledgeable and experienced in both systems development and public accounting procedures, to be in charge of the Accounting Branch for a minimum of two years, to plan and implement a revised accounting system. (p.34)

25. Examine payment and review processes and modify procedures to better utilize computer resources. (p.35)

II. INTRODUCTION

A. PURPOSE

This survey and analysis was conducted to determine optimal methods for the automated delivery of necessary management information to managers in the Colorado Department of Highways. The phrase, "optimal methods for automated delivery", is focused on the development and implementation of systems and the macro description of system configuration and organizational arrangement to accomplish the strategic management goals of the Department.

B. SCOPE

The project was limited to the Department of Highways and the recipients and providers of data/information from systems in existence, or in the planning and development stages. Data processing capabilities, constraints, plans, performance, and costs were examined. Directors of host computer agencies were interviewed in order to develop realistic options for future implementation.

C. METHODOLOGY

The initial step taken was to review studies, audits, authorizing documentation and records related to the development of management systems, audits of the Financial Management System and the Department's performance, system development records, operational data processing directives and records, current budget documents, and the organizational manual.

A survey was designed and conducted to supplement existing information from surveys and studies conducted by the Management Steering Committee,

State Division ADP, Management Information Systems Branch, and the Division of Administration. These recent prior studies addressed an inventory of reports, computer file disk requirements, terminal requirements, number of programs, volume of activities, user and auditor comments on existing systems and data processing support, and computer applications and capacity. The survey for this study was primarily directed toward the management information and data processing support that would be needed to support the strategic plans of the Department's managers in the next five years. In order to ensure that the survey would not repeat prior efforts, data considered reliable from the prior efforts cited were compiled, and only additional information was requested. Interviews with major users were conducted by request, or on an exception basis to clarify or expand on responses to the questionnaire.

Interviews were conducted with the State Auditors involved in a current audit of the Department, major providers of computer support, the State Controller, and designated Accounting and Management Information Systems personnel of the Department.

Following the survey and interviews, the additional information was integrated with data available from prior records to provide the basis for this report. The approach was to determine the dimensions of current and projected data processing capability required, and the configuration of equipment and other resources envisioned to provide such a capability. Recommendations were developed for the direction of systems development efforts and the organization considered necessary to accomplish this task.

III. FINDINGS

A. MANAGEMENT INFOIMATION SYSTEMS BRANCH

1. Assignment of Responsibilities

a. The Management Information Systems Branch reports to the Administrative Officer in the Division of Administration of the Department, as shown in the Appendix (Exhibit I). The Administrative Officer is the appointing authority for this Branch and is responsible for budget preparation and expenditure plans, daily operations and coordination of Division activities with other divisions, and production of departmental reports by the use of computing equipment.

It is noted that the assignment does not address systems development responsibilities specifically; emphasis is placed on the production of reports by the use of computers; and, although responsibility for coordination with other divisions is cited, it does not address coordination with agencies external to the Department such as those supplying computer support from the General Government Computer Center (GGCC) or the University of Colorado (CU).

b. The Management Information Systems Branch is responsible for electronic data processing, developing procedures and forms involving both computers and manual operations, preparing special reports, maintaining liaison with the Division of ADP, Department of Administration, preparing the data processing budget, preparing

feasibility studies for new and/or updates of systems, assisting in the RFP process, interfacing with State operated computing facilities, and maintaining systems and user documentation and a systems catalog.

Again, systems development responsibilities are addressed in only an indirect way - in terms of feasibility studies and systems documentation preparation.

c. The Administrative Systems Section is assigned the duty of designing administrative processing systems, and to conduct feasibility studies to determine the needs and desires of the Highway Department management for automated applications.

d. The Engineering Systems Section has an assignment that is similar to the above as applied to engineering applications.

e. An additional assignment has been made to both of the Sections mentioned in paragraphs c. and d. above to oversee applications on the computer under the direction of the Department's Management Steering Committee. This committee is not portrayed on the organizational chart of the Department. The Management Steering Committee is comprised of one manager from each of six Divisions, and it was proposed that they be charged with responsibilities to: review usage and level of service, identify problems, recommend remedial actions, reduce

ADP costs, review priorities, study requests for new systems, and develop policies for coordination of ADP activities. The committee is comprised of persons with primary responsibilities in other Divisions, who do not have time, authority, or incentive to develop systems. A review of their proceedings and accomplishments reveals that they have performed valuable services of an informative, coordinative nature, as a user group.

f. A search for a Department of Highway's strategic plan was unsuccessful. Divisional plans and a five year construction plan were found, but from these, the total direction of the Department's effort cannot be deduced. An ADP Policy Directive was drafted in March 1982 but was never put into effect. It appears that the various Divisions have been, and are likely to continue, on separate courses with respect to systems development, data processing support, applications software, and to a considerable degree, hardware (terminals, micro computers, pheripherals, mainframe access, etc.) unless redirection and control is exercised by the Department. This redundant approach by each Division is expensive, although the actual cost may appear to be smaller, since expenditures are made in piecemeal, less visible, ways. Plans have been made in conjunction with budget requests, but these are directed toward individual Division needs as opposed to a coordinated Departmental strategy. In short, there is no comprehensive plan for the Department upon which to base a departmentwide management systems development plan. There is

no plan for departmental systems or data processing development even though the need is evidenced in studies of mainframes, microprocessors, word processing, hardware inventory, etc., and in ever increasing expenditures for automation. There is a plan recently developed by MIS for the Department, but it does not reflect the burgeoning needs expressed by the Divisions, in a comprehensive, prioritized framework.

2. Systems Resources

The systems resources of the Department include the personnel assigned to the development, operation, and maintenance of automated systems; materials and equipment used to process and provide necessary data/information; and facilities required to support data processing. Also, resources include personnel, equipment, materials, and facilities available to and/or used by the Department that are procured from other State agencies or private concerns.

a. Personnel. As of February 3, 1983 the Department had 44 FTE personnel working (46 authorized) directly on the Management Information Services Branch functions. They work on either of two shifts, five days per week. One weekend per month, 72 hours are worked. Four FTE personnel work in data processing function in the Transportation Planning Division, four in the State Patrol, and one at District 6. Total personnel costs including fringe benefits and shift differential and operating expense is approximately $2.6 million per year. The ADP contingent is comprised of:

3.0 FTE Supervisory/Clerical positions

21.0 FTE Administrative Systems including:

- 8 FTE Operations
- 13 FTE Systems/Programmers

22.0 FTE Engineering Systems including:

- 15.0 FTE Programmer/Analysts
- 1.0 FTE Supervisory
- 3.0 FTE Data Entry and RJE Operators
- 1.0 FTE Clerical
- 2.0 FTE (vacant)

In addition there are:

4.0 FTE DTP Programmer/Analysts

Of the 46 positions authorized, 44 are filled. Of the 44 filled positions, only 6 are considered to be experienced programmer analysts, and one of these is expected to retire in about six months. The "luxury" of devoting any of the experienced personnel to full time systems analysis work is precluded by the need for training less experienced personnel, which takes an estimated 18 months, and other duties related to operations maintenance, data processing, supervision, and operations.

Turnover in the Branch has been approximately 20 percent in the last year. This has been mainly in positions assigned to administrative, as opposed to engineering systems. A review of the reasons given by those departing reveals that the prominant reason was related to obtaining higher salaries.

Obtaining experienced ADP personnel, given State procedures and salary levels, has been difficult. This problem was further compounded by hiring freezes, budget limitations, and work pressures. Frustrations caused by operations, applications maintenance, training of users as well as new employees coupled with noncompetitive salary opportunities, limit the time that the qualified personnel have to engage in development of new systems or to spend doing satisfactory and/or satisfying development work.

The causes cited are not unlike those occuring in other State agencies, but solutions have been found in many agencies through strong management emphasis, organization of work, recruiting, and hiring approaches.

b. Equipment and Systems

1) As shown on Exhibit IV of the Appendix, there are over 50 significant systems supported by at least 15 large and small computers. About half of the administrative systems are run on the Hewlett-Packard 3000 mini (or midrange) computer housed in the West Annex of the Department. The remaining half are mostly split between the General Government Computer Center's IBM 3033 and the University of Colorado's Cyber 170/720 computer. Five other administrative systems are run on four smaller computers throughout the Department.

This configuration appears to have emanated from the following causes:

- Lack of central funding and direction within the Department,
- A recognized need for automation by members of various Divisions, Branches, and other units, with a penchant to conduct independent operations, and
- The availability of equipment and software on the market to simplify administrative work, to increase productivity, or to make new data/information available that can result in improved management.

However, these actions result in predictable inefficiencies, e.g.:

- Separate data storage that is inaccessable to other Divisions of the Department,
- Expensively redundant efforts in terms of procurement, training, and operation,
- Series of automated activities interrupted by manual activities creating instead of reducing work,
- Limited lateral exchange of engineering and administrative analyst resources,
- Noninteractive equipment, and
- Nonstandard data definitions.

2) The Department's HP 3000 midrange computer has chronically been undercapacity for the applications desired by the managers

of various units. Historically, demands have exceeded capacity for six years or longer. According to the Director of the State Division of ADP, midrange computers are inherently uneconomical in terms of their output versus the costs of operation.

3) As stated in the Department of Highway's Computer Capacity Study dated July 27, 1982, the CDOH owned HP 3000 is operating at capacity, and expansion at either the General Government Computer Center or the University of Colorado is conjectural. Interviews at each location generally confirmed this. Purchasing computer time at other locations has significant disadvantages, viz:

   - Priorities of use are set by the owner or dictated by more powerful users (e.g, the legislature),
   - Development of new applications that are important to the Department can suffer significant delays,
   - More communication is involved slowing reaction time to user needs,
   - Costs are difficult to relate to services received, and
   - Application software must be written to constraints of the hardware used.

4) The System Needs Survey conducted for this study, as an add-on to prior surveys, is discussed in more detail in Findings IIIA4,

"System Needs." Essentially, it shows considerable and justifiable need for expansion of present systems development and data processing capabilities. The need for automation is not only expanding, but is clearly being urged on by the proliferation of powerful and economical computers of all sizes. Wherein the Department fails to provide enlightened direction and control, the vacuum will be filled by individual solutions and hardware that is likely to be incompatible for the total needs of the Department.

3. Systems Effectiveness

a. The term "systems effectiveness" is used to describe the accomplishments of the objectives that the automated system was designed to achieve. The measurement of effectiveness is drawn from the stated satisfaction of users of the system as they perceive the service. User perceptions are often biased depending on factors outside of the system deliverables, for example, such things as interpersonal relationships, communications, and coordinative actions. Frequently, many perceived problems disappear when users understand the reasons for which objectives of the original design have not been fully achieved - or at least when responsibility is properly placed. In brief, the communications aspects of system development, installation. and implementation take time and effort and are very important considerations, which evidently haven't been fully exploited in the past.

b. From previous surveys, supplemented by the one conducted for this study, the following were noted:

1) Comments regarding the MIS Branch:

- Reluctance to work service requests,
- Inability to deliver service within a realistic time frame,
- Negative approach,
- Information on RFPs available after the fact,
- Months behind schedule,
- Priorities are set based on current use and new uses suffer low priorities,
- Problems don't get fixed, unable to get modifications to existing systems, and
- User training is nonexistent.

2) Comments on specific systems:

- Couldn't get on mainframe - had to become self sufficient,
- Couldn't obtain evaluative data, although the elements are in the computer, the present set-up precludes efficient accountability,
- MMS* was not designed to serve all users,
- FMS access not provided to necessary users, training not given, FMS is overextended, and
- Cannot track FMS data, no audit trail, inadequate documentation and controls.

* Please see glossary for title of acronyms and abbreviations.

3) Comments on Steering Committee operation,

- Powerless, a user committee,
- Nothing happened when the committee attempted to reestablish its purpose the Director took no action,
- Recommends remedial action, and
- Helps communicate problems and difficulties, and to gather data.

4) Comments on Departmental problem,

- Data processing capability and effort is fragmented in terms of development, hardware, personnel, guidance, and control,
- Inadequate emphasis, knowledge, and interest by the Commission,
- Divisional prerogatives more important than Departmental economy,
- Department level priorities have not been set,
- Unfavorable audits based on accessibility of data, audit trails, controls, and documentation, and
- Information needs haven't been defined.

The users comments serve as a "cogent indictment" that some important problems exist, although taken individually, they are not necessarily accurate. Lack of emphasis, hardware capacity limitations, personnel capabilities, communications and interpersonal relations, Divisional prerogativism and excessive demands indicate weak control and lack of emphasis on the part of the Department.

c. An ADP Master Plan has been developed by the MIS Branch over the last two years (1981-1982). Improvements have been incorporated each year including a Disaster Recovery Plan in the 1982 edition. The plan could be improved by incorporating the following:

- More detail on new applications and enhancements to current applications (i.e., justification, file requirements, transaction volumes, schedule dates, file space requirements, and impact on processors), and
- Communications additions/changes to data circuits and modems.

The major failing of the existing plan is that it doesn't address the total needs of the Department. This is not considered the responsibility of the MIS Branch in that the Department has not made its needs known through a plan of its own.

d. Efficiencies could be made in computer operations through the use of a reportwriter (QUIZ), a screen formater (QUICK), and a batch generator (QTP). These modules have been tested on a one month basis and it was found that programming efforts were reduced 50 to 90 percent depending on the particular coding requirements. They can be obtained for a one time price of $19,000 plus modest additional expenditures for training and maintenance support. The payback period is estimated at less than six months.

As the use of HP 3000 facilities increases the acquisition of a performance measurement tool (Optimum Performance Tool @ $6,400)

to measure cycle consumption, core paging problems, and impact of proposed software could materially improve operational effectiveness.

e. The procedure manual is available to each team leader and is rated as in good condition. However, use of the procedure was judged as infrequent.

f. Documentation varied by system and more work is needed for some applications. Documents are checked out infrequently, and when they are, they become difficult to locate. No itemized journal listing the documentation published to date, and no procedure for organizing a library, were found.

g. User manuals have been written by the users and are available from the users. No user manuals were found in the MIS Branch.

h. Security and accessibility were found to be as stated by the State Auditor. Various systems and files can be accessed using the same passwords.

4. Systems Needs

The backlog of work for the MIS Branch is estimated at 8.4 months of assigned and unassigned work, plus an estimated 3.0 months to develop the additional systems identified by MIS. This is based on the present complement of personnel and their levels of qualification.

Also, it is based on a listing of projects that are generally maintenance of applications in service, as opposed to major developments that are needed. It does not reflect all Departmentwide needs (eg., need for conversion of programs on the CU Cyber 170/720).

The survey* for this project and previous surveys, reveal the following major ADP systems are needed:

- A Public Roads Information System using a data base management system that is easily accessible by various CDOH users,
- A storeroom inventory system connected to Procurement Branch and networked to all storerooms,
- Expansion of the State Patrol MIS to provide distributed data processing (DDP) to the Troop level,
- A system to provide accounting, personnel and budgetary control at the Highway's division, district, maintenance sections, and State Patrol Troop level,
- Word processing for all divisions and districts,
- A project cost accounting system with user friendly query capabilities available to Division of Highway's managers and district personnel,
- A decision support system to help analyze the effect of construction funding decisions on the highway system,
- An automated special transportation permit system,
- A construction management system containing performance indicators, MBE data, and project history records,

*The data from this survey is available at the Internal Auditor's Office of the Department.

- A rewrite of current engineering programs,
- A rewrite of the Maintenance Management System (MMS),
- Systems to use interactive graphics,
- Building operations preventive maintenance scheduling,
- Financial audit software,
- Various specific user-oriented small applications in a stand alone environment, and
- The ability to extract vehicle, traffic and accident data from various computers including CDOH and the Department of Revenue.

Managers responding to the survey wanted to eliminate duplicate and nonstandardized data, obtain hardware for their site, have access to word processing hardware, computerize current manual operations, and increase managerial information systems including extending their query capabilities to do unstructured requests.

Duplicate Systems. Two major areas were evident in which major duplications occur. The first is in the inventory of the state highway system. Numerous data bases exist on several different installations. Redundant files and effort exists and roadway information can not be integrated under these circumstances. New and unanticipated requests for information are extremely difficult to answer.

The second area of duplication of effort and systems occurs in financial management. The Department runs a budget and bookkeeping

system on the HP 3000 administered by the Accounting Branch. The State Patrol has a budget control checkbook system on its MIS. Most districts maintain a manual checkbook system for budget control purposes, and the Maintenance Management System has evolved into being a cost accounting system for the maintenance function.

Hardware. In addition to the desire for new systems there was revealed in this ADP survey a propensity toward hardware that would provide immediate access to data or would possess stand alone computing capability. Managers answering the survey saw their hardware needs as 38 terminals, 100 microcomputers, 2 minicomputers, 9 printers, 5 graphic printers, 15 wanted linkage to a specified mainframe, and 3 each wanted linkage to the Department of Revenue's or the Administration of Justice's computers. Although a number of hardware requests are duplicated because several systems requests were duplicated, (for example both Staff Maintenance and Procurement asked for a storeroom inventory system and micros to support it), a number of managers when requesting systems answered "unknown" in the hardware column. Once the hardware is known the numbers would increase.

The large number of requests for microcomputers shows a desire of managers to have computing capability available to them to meet their informational needs. There is a very high interest level within the Department on the new technology available in tabletop computers. Requests for microcomputers was not limited to applications at remote sites

such as districts or residencies, but came from District I and VI as well as numerous requests from headquarters. Thus, it appears that lack of or cost of computer communications is not the reason for requesting microcomputers since Districts I, VI, and headquarters are located close to the mainframes used by the Department. It may be a belief by many managers that having their own microcomputer is the panacea for obtaining computer services.

Word Processing. Word processing as a system, was requested both from the headquarters and district branches. The Department currently lacks a clear sense of direction in the area of word processing. Software is available to do word processing for practically all levels of computers, and it appears the Department is stressing microcomputers with word processing capability to fill the vacuum.

Currently, the State has a contract with Wang Corporation to supply word processing equipment. Both of the Departments of Regulatory Agencies and Natural Resources have installed complete Wang systems. The Department of Institutions is studying the Wang systems. Wang will do free evaluations, including cost/benefit analysis, of any department that requests it.

Computerize Manual Operations. Requests for major systems to replace current manual operations included a storeroom inventory system to replace card files, an automated permit system to replace current

permit processing and truck routing, a budget control system to replace manual accounting systems in the districts and headquarters, and computerized personnel data to replace manual records. Systems such as these can be cost beneficial by replacing manpower currently performing the manual function.

Management Decision Support Systems. Management decision support systems (DSS) is a generic name used to describe a system that can be queried with unstructured requests, or can provide information that will support a manager's decision-making process, not substitute for it. Several managers requested such systems including a project cost accounting system with unlimited query capabilities, a system to help analyze the effects of construction funding on the infrastructure of the state highway system, and a construction management system that would track and report performance on a per project basis.

B. ACCOUNTING

1. Financial Management System

a. The FMS and related accounting processes were reviewed to provide insights into systems development efforts of the Department in order to derive a basis for recommending the direction that future development efforts should take. This system should provide the essential framework upon which many other administrative activities should be based, starting with budget preparation and allocation, and including project reporting, status, costs, and the like. The points listed here were extracted from numerous studies and audits on the subject, or derived from interviews conducted during this project. There was no intent to reopen "gruesome details", but rather to provide a basis for improved development of systems.

b. The following events that occurred in the FMS development are listed as they should have occurred following the typical systems development process:

1) The original manual accounting system was not examined for the purpose of improving methods and procedures, satisfaction of requirements and procedures of other agencies (State and Federal) and standard accounting practices prior to automation. The manual system was unique in that it had been developed over many years as new requirements demanded and unique solutions were developed. It had incorporated many redundancies, inefficiencies and appendages - some known only to the employees who had created them, some of which were unnecessary.

2) An adequate requirement analysis was not performed or documented before the fact. The manual system did not serve all of the necessary users and limited queries at best did not produce the total requirements to be placed on the automated system. Whatever analysis that had been performed was not documented at that time and has been critized in recent years. Documentation has been produced since, but has had less than optimum effect since the changes addressed elements of the system and not the total concept.

3) A fully documented conceptual design of the system was not made.

4) An outline of the steps necessary to demonstrate compliance (acceptance test plan) with the requirements analysis was not developed. This left an insufficient basis upon which to determine that the automated system was performing satisfactorily prior to switching over from the manual accounting system.

5) An extensive software search was not conducted to locate the most appropriate application for the existing manual system. At this point, a software search would have been difficult in any case, without the benefit of an improved accounting system, a definitive requirements analysis, or a conceptual design.

6) Prior to operation, adequate user manuals were not developed and sufficient training was not conducted. Subsequent follow-up efforts have accomplished these to some degree of satisfaction.

7) Inadequate safeguards for file integrity and other controls naturally result from design oversights. The responsibility is a user responsibility, and a systems analyst responsibility, but it is also a management responsibility - not a data processing or programmer responsibility. Someone with the authority to command the resources, the knowledge to develop the system, and the time to devote to this specific function (separated from the maintenance and operation of computer services) should have had the responsibility for developing this system. Systems development should involve management systems (manual) design personnel; highly qualified user personnel (in this case accountants), systems analysts, and others as necessary (eg. training personnel to develop user manuals), systems development should be viewed as a Departmental effort rather than a Branch effort. Only after the system has been groomed for automation and the conceptual design has been documented, spelling out all of the requirements, controls, and operational mechanisms, should a search for software be conducted and the project turned over to the programmer analyst for automation.

Properly conducted systems development was not possible. No developmental entity existed or was considered. The resulting FMS could have been predicted by anyone with sufficient systems development experience. Management emphasis, resources, and development discipline were lacking.

It has been stated that the FMS will never be completed. A general misconception is that system development is ever complete. Automated systems, like t' manual counterparts, continue to change to meet the avail. .lity and demands of new technology, procedural revisions, and new information desired by managers. Having "developed" a system, more efficient avenues for processing emerge, and the advantages of these should be incorporated into the system. The incorporation of additional system features is frequently the primary reason for the addition rather than reduction of personnel. The advantages of greater management control and productivity often are difficult to quantify when new demands are created for data processing services that had not been envisioned in the original design concept. It appears to managers that a new system requiring more personnel, is less efficient than previously, when in actuality more services have been made available and efficiencies have been achieved.

2. Accounting Branch

a. Members of the Accounting Branch were interviewed to determine the

scope and magnitude of the problems, from a financial standpoint, between the Financial Management System (FMS) and the Central Accounting System (CAS). Certain difficulties have already been identified by the State Auditor that are not always related to the FMS difficulties.

A basic problem of the FMS is that it created a parallel, separate set of books from the CAS, both of which must be kept in balance. The difficulties and failures in this task have been well documented by the State Auditor at least as they affect financial reporting. These problems have also been addressed by the State Controller and by the Department as recently as May 1982.

Having two parallel accounting systems that do not communicate in both directions requires separate data entry into the systems. For a variety of reasons the data do not always agree, creating a severe problem of reconciliation. Such reconciliation requires, by the Accounting Branch's own estimate, 8.5 FTE of a total staff of 46 FTE, 18.5% of staff. Since FY 77, the period during which FMS was developed and implemented, the Accounting Branch staff has grown from 33 FTE to 46 FTE. (The numbers have been adjusted to account for internal transfer of staff). Although various reasons have been given for the increase in staff (two additional data entry operators were required, more account analysis is being performed, etc.), the fact remains that the workload

has increased with the implementation of automation.

There is general agreement between the State Auditors, the State Controller, and ourselves that the ABL in the CAS is inadequate for the Department's needs for various reasons that are well documented. However, there is also agreement that the CAS could be the primary data processing system and that the FMS could be used to produce reports and federal billings unique to the Department and not possible to do on the CAS/ABL system. An FMS-2 system can be developed so that it would serve in the same relationship to the CAS as the ABL does in the Controller's system. This approach would eliminate a dual set of financial records, provide agency support documents unique to the Department, and do away with the present requirement of frequent dual entry into separate and distinct systems.

Recommendation: Employ the CAS as the general ledger level of accounting for the Department. Design an FMS-2 system to function as an ABL to provide reports unique to the Department's needs. FMS-2 should be able to transmit to and receive from the CAS all necessary data regardless of where and by whom entered.

b. While the Department is charged by statute with various responsibilities such as building and maintaining roads, traffic safety, law enforcement, etc., it is also charged with performing its various functions in an efficient and effective

manner. The dual responsibilities cannot always be discharged harmoniously because, as in other agencies as well, there can be a struggle between the "program" organization and the "business" organization. The resolution of these problems is the responsibility of the Director and can, in part, be addressed by the type of organization he structures.

The Department has been subject to frequent financial audits and more recently a performance audit by the State Auditor. In addition, other reviews have been conducted by the Controller and the Internal Auditor. The Accounting Branch now finds itself reacting to numerous recommendations rather than implementing a plan to overcome problems and improved performance.

Our findings in the Accounting Branch found a lack of a systems approach within accounting as well as within the computer. Furthermore, functions are performed in accounting that are not in compliance with Fiscal Rules and Fiscal Procedures. Job assignments appear to be overspecialized in some cases, thereby limiting output to the span of ability of a single individual. An example of the lack of systems approach and subsequent efforts to overcome shortcomings, is the encumbrance process referred to on p 35. A service request was initiated over one and one-half years ago that has yet to be implemented. On the other hand, should MIS be responsible for the design of such a system?

Recommendation: Before a total systems design is undertaken, conformance to Generally Accepted Accounting Principles and State Fiscal Rules and Procedures should be achieved.

In order to break the present cycle and to achieve Departmental objectives, an accounting system with a fresh look must be developed to be integrated into FMS-2. This approach involves a rethinking of the entire system, not just a revision of current procedures. Additionally, the system must satisfy not only the needs of the Department, but also the State Controller. An objective of the process should be to perform only the work that is required consistent with the needs and requirements of the users of the accounting system.

Recommendation: Obtain the services of a highly qualified professional, knowledgeable and experienced in both systems development and public accounting procedures, to be in charge of the Accounting Branch for a minimum of two years, to plan and implement a revised accounting system.

c. Our review of the accounts payable process revealed that accounting technicians are assigned specific tasks that are extremely specialized. When questioned as to why they performed certain functions such as logging field purchase orders in a book they could not give a definitive reason.

The encumbrance and unencumbrance process at the Department is an entirely manual process that uses the computer only as a storage file. The process obviously can allow purchases, contracts, etc., to go unencumbered, thereby causing errors in financial statements. Other potential errors in the process are the encumbering of unencumbered purchases or failing to unencumber purchases when the expense is incurred.

Recommendation: The Department should examine its payment and review processes to conform to State Fiscal Rules, eliminate unnecessary reviews, move and train personnel to perform the necessary reviews in a consequential manner, and modify procedures to better utilize the computer resources available.

SUMMARY

The Department of Highways has over 50 significant administrative and engineering systems with more than 30 needed in the next five years. The Department is using at least 15 large and small computers. The MIS Branch has control over two of these (HP 3000 and HP 125) and must depend on the cooperation of others to provide data processing services, data, information, and maintenance. This dependency can become constraining when any of the major host computers, which are operating at or near capacity in some respect, become unavailable due to the priorities of authoritative users (eg. the cyclical student demands at CU and the legislative demands on the GGCC computer). Also, any operations or plans of MIS depend on the operations and plans of those in charge of host computers. When hardware is changed/converted/modified at the provider organizations, the CDOH is directly and helplessly impacted in terms of operational continuity, time involvement, and cost.

The MIS Branch has relatively few fully qualified systems development personnel, is beleagured with requests from within the Department, and has insufficient authority and control over the total data processing resources of the Department. In the meantime, the proliferation of relatively inexpensive computers and the long standing needs for management information is increasing the pressures for automation. When these needs can't be successfully met by the MIS Branch, dissatisfied units in the Department attempt to solve their own problems. This can result in long term problems for the Department.

A comprehensive, integrated, and strategic plan for the Department is needed. It should include the general direction automated data processing will take and provide

the requisite authority for accomplishment. A plan is needed to overcome existing deficiencies in both ADP and accounting services. The plan should be agressively implemented to attain improved performance.

IV. RECOMMENDATIONS

A. SYSTEMS DEVELOPMENT

1. Develop a plan for the Department, tying together the objectives of the Divisions. Develop supporting plans and policies, particularly for staff functions, to include computer services, accounting, and budgeting. Coordinate with the State Division of Automated Data Processing.

   Reasons:

   - To provide the basis for prioritizing supportive efforts,
   - To achieve economies through the elimination of independent, redundant, and incompatible development and acquisition,
   - To optimize the use of resources - personnel, material, equipment and facilities, and
   - To provide direction for consistent, cohesive interdepartmental functioning.

2. Create an Office for Systems Development, to report to the highest decision making level in the Department - the Executive Director - for at least the first four years of the development effort. Delegate authority and assign responsibility to this Office for the planning, development, and installation of all automated systems for the Department.

Reasons:

- To assure that the important development work is accomplished in accordance with priorities established by the Department,
- To provide for the proper development of systems to include assessment of feasibility, complete system design, software searching and installation,
- To provide complete implementation including testing, parallel operations, and user training,
- To assure proper documentation, controls, edits, and tracking mechanisms are required by system design,
- To bring together fragmented development efforts and optimize the use of available resources,
- To establish effective controls over data processing activities and minimize the number of times the same data is collected and stored,
- To communicate systems needs and status information within the Department,
- To be cognizant of all departmental needs for automated systems,
- To be responsible for timely, cost effective systems development,
- To coordinate and control the acquisition of hardware and applications software,
- To coordinate and negotiate departmental development efforts with governing agencies and major providers of computer services,
- To ensure responsive decision making and user participation by each Division involved in departmentwide development,

- To optimize the use of data processing resources,
- To focus executive attention to important systems development work,
- To provide qualified personnel and time on priority development, and
- To ensure that nagging development problems are solved.

3. Obtain a Systems Development Director, four highly qualified systems development analysts and one clerical person, and dedicate their entire efforts to the tasks of systems development, installation and implementation. Make clear assignments of responsibility for systems development functions. Start with a departmental master plan for systems development and computer services. Following this, progress in priority order in comprehensive development, redevelopment and improvement of systems.

   Reason:

   - To provide an adequate number of experienced personnel to accomplish the development of new systems as set forth in this study, while upgrading and maintaining present operations.

4. Designate a computer services/data processing staff to maintain programs and computer operations. They should report to the Director of Systems Development and perform programming, operating, and testing functions, and assist in the implementation of new systems as appropriate.

   Reasons:

   - To assure that ongoing work can be continued without interruption, and
   - To complement systems development efforts effectively.

5. Involve Division Directors in the development of the strategic systems development planning, and in the review of progress of each system development affecting their Division.

Reasons:

- To assure coordinated development,
- To achieve managers needs,
- To overcome obstacles to progress,
- To keep managers apprised of progress and new developments,
- To increase manager's familiarization with computers and problems of development, and
- To obtain ideas and support.

6. Involve the Internal Auditor of the Department in the planning, design, and development stages of new data processing systems and major changes to existing systems.

Reasons:

- To prevent oversights in the design and development of systems,
- To assure that auditable and properly controlled systems are developed,
- To provide assurance that the systems/applications carry out the policies of managers,
- To assure that systems are properly documented to provide for maintenance and audit trails,

- To provide controls against serious loss or error, and
- To assure that systems/applications conform with legal requirements.

7. Using the professional staff mentioned in 3. above, continue the development of a strategic plan to evolve systems and to design a comprehensive approach to hardware and applications software configurations and acquisition, implementing the considerations and priorities in the Department's master plan.

   Reasons:

   - To assure optimum results and cost effective applications of resources available and those to be acquired,
   - To provide the basis for communicating intentions and informing those who must authorize the work, those who will be involved, and those who must perform direct or related tasks, and
   - To evoke the decision making process regarding funding, staffing, scheduling, and accomplishing the work.

8. Delay or freeze studies and acquisition of equipment until the plan has been approved, then control the acquisition to provide for balanced, compatible development in accordance with the plan. Avoid piecemeal approaches and studies such as mainframe, microcomputer, network, database, etc., and perform these only as they pertain to the overall strategy developed under the master plan.

Reasons:

- To conduct balanced and purposeful development that addresses the Department's total expressed desires.

9. Change the present Steering Committee title to "User" Committee and continue the function on the request of the Director of Systems Development, following the completion of the strategic plan and the initiation of development activities.

Reasons:

- To provide user input on systems under development and in operation. This will assure that maximum benefit is derived from potential users through the identification of previously unforseen and potentially effective applications of the data/information existing or to be made available,
- To assure the developers of systems of the acceptability and workability of intended applications and changes to existing systems,
- To identify problems and recommend remedial actions,
- To inform users of the implication, impact, and opportunities associated with new developments or changes, and
- To obtain user support.

10. Create a Steering Committee comprised of Division Directors who may be represented on the committee by high level, knowledgable members of their Divisions with full authority to act on the part of the Division they represent.

Reasons:

- To contribute to the strategic system development plan for the Department,
- To approve or disapprove provisions of the plan,
- To establish priorities,
- To review progress, and
- To approve requests for new systems or major changes to existing systems when considerable work hours (eg. 60 hours or more) are required.

B. STRATEGIC SYSTEMS PLAN

1. The organizational arrangement recommended to implement the systems development efforts described in this report appears on pages 46 and 47.

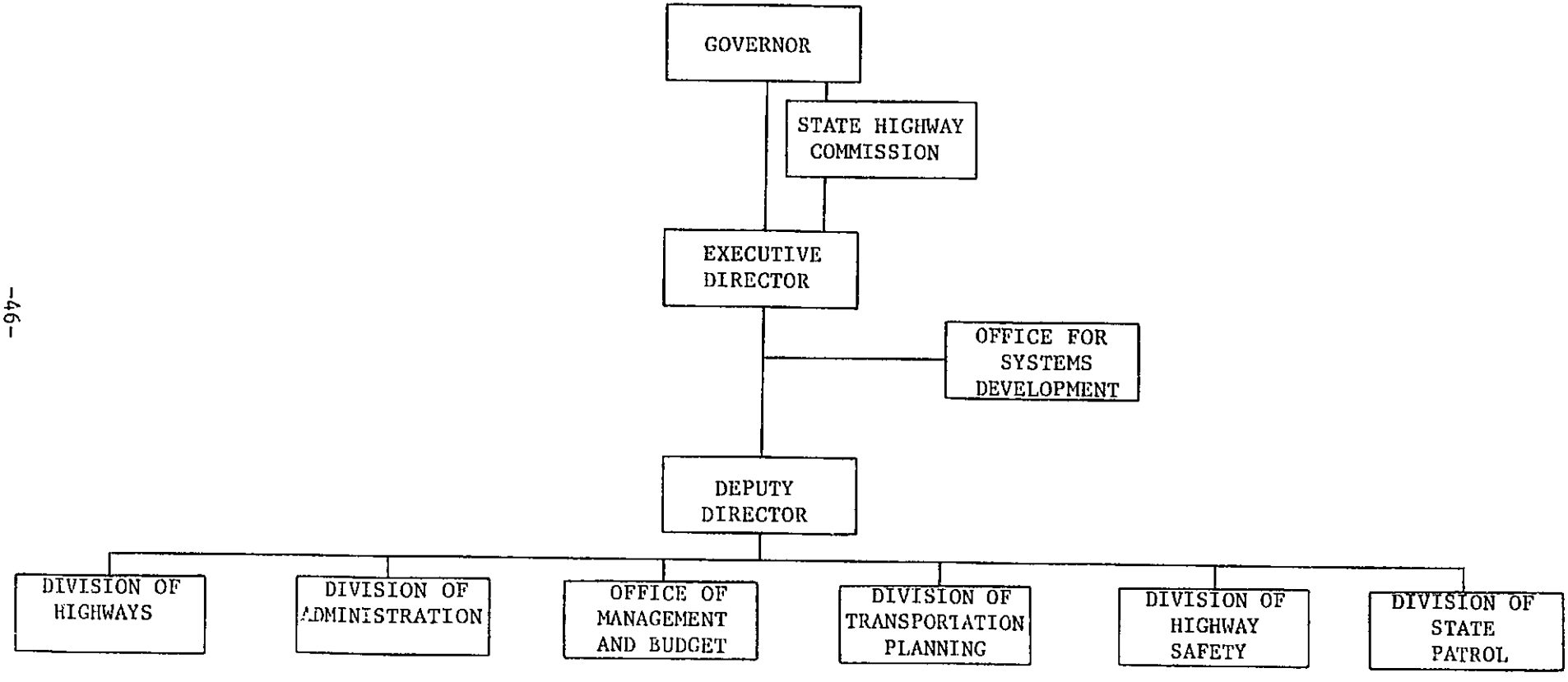
Reasons:

- To assure sufficient departmentwide emphasis on the urgent need for attaining control over balanced, consistent, economical development of systems, and acquisition of hardware and applications software,
- To facilitate decision making on interdivisional matters and prevent undue delays,

- To eliminate divisional prerogativism, bias, and interpersonal barriers from blocking progress,
- To facilitate lateral exchange of administrative and engineering analyst resources,
- To establish a division of responsibilities within the Office for Systems Development,
- To assure cooperation in the transition of systems development from the design to the programming, installation, and implementation stages, and
- To provide for organizational realignment of the function in approximately four years or when it can be determined that utmost emphasis on development is no longer required.

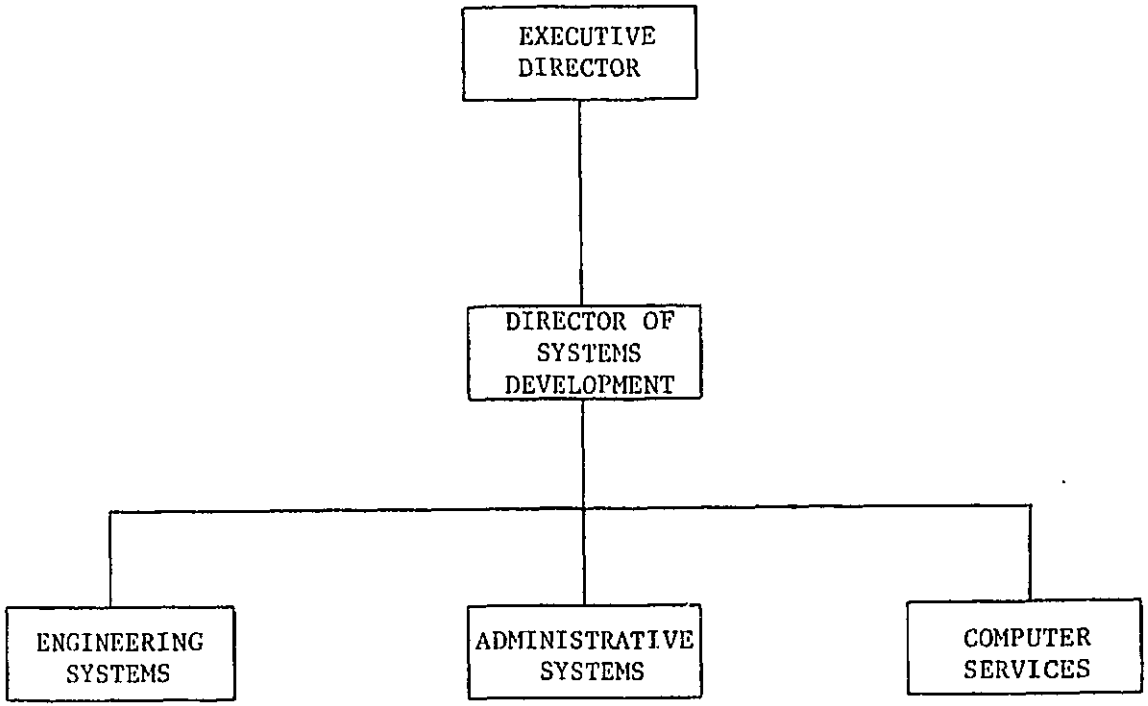
DEPARTMENT OF HIGHWAYS

(Proposed Organization)
March 1983



OFFICE FOR SYSTEMS DEVELOPMENT

(Proposed Organization)
March 1983

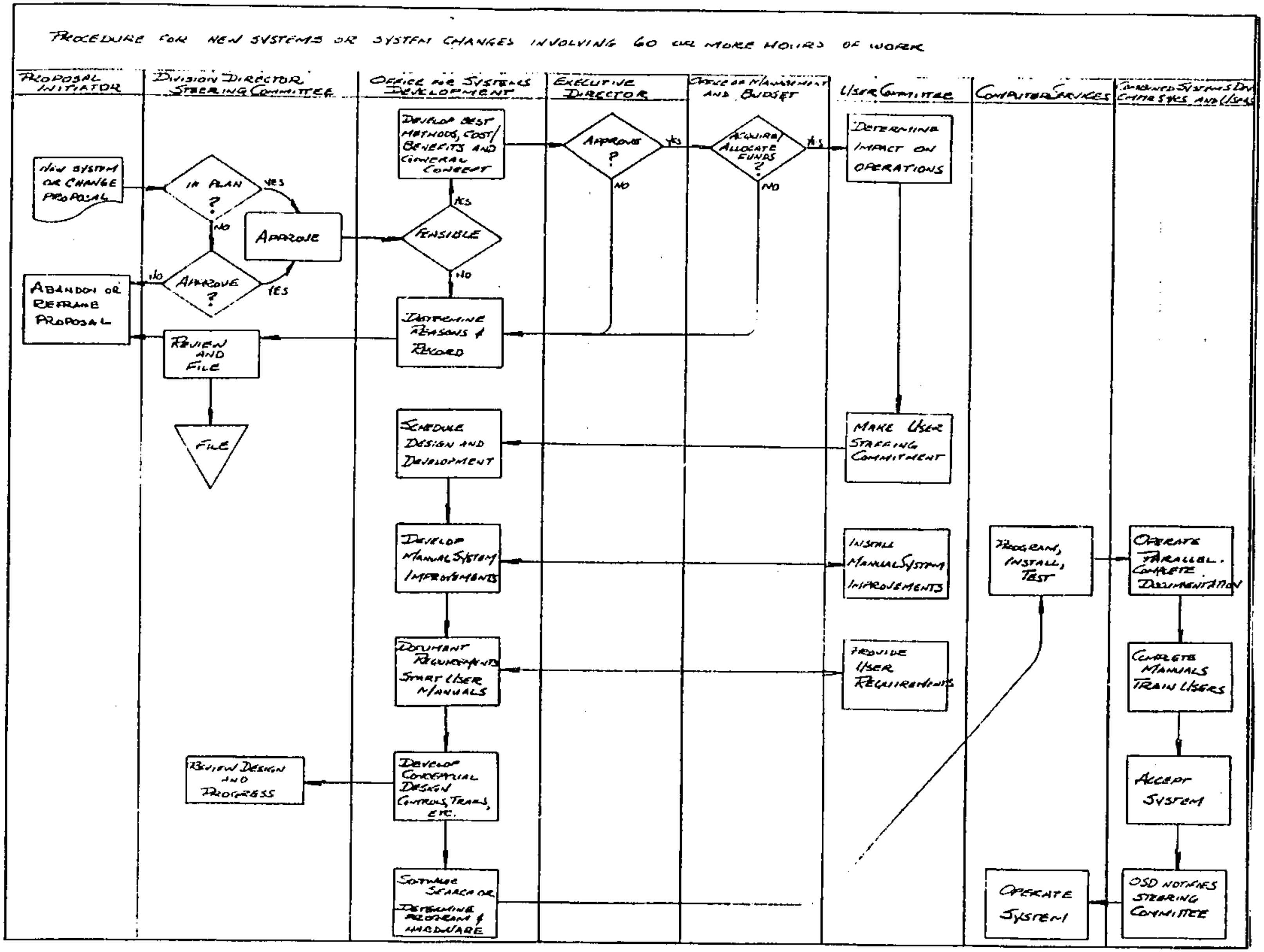


2. The approach recommended to overcome existing obstructions and establish productive development will have been initiated by the preceding recommendations. From this point, it is recommended that the procedure for systems development follow these general patterns:

PROCEDURE FOR NEW SYSTEMS
(See flow chart following this procedure)

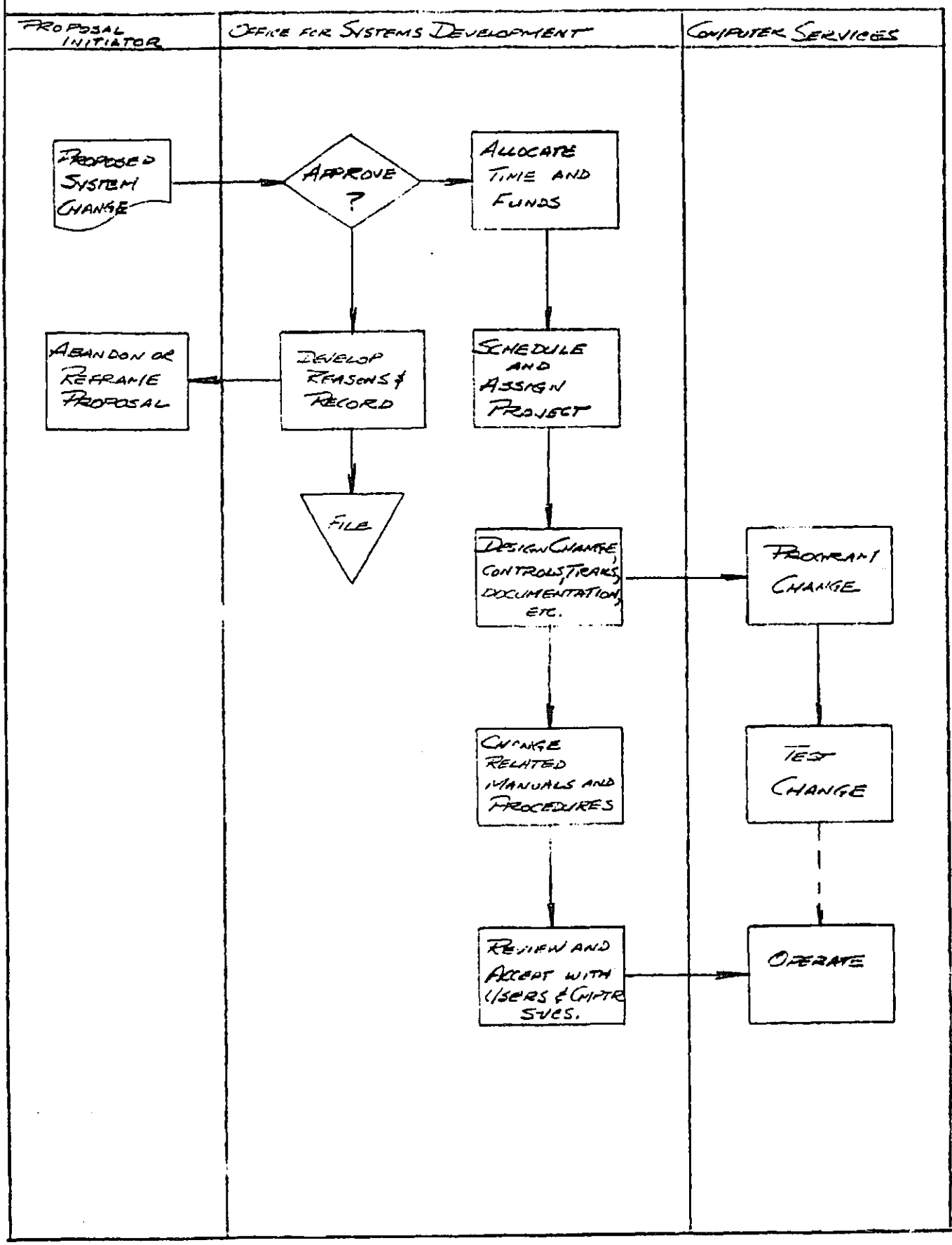
RESPONSIBLE PERSON OR GROUP	ACTION REQUIRED	DISPOSITION
1. Proposal Initiator	Submit Proposal	to Steering Committee
2. Steering Committee	Approval	to Office of Systems Development
	Disapproval	to Proposal Initiator
3. Office of Systems Development	Determine feasibility	
	If infeasible, give reasons	to Steering Committee then Proposal Initiator
	If feasible, develop concept and cost benefits	to Executive Director
4. Executive Director	Approve	to Office of Management and Budget
	Disapprove	to Office of Systems Development then Steering Committee then Proposal Initiator
5. Office of Management and Budget	Obtain/Allocate funds	to User Committee
	Funding not possible	to Executive Director then Office of Systems Development then Steering Committee then Proposal Initiator

	RESPONSIBLE PERSON OR GROUP	ACTION REQUIRED	DISPOSITION
6.	User Committee	Determine impact Commit staff	to Office of Systems Development
7.	Office of Systems Development	Schedule design and development - conduct manual system improvement - document requirements with Users	to User Committee
8.	User Committee	Negotiates changes Approves	as necessary to Office of Systems Development
9.	Office of Systems Development	Develop conceptual design with controls, audit trails, etc.	with Users to Steering Committee to Computer Services
10.	Steering Committee	Review design and progress	
11.	Office of Systems Development	Select software or programming and hardware	with Computer Services
12.	Computer Services	Program or install software and test	
13.	Computer Services	Install system, operate parallel to manual system, complete documentation	with Users and Systems Development
14.	Office of Systems Development	Accept system, inform participants, and complete User manuals.	


PROCEDURE FOR NEW SYSTEMS OR SYSTEM CHANGES INVOLVING 60 OR MORE HOURS OF WORK
PROPOSAL INITIATOR
DIVISION DIRECTOR STEERING COMMITTEE
OFFICE FOR SYSTEMS DEVELOPMENT
EXECUTIVE DIRECTOR
OFFICE OF MANAGEMENT AND BUDGET
USER COMMITTEE
COMPUTER SERVICES
NEW SYSTEM OR CHANGE PROPOSAL
IN PLAN ?
YES
NO
APPROVE
APPROVE ?
NO
YES
ABANDON OR REFRAME PROPOSAL
REVIEW AND FILE
FILE
DEVELOP BEST METHODS, COST/BENEFITS AND GENERAL CONCEPT
FEASIBLE
YES
NO
DETERMINE REASONS & RECORD
APPROVE ?
YES
NO
ACQUIRE/ ALLOCATE FUNDS ?
YES
NO
DETERMINE IMPACT ON OPERATIONS
SCHEDULE DESIGN AND DEVELOPMENT
MAKE USER STAFFING COMMITMENT
DEVELOP MANUAL SYSTEM IMPROVEMENTS
INSTALL MANUAL SYSTEM IMPROVEMENTS
DOCUMENT REQUIREMENTS START USER MANUALS
PROVIDE USER REQUIREMENTS
REVIEW DESIGN AND PROGRESS
DEVELOP CONCEPTUAL DESIGN CONTROLS, TRAILS, ETC.
SOFTWARE SEARCH OR DETERMINE PROGRAM & HARDWARE
PROGRAM, INSTALL, TEST
OPERATE SYSTEM
OPERATE PARALLEL. COMPLETE DOCUMENTATION
COMPLETE MANUALS TRAIN USERS
ACCEPT SYSTEM
OSD NOTIFIES STEERING COMMITTEE

-50-

PROCEDURE FOR SYSTEMS CHANGES INVOLVING LESS THAN 60 HOURS OF WOR



C. SYSTEMS CONFIGURATION

1. Include the systems requested in this study in the Department's ADP Master Plan. Have the ADP Steering Committee prioritize these systems for the Department.

   Reasons:

   - To develop in a single document the needed management information requests of the Department, and
   - To develop a clearer picture of the future hardware needs of the Department.

2. Remove the CRTs from District VI and District I.

   Reason:

   - To save $6000 per year for equipment that is barely used. The Department could have purchased two microcomputers already for what it has paid for unused equipment.

3. Bring the Mapper and Microcomputer studies to a close and publish the results.

   Reasons:

   - The Mapper study is costing the Department thousands of dollars in line charges and personal services costs and apparently, no one is accepting responsibility, and

- The microcomputer study is extended to August 1983. This is too long and should be concluded by May, 1983.

4. Purchase software for the HP 3000 that will increase productivity of the system operating on it. This would include a report writer that is user friendly, a screen formatter, a batch generator, and system software to detect access.

   Reasons:

   - To reduce programming effort and cost,
   - To satisfy a recurrent State Auditor comment, and
   - To increase the speed of generating important but irregular processing or information requests.

5. Discontinue adding new systems to the University of Colorado Computer Center's hardware until they have completed plans on what their future hardware configuration will be.

   Reasons:

   - To avoid having to redo these systems to run on other hardware in the event CU decides not to use a mainframe in the future.

6. Continue the distribution of word processing within the Department.

Reason:

- To provide a cost effective word processing capability in the Department.

7. Install and link microcomputers in the districts to FMS, provide them with a budget control application and include data entry of accounting documents.

Reasons:

- To eliminate duplicate manual accounting systems,
- To reduce data entry personnel, and
- To provide operating managers with immediate access to financial data to better manage their budgets.

8. Proceed with distributed data processing for the State Patrol, and when acquired, link the Patrol minicomputer to FMS.

Reasons:

- To eliminate duplication of accounting systems,
- To distribute MIS processing to the Troop level where it is most effective, and
- To supply information in a hierarchial structure that conforms to the organization structure of the Patrol.

9. Begin the steps necessary for purchase of a Department mainframe computer to be operated by computer services, considering capacity,

conversion problems, cost, funding, pheripheral equipment, location, and other relevant factors. The Commission should fund the study adequately and it should be done jointly with the State Division of ADP.

Reasons:

- To provide a plan to meet the Department's future systems' hardware requirements,
- To know the Department's plan for hardware prior to CU and GGCC beginning their future hardware purchases,
- To do a professionai study prior to committing large sums to acquisition,
- To decide the best hardware configuration for the Department, and
- To plan to bring together the fragmented ADP resources of the Department.

10. Develop and assign, or hire, systems development and distributive data processing expertise.

Reasons:

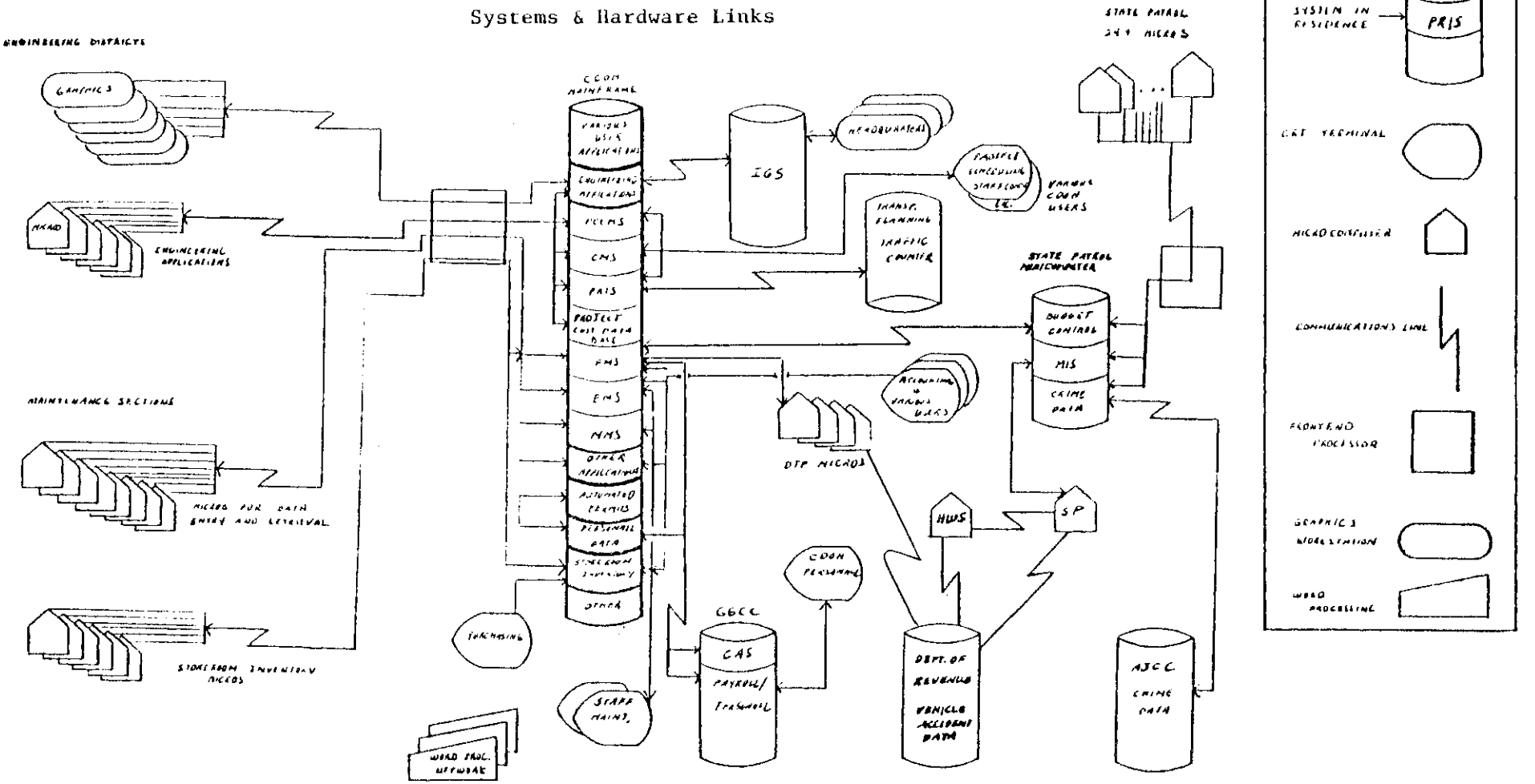
- To begin networking whatever computer hardware is resident in the Department to the levels of the organization where it is most beneficial,
- To provide networked systems that combine the better features of centralized data bases with those of decentralized processing,
- To provide information resources and equipment configurations that would strengthen and reflect the organization of the Department's operations,

- To support a network of microcomputers and terminals located throughout the state, and
- To provide input to the mainframe plan for a systems architecture that will support distributed data processing.

On the following pages, a chart displaying a possible configuration of systems and hardware for the Department is presented.

COLORADO DEPARTMENT OF HIGHWAYS
AUDIT BRANCH
FEBRUARY 1983

Possible Senario of CDOH Future Systems & Hardware Links



APPENDIX

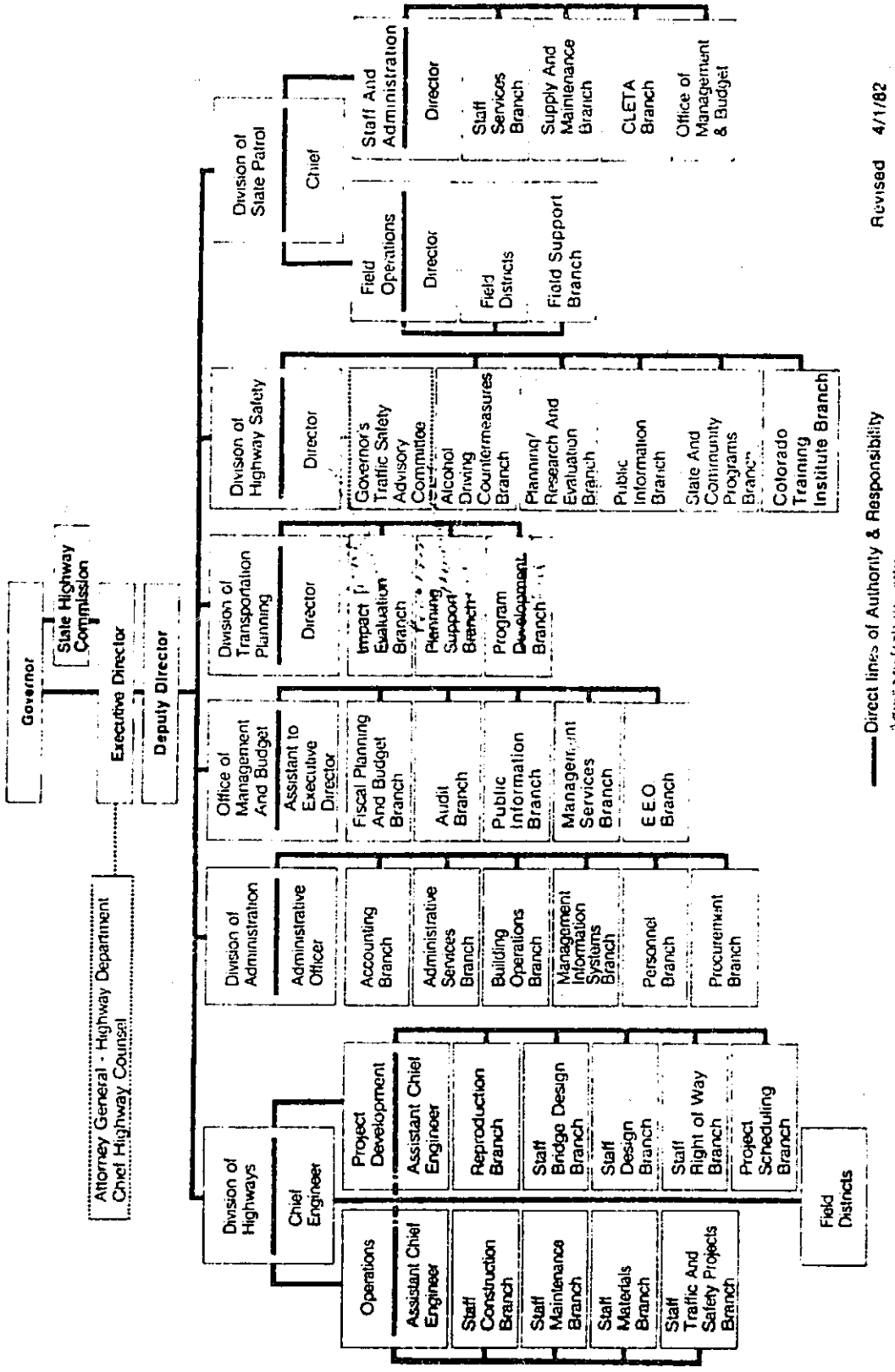
COLORADO DEPARTMENT OF HIGHWAYS

ORGANIZATION MANU

ORGANIZATION: ORGANIZATION CHAR

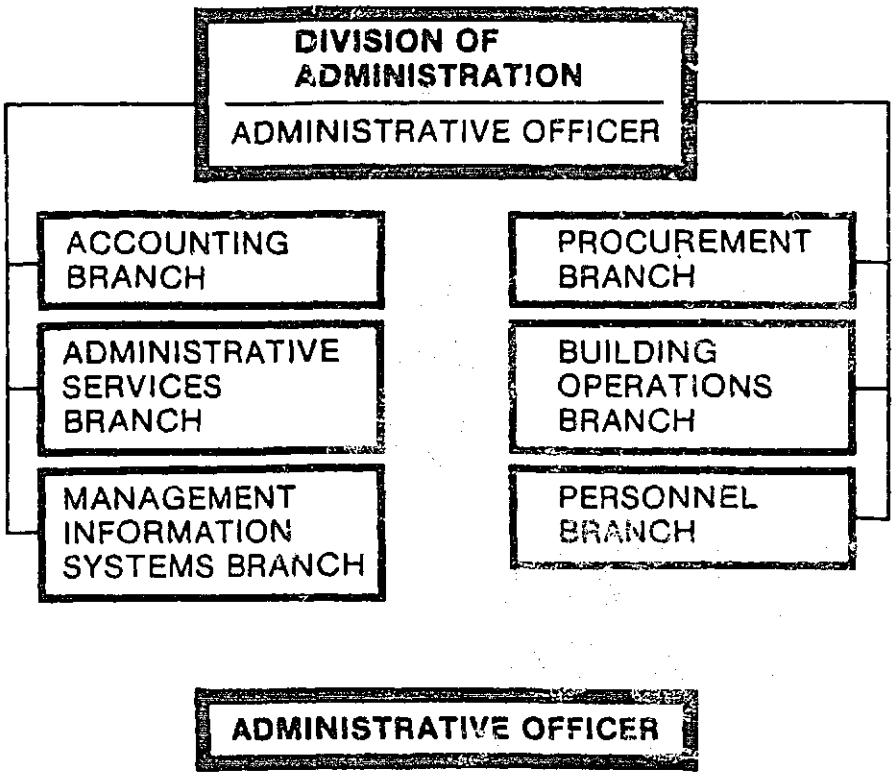
EFFECTIVE	SUPERSEDES	APPROVED BY	DIS
4/1/82			

Department of Highways Organization Chart



COLORADO DEPARTMENT OF HIGHWAYS	ORGANIZATION MANUAL
	ORGANIZATION: DIVISION OF ADMINISTRATION

EFFECTIVE	SUPERSEDES	APPROVED BY	DISTRIBUTION
4/1/82			



Assigned Duties:

A. Is appointing authority for the division.

B. Responsible for managing the division efficiently, effectively, and within established staff and budget limits.

C. Responsible for preparing the budget for the division branches and the Highway Commission. Recommends annual expenditure plans for each branch, including the addition of new activities and deletion of those no longer necessary.

D. Responsible for the daily operations of the division and the coordination of its activities with other divisions.

E. Responsible for the production of departmental reports by the use of computing equipment in support of engineering applications, general accounting requirements and miscellaneous computer based reporting activities.

F. Responsible for the department's financial management systems, general accounting applications and distribution of accounting reports, coordination of accounting with the Federal Highway Administration, the State Controller's office and the several divisions of the department.

G. Responsible for the department's archival program, internal distribution of mail; office, storeroom operations, and the operation of the department's central warehouse.

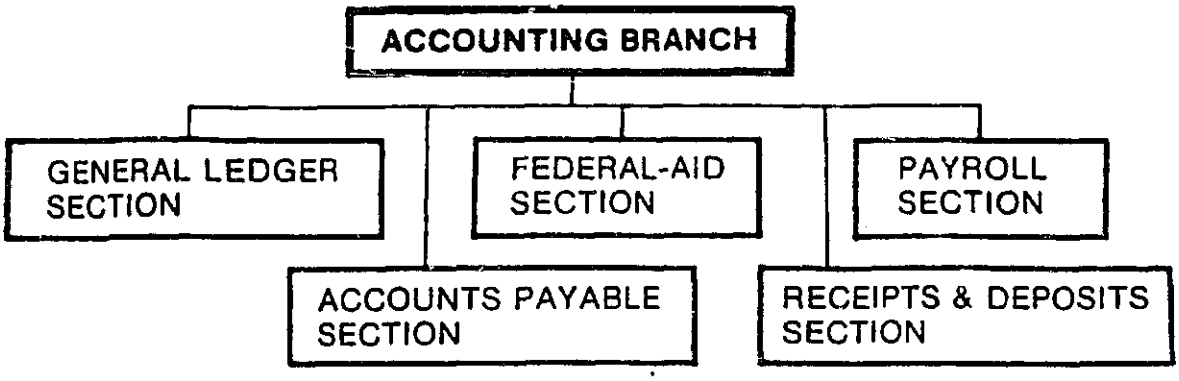
H. Responsible for department procurement activities delegated by the State Purchasing Officer and for the accounting of fuel and warehouse inventories at district offices.

I. Responsible for the operations and maintenance of the Headquarters Complex physical plant.

J. Responsible for recruiting, examining and selecting qualified personnel for the Department's needs, the clarification of all positions, the primary review of employee complaints and the enforcement of the State Personnel Rules as they apply to Civil service employees of the Department.

K. Serves as Secretary of the Highway Commission, which includes administrative support, management of agendas, secretarial duties, meeting coordination and managing Commission activities.

COLORADO DEPARTMENT OF HIGHWAYS	ORGANIZATION MANUAL	
	ORGANIZATION: ACCOUNTING BRANCH	
EFFECTIVE: 4/1/82	SUPERSEDES:	APPROVED BY: DISTRIBUTION:



ACCOUNTING BRANCH

Assigned Duties:

A. Maintain an accounting system.

B. Provide monthly operating statements for all the department cost centers and projects.

C. Prepare the annual financial report for the Department of Highways.

D. Disburse funds for:

1. Employee payrolls
2. Vendors

E. Prepare billings to the Federal Highway Administration, local state government entities, and other third parties for expenditures made on their behalf.

F. Monitor the cash flow and arrange with the State Controller for short term loans, as needed.

G. Interpret the State Fiscal Rules as they relate to specific department operations.

H. Respond to federal, state and internal audit reports.

GENERAL LEDGER SECTION

Assigned Duties:

A. Ensure accuracy and propriety of accounts and transactions in financial management and central accounting systems' general ledgers.

B. Preparation of financial statements and reports.

C. Provide necessary training to headquarters, field and accounting staff to improve accountability.

D. Provide assistance to all divisions in the department.

E. Ensure accurate and timely billings for accounts receivable.

F. Develop internal operating procedures to improve accountability and assure compliance with state, federal and department regulation.

G. Provide manual to all users of the financial management system.

H. Coordinate systems modifications and development with other branches.

ACCOUNTS PAYABLE SECTION

Assigned Duties:

A. Record encumbrances from contracts and purchase orders, and the subsequent liquidation when payment is made.

B. Pre-audit voucher requests and vendor invoices for coding, discounts, extensions, and proper approvals.

C. Pre-audit expense reports for compliance with the State Fiscal Rules.

D. Enter voucher, time sheets, and contractor estimate data into the system thru terminal input.

E. Control the system preparation of warrants and mail the warrants.

F. File and retain source documents supporting disbursements made.

G. Update data files supporting monthly and annual reports of equipment held by the department.

H. Maintain an imprest cash account for the payment of emergency type disbursements.

I. Prepare State tax exemption certificates.

J. Respond to inquiries from department personnel and vendors.

PAYROLL SECTION

Assigned Duties:

A. Prepare all payrolls for the Department of Highways.

B. Update prior months payroll registers for current months use by data processing in preparing monthly and semi-monthly payroll warrants.

C. Determine entitlement, compute and prepare separate payrolls for such items as overtime, resigned, retired, or new employees, Also, shift differential bonus pay and foreign exchange students pay.

D. Compute and update deduction listing for Bonds, PERA, CAPE, United Way, etc., and prepare and issue checks to the appropriate agencies.

E. Prepare edit/balance listing to use for zero balancing or verifying input change transaction.

F. Maintain and balance payroll ledgers.

G. Prepare State Department of Personnel service change list.

H. Prepare various reports for both Highways and the State Department of Personnel system.

I. Prepare payroll vouchers and appropriate cost distribution code forms.

J. Perform other related duties as directed by the Department Controller.

K. Prepare monthly electronic fund transfers.

L. Review of payroll clearing accounts.

FEDERAL-AID SECTION

Assigned Duties:

A. Prepare detailed project agreement estimate for project agreement or modification.

B. Prepare Federal Highway Administration vouchers for concurrent billings, reclaim billings, and final claims and closing of projects with FHWA.

C. Closing Department Federal-Aid project accounts.

D. Closing contracts with contractors.

E. Review monthly contractors' estimates and approve for payment.

F. Process monthly entity billings for payment.

G. Prepare project financial statements and related reports.

H. Prepare "accrued unbilled" report.

I. Prepare detailed summary of final project costs for final FHWA vouchers.

J. Maintain project information file.

K. Process project expenditure edit.

RECEIPTS AND DEPOSITS SECTION

Assigned Duties:

A. Receive, verify, process and deposit to State Treasurer all revenue collected by the Department of Highways for damage claims, transport permits, outdoor advertising licenses and permits, inspection fees, house moving permits, testing, sale of supplies and materials, rent from buildings and land, royalties on gas and oil leases, commissions on toll phones, jury duty, compensation insurance, sale of used equipment, etc.

B. Responsible for crediting and depositing collections received from cities and counties.

C. Deposit with State Treasurer all wire transfer payments from the federal government.

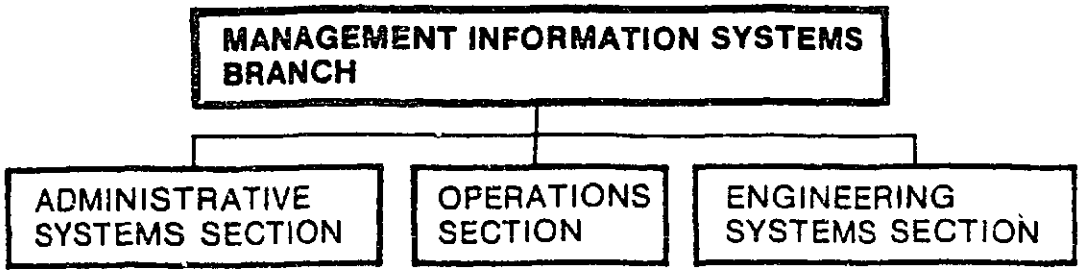
D. Receive, verify, process and deposit to State Treasurer all revenue collected by Division of State Patrol for sale of photo prints, copies, finger prints, blood alcohol reports, sale of used equipment, billings for aircraft use, damage claims, etc.

E. Responsible for processing and depositing to State Revenue Department revenue collected by Division of State Patrol for road taxes, diesel fuel permits, PUC permits and sales of abandoned cars.

F. Receive and deposit to State Treasurer all revenue from Division of Highway Safety for federal grants, refunds, etc.

G. Enter each deposit and receipt into financial management system.

COLORADO DEPARTMENT OF HIGHWAYS	ORGANIZATION MANUAL	
	ORGANIZATION: MANAGEMENT INFORMATION SYSTEMS	
EFFECTIVE: 4/1/82	SUPERSEDES:	APPROVED BY: DISTRIBUTION:



MANAGEMENT INFORMATION SYSTEMS BRANCH

Assigned Duties:

A. Supervision of three organizational groups within the Branch: Administrative systems; Engineering Systems; and Operations.

B. Responsible for all electronic data processing within the Department of Highways.

C. Develop procedures and forms involving both computer and manual operations.

D. Prepare special reports as requested by management and/or other user groups.

E. Maintain liaison with the Division of ADP, Department of Administration in regard to hardware, software, and personnel staffing.

F. Prepare annual budget for the branch for submission to both the Department of Highways and the Division of State ADP.

G. Prepare feasibility studies for new and/or updates of systems and develop timetables for completion of such tasks.

H. Assist in the preparation and evaluation of RFP's (Request for Proposal) for both hardware and software required by other groups within the Department of Highways.

I. Provide interface to other computer centers (General Government Computing Center, University Computing Center, and any other State operated computing facilities).

J. Prepare and maintain system documentation and user documentation for all systems as well as a catalog of all systems available within the Department of Highways.

OPERATIONS SECTION

Assigned Duties:

A. Process source documents for automation.

B. Schedule and produce reports on a pre-defined processing cycle.

C. Schedule equipment maintenance for high performance.

D. Establish and maintain quality control of reports.

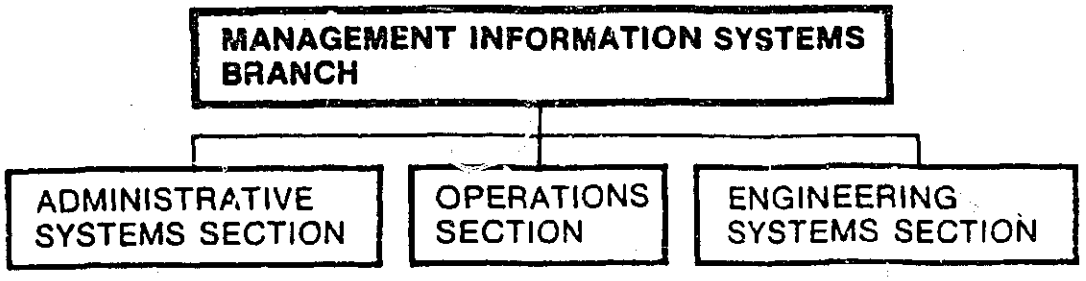
E. Train personnel to operate the various types of computer equipment.

F. Maintain cleanliness and safety standards.

G. Buy and maintain supplies for section.

H. Work with operations people at Division of ADP and University of Colorado.

COLORADO DEPARTMENT OF HIGHWAYS	ORGANIZATION MANUAL	
	ORGANIZATION: MANAGEMENT INFORMATION SYSTEMS	
EFFECTIVE: 4/1/82	SUPERSEDES:	APPROVED BY: DISTRIBUTION:



MANAGEMENT INFORMATION SYSTEMS BRANCH

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G. Buy and maintain supplies for section.

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ADMINISTRATIVE SYSTEMS SECTION

Assigned Duties:

A. Functions as a service bureau to design administrative computer processing systems in cooperation with the user, and conduct the necessary training sessions that are required by the user.

B. Prepare all administrative documentation, source documents, and instruction manuals as well as translate user specifications into computer readable language.

C. Under the direction of the Department's ADP Steering Committee, oversee all administrative applications on the computer to prevent duplications and to provide for more efficient program utilization.

D. Provide technical backup as well as systems and programming support to all users for all existing administrative applications.

E. Develop and analyze time and cost statistics for economic evaluations and cost/benefit studies.

F. Maintain records of the activities of the Administrative systems Section.

G. Conduct feasibility studies to determine the needs and desires of the Highway Department management and recommend automation for the applications that are justified.

H. Keep informed of changes and improvements in the data processing industry which would be an advantage in Highway Department computer applications.

I. Communicate with other state highway departments concerning sharing systems and programs.

ENGINEERING SYSTEMS SECTION

Assigned Duties:

A. Prepare all engineering documentation and instruction manuals, including the input forms required.

B. Conduct training sessions required by the user to utilize the systems and also assist the Engineering Operations Section.

C. Maintain and update all major Engineering Systems for the division.

D. Function as liaison with the University of Colorado Computer Center in the areas of programming and systems standards, production problems, and charges related to the Highway/Computer Center contract.

E. Under the direction of the Department's ADP Steering Committee, oversees all engineering applications on the computer to prevent duplications and to provide for more efficient program utilization.

F. Responsible for the installation, training of users, and maintenance of teletype operations in headquarters and at all field locations.

G. Conduct feasibility studies to determine the needs and desires of the Engineering Staff and recommend automation for the applications that are justified.

H. Keep informed of changes and improvements in the data processing industry which would be an advantage in Highway Department computer applications.

I. Communicate with other state highway departments concerning sharing systems and programs.

EXHIBIT III

MEMORANDUM

DEPARTMENT OF HIGHWAYS
4201 East Arkansas Ave.
Denver, Colorado 80222

DATE: January 6, 1983

TO: Users and Potential Users of
Automated Data Processing Services

FROM: Joe Dolan, Executive Director

SUBJECT: Automated Data Processing Development Survey

The Department is considering the direction that should be taken in the development and managment of automated data processing services. To do this, we must assess the capabilities we need to add to our existing ADP system as well as future ADP needs so that we can work toward consistent, compatible, and economic development of responsive, cost effective, reliable, and accurate data processing support.

Your response to this survey is necessary by the 17th of January to provide sufficient time for analysis and synthesis of the information which will be used in response to the current review by the State Auditor. More important, the study is designed to provide the basis for recommending a long term departmental strategy for data processing development and organization. The latter consideration makes it imperative that you make an exhaustive effort to determine the realistic data processing <u>needs</u> of your division or branch to properly manage your unit.

Upon completing the survey, deliver or send it to our Audit Branch in Room 274 of the Headquarters Building. Address any questions regarding this survey to the Audit office as well.

Interviews will be conducted by request, or on an exception basis to follow up on incomplete information, to explore good ideas, or to obtain clarification of responses to the questionnaire.

INSTRUCTIONS FOR COMPLETING SURVEY

Please respond only for additions to current systems or for future ADP applications that you envision your organization needing. Do not respond for systems or applications already existing.

MANAGEMENT INFORMATION NEEDED

Please describe each application that you envision will be needed as additions to current systems or will be a new system. Not simply changes in existing programs. These applications are those that provide management information, information used in decision making including accounting, statistical, scheduling, estimates, etc. It would not include scientific or engineering applications that are only mathematical calculations.

ADD ON TO EXISTING SYSTEM

Check this column if the application is an addition to an existing system. This would usually occur when the data needed to produce the desired output is already existing in the department.

NEW SYSTEM MUST BE DEVELOPED

Check this column if the application is a new system. A new system would mean the construction of a new group of interrelated programs that seek the attainment of a common goal.

TURNAROUND TIME

Check the column which is acceptable to you in receiving information from this application. Desired immediately usually means that queries will be by CRT with almost instantaneous response. For turnaround in days or weeks please indicate a number of days or weeks that would be acceptable to receive information after the event the application records has occurred.

MANIPULATE DATA

Check this column if you believe the data base created by this application will be manipulated by your organization's own programs on your site on hardware in your possession.

ACCESS TO DATA ONLY

Check this column if your organization will only need to query the data base and not manipulate the data.

ACCURACY

Check this column if accuracy is critical.

AGENCY THAT MUST SUPPLY DATA

Name the CDOH branch or outside agency that must supply the data you need for this application. You may name more than one and you may name your own branch.

VOLUME AND FREQUENCY OF TRANSACTIONS

Please estimate the number of transactions that will have to be input and their frequency, per week, per year, etc.

RATE NECESSITY

Check the column that most nearly describes your organization's need for this application.

HARDWARE

Please list the hardware you believe will be required to handle this application. It would be anything from already existing hardware to the need for a large mainframe with periphrals. Or it may be only a terminal at your site connected to a department computer.

If you have any questions contact Robbie Roberts or Alan Boisvert at 757-9722.

ADP DEVELOPMENT SURVEY

NAME _____

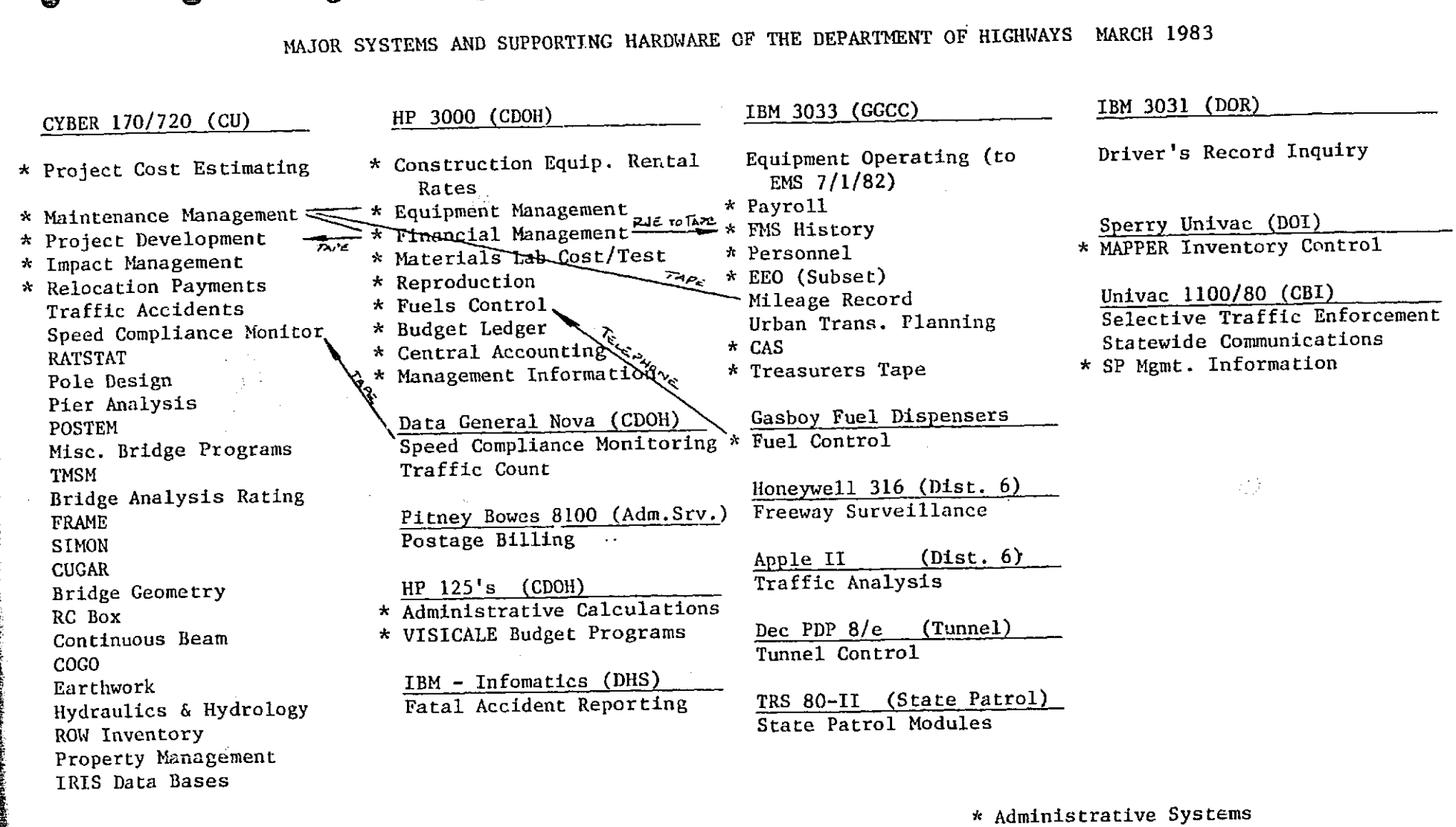
BRANCH _____

DATE __/__/__

LIST ONLY ADDITIONS TO EXISTING SYSTEMS AND FUTURE APPLICATIONS YOU ENVISION.
INCLUDE CURRENT MANUAL SYSTEMS THAT SHOULD BE AUTOMATED.

MANAGEMENT INFORMATION NEEDED PLEASE DESCRIBE CONCISELY	CHECK ONE: ADD TO SYS.	CHECK ONE: NEW SYS.	TURNAROUND DESIRED: IMMED.	TURNAROUND DESIRED: NO. OF DAYS	TURNAROUND DESIRED: NO. OF WEEKS	CHECK APPLICABLE: MANIPULATE DATA	CHECK APPLICABLE: ACCESS ONLY	CHECK APPLICABLE: ACCURACY	BRANCH OR AGENCY THAT MUST SUPPLY DATA	VOL. & FREQ. OF TRANS.: VOL.	VOL. & FREQ. OF TRANS.: FREQ.	CHECK NECESSITY: NICE 1	2	3	NECESS. 4	5	HARDWARE TYPE & QTY NEEDED

MAJOR SYSTEMS AND SUPPORTING HARDWARE OF THE DEPARTMENT OF HIGHWAYS MARCH 1983



* Administrative Systems

EXHIBIT IV

GLOSSARY

ABL	-	Agency Budget Ledger
ADP	-	Automated Data Processing
BAMS	-	Bid Analysis and Monitoring System
BARS	-	Bridge Analysis and Rating System
CAS	-	Central Accounting System
CDOH	-	Colorado Department of Highways
COGO	-	Coordinate Geometry
CU	-	University of Colorado
DDP	-	Distributed Data Processing
DOH	-	Division of Highways
DP	-	Data Processing
EAM	-	Electronic Accounting Machines
EEO	-	Equal Employment Opportunity
EMS	-	Equipment Management System
FINEST	-	Final Estimate
FMS	-	Financial Management System
FTE	-	Full Time Equivalent (personnel)
GGCC	-	General Government Computer Center
HPMS	-	Highway Performance Monitoring System
IGS	-	Interactive Graphics System
IMS	-	Impact Management System
IRIS	-	Information Retrieval Inventory System
MAPPER II	-	MAintaining, Preparing, and Producing Executive Reports
MBE	-	Minority Business Enterprises
MIS	-	Management Information System
MMS	-	Maintenance Management System

OSD	–	Office for Systems Development (proposed)
PCEMS	–	Pre-Construction Engineering Manpower System
PHS	–	Project History System
PMS	–	Pavement Monitoring System
PRIS	–	Public Roads Information System
RAP	–	Resource Allocation
RFP	–	Request for Proposal
SP	–	State Patrol