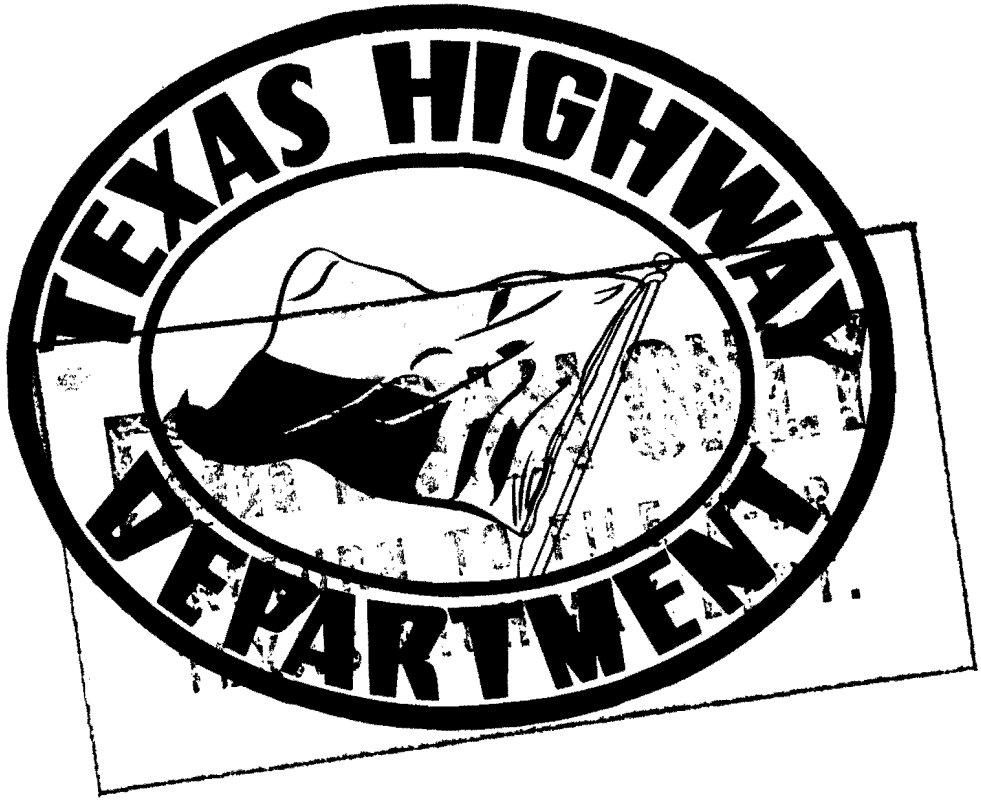
VOLUME 1

SPECIAL REPORT

FINANCIAL MANAGEMENT STUDY



Prepared for

THE TEXAS HIGHWAY DEPARTMENT

and

THE U.S. DEPARTMENT OF COMMERCE
BUREAU OF PUBLIC ROADS

By

ERNST & ERNST

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BUREAU OF PUBLIC ROADS

JANUARY 1, 1966

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VOLUME I

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C O N T E N T S

VOLUME I

VOLUME I - Continued

VOLUME I - Continued

VOLUME II

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CERTIFIED PUBLIC ACCOUNTANTS
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State Highway Commission, and
Mr. D. C. Greer, State Highway Engineer
Texas Highway Department
State Highway Building
Austin, Texas

Gentlemen:

We have completed our study of the financial management of the Texas Highway Department and present herein our findings and recommendations.

The objectives and scope of our study were as follows:

Study and analysis of the organization; operating policies; manpower staffing, utilization and controls; data processing equipment needs and potentials; financial management practices and procedures; and operating policies of the Highway Department to achieve desired fiscal management goals and maximum, efficient utilization of electronic data processing equipment.

Development of a recommended financial management system which will meet the concurrent audit and billing regulations of the Bureau of Public Roads, and satisfy the requirements of the State Auditor.

Our report is divided into four Sections for convenience and easy studying and to accomodate the degree of interest of the reader. Section I summarizes our findings and recommendations so that a casual reader may quickly grasp their essential elements. Section II contains the body of the report and sets out in detail our findings and recommendations; it has been designed to serve as a reference guide in implementation. Section III has been prepared as an appendix to the main body of the report; it contains alternate plans which were studied and discarded as well as data gathered in support of our conclusions. Section IV (Volume 2) is a companion reference manual to Section II; it contains exhibits related to the material presented in Section II.

The Department should immediately organize and start planning for a timely implementation of the primary recommendations of this study.

The Department's own studies which it was pursuing at the time we commenced our work contributed in real measure to the thoroughness and effectiveness of our effort; and we acknowledge with appreciation the cooperation and guidance of the Steering Committee and the other employees of the Department.

Very truly yours,

Ernst & Ernst

Ernst & Ernst

San Antonio, Texas
January 1, 1966

Summary

I. SUMMARY

A. WHAT IS NEEDED

We have recognized in this report a general need for modernization of the accounting function in the Texas Highway Department. As mentioned in the minute order passed by the Highway Commission authorizing the initiation of our study, this one overall need has been recognized internally for some time. Our principle task has been not to amplify the overall need, however, but to seek and offer definite recommendations for meeting specific requirements.

In order to tender suggestions for improvement, it is first necessary to isolate and identify the problems. The following statements, in our opinion, are a condensed rendering of what we consider the main needs to be; not necessarily in order of importance:

1. The basic philosophy towards the accounting function in the Texas Highway Department needs to be changed from one of record keeping and documentation of past events to the gathering and presentation of current business facts to those managers in a position to make improvements in a progressive manner.

2. Accounting data needs to be collected and disseminated to all levels of management on a continuing basis in various degrees of detail.

3. Forecasting and planning activities need to be formalized and carried out more frequently and in more detail. Budgets need to be aligned with organizational responsibilities.

4. Computer methods need to be employed more extensively in the application of accounting and paperwork processing to save time and clerical effort, and to increase the accuracy of reports.

5. All accounting personnel need more centralized direction and more clearly defined authority and responsibility.

6. The scheme of accounts and codes needs revision to provide for the more efficient collection, processing and presentation of accounting data.

7. The present accounting system cannot be patched to fulfill such broad objectives. A new overall integrated system needs to be designed to meet present requirements and those of the foreseeable future.

8. Accounting for the costs of construction needs improvement especially in promptly collecting full Federal aid reimbursement.

9. Definite plans need to be made and agreed on for the best total utilization of computers and automation in all areas of the Department such as business data processing, highway and bridge design, motor vehicle file maintenance, and traffic studies.

10. Improved methods need to be developed for scheduling and coordinating the Department's overall manpower in order to place this precious resource where the work is when it needs to be done, with as little waste of effort as is possible.

B. WHAT TO DO

1. Accounting Systems

We recommend making only minor revisions to the monthly and annual financial statements now prepared by the Texas Highway Department. These statements, namely a Balance Sheet and a Statement of Revenue and Disbursements, are based on generally accepted highway accounting principles and have considerable value as a historical chain of comparable financial data, which should be preserved. However, we have made several revisions in the mode of presenting the accounts both in sequence, and in description and classification, which we feel will further enhance their value.

We recommend a revised system of budgeting which will provide for planned expenditures that fit organizational responsibilities, and for budgets of indirect and administrative expenses in the districts. This will mean that not all district expenses can be charged directly to projects or maintenance budgets, but that some administrative expenses must be planned and recognized separately.

Provision has been made in the accounting system recommended for comparing budgeted or planned expenses to actual costs on a monthly basis through the use of a central computer in Austin. This procedure would replace much of the manual paperwork now performed in district accounting offices. The system which is recommended has the following characteristics:

a. Accounting transactions involving men and machines will be translated to computer processable documents at or near the source point through the use of plastic card imprinters similar to those used in gasoline filling stations.

b. The translation of data from time reports and equipment usage reports will be performed by regular clerical personnel using pre-embossed plastic cards to identify road projects, maintenance sections, men, and machines.

c. Imprinting will be done onto heavy paper (card stock) forms which will be mailed daily to Austin via the district accounting offices where document controls will be established and preliminary editing of data will take place.

d. Conversion of the imprinted card stock forms to computer processable punched cards will be done daily in Austin by a card scanner-punch located in the Fiscal Management Division in the State Highway Building.

e. Punched cards, after scanning, will be read into a small computer, also managed by the Fiscal Management Division, and will be written onto magnetic tape for further large scale computer processing. Control totals will simultaneously be accumulated for balancing to district accounting office totals.

f. Other accounting transactions will be mailed to Austin on a scheduled basis for manual key punching into cards for subsequent computer processing. Such transactions would involve vendor payments, contractor quantity estimates, and adjusting or other general accounting entries.

Essentially the paperwork processing workload now assumed by the district accounting offices would be taken over by the central computer system in Austin. Cost and budget ledgers now kept in district offices

would be replaced by monthly computer printouts which would be return mailed to the districts from Austin for review and information. Estimated personnel requirements of the present and recommended systems are summarized in the following schedule:

COUNT OF ESTIMATED PERSONNEL REQUIRED

	PRESENT	RECOMMENDED	INCREASE (DECREASE)
Accounting Personnel:			
Districts	300	175	(125)
Divisions	168	80	(88)
Data Processing Personnel	61	80	19
Motor Vehicle Clerical Personnel	150	100	(50)
TOTALS	679	435	(244)

Estimated annual operating costs of the present and recommended systems are summarized in the following schedule:

ESTIMATED ANNUAL OPERATING COSTS
(in thousands of dollars)

	PRESENT	RECOMMENDED	INCREASE (DECREASE)
Personnel	$3,745	$2,445	$(1,300)
Machine Rental	459	667	208
Supplies and Sundry	100	150	50
Communications Costs	8	45	37
TOTALS	$4,312	$3,307	$(1,005)

We have estimated the total cost of conversion from the present to the recommended system to be approximately $1.8 million. Based on these estimates, this conversion cost would be recovered through annual savings in approximately 1.8 years.

2. Organization

We recommend the creation of a new division, to be known as the Fiscal Management Division, to coordinate all accounting and financial

reporting activities of the Texas Highway Department. It would be formed initially by combining the forces of the present Aid and Accounting Divisions, but later would absorb all other related accounting activities including financial planning, budgeting, cash forecasting, and division cost accounting. This Division would be responsible for the collection and processing of accounting data, and we recommend that it have its own small computer, located in the State Highway Building, for balancing and doing some limited processing of input data received from the districts. Month-end batch processing would be done by members of the Financial Management Division on the Automation Division's large computer located at Camp Hubbard.

The organization of the Financial Management Division should be divided into five major sections with sub-units as shown in Exhibit II.B.3.-1. We believe that personnel to administer the Fiscal Management Division can be selected from among the present accounting personnel of the Department without having to find experienced financial managers from external sources. However, it may be necessary to seek personnel for the Business Data Processing Section from the present Computer Center, the districts, or from non-accounting personnel in the Austin divisions.

Although our findings and recommendations are confined primarily to matters pertaining to financial organization, we also offer the following general suggestions:

a. District boundaries should be studied further, towards a possible realignment to better equalize the workload, after sufficient data has been gathered through the recommended budgeting and manpower control methods.

b. Standardized district organizations should be established both to fit the pattern of today's situation, and to fit the pattern which would exist after adjusting district boundaries.

c. Functional responsibility for all accounting activities should be assigned to the Director of the Fiscal Management Division, with administrative control of district accounting personnel being assigned to the District Engineers.

d. At the best practical time, the Houston Urban Office should be merged into the operations of the Houston District.

e. Written policies should be published which clarify the positions of the divisions with respect to outside agencies, and a long-term plan for the functional reorganization of the divisions should be established to eliminate duplicate functions.

f. The Personnel Division should expand its functions to include a coordinated statewide employee training program on a continuing basis, and to develop an inventory of skills of all personnel employed by the Department. Better coordination of employment and recruiting should also be established.

g. Compensation levels of the present administrative staff should be increased to maintain the present high quality of personnel, and to provide incentive for subordinates.

h. The computer center should be made a part of a division specializing in technical services including reproduction and photogrammetry. (This recommendation was put into effect in December, 1965, when the Automation Division was created.)

3. Data Processing Hardware

We recommend that immediate steps be taken to obtain a large scale third generation computer in about two years to serve the full needs for engineering problem solving and motor vehicle file maintenance, and part of the needs for business data processing and traffic studies all on a time shared basis. This equipment would be used routinely on a two shift basis, and would be available to answer file inquiries on a 24 hour basis. We have shown a tentative configuration for such a computer in Exhibit II.C.c.-1. It would cost between $40,000 and $50,000 in monthly rental. For traffic studies requiring larger internal memory than the 450 to 500 thousand positions recommended for the computer shown, we suggest that computer time be rented at an outside service bureau or other state agency on a limited basis. For the daily routine business data processing needs, we recommend that a separate small computer be obtained within six to eight months for the Fiscal Management Division as shown in Exhibit II.C.3.-2. This computer would be supported by a separate key punch section, an optical scanner-punch and two card sorters to process the accounting transactions received from the field districts on a daily basis. It would also be used to perform many of the tasks now done in the tabulating shops in the divisions.

In order to provide immediate means for testing programs for the third generation computer, to assist in conversion of motor vehicle files, and also to promote more efficient general use of the present equipment, we recommend that the present two computers be modified as soon as possible as follows:

a. Trade the smaller computer for one which has four tape units that can be interswitched with the larger computer. This will provide a total of eight tape units for the larger machine so that eight-tape programs can be written and tested.

b. Place a high speed card reader and all such peripheral devices on the smaller computer, so that the larger computer will be strictly a tape system.

c. Consider a second printer for connection to the smaller computer to increase the printing capacity of the entire system.

All of this modified equipment plus the present tab shops will be replaced by the large scale computer recommended for installation in about two years plus the small computer recommended for the Fiscal Management Division. In a period of four or five years it also is possible that the Fiscal Management Division computer could be absorbed into the main computer center either by attaching a peripheral device directly to the large computer, or by physically transporting data to Camp Hubbard on a daily basis for processing.

4. Motor Vehicle Division System

The Motor Vehicle Division exists to administer the Texas motor vehicle laws pertaining to registration, Certificate of Title and portions pertaining to the operation of vehicles. The activities of the Division are to collect the State's revenues from vehicle registrations and to provide a permanent central record of vehicle ownership through Certificate of Title procedures. These functions are supplemented by an extremely responsive inquiry system which provides data to law enforcement, governmental and commercial organizations regarding motor vehicles in the State of Texas.

The recommended Motor Vehicle Division System involves use of the latest computing techniques and equipment. The recommended computer to handle the system requires "time sharing" a large computer with other functions of the Texas Highway Department. This method provides for continuous access to the motor vehicle files and for simultaneously "batch" processing other Highway Department work. The Motor Vehicle Division is to be directly connected to the computer, and to the computerized motor vehicle files by eight remote terminals. These remote stations or terminals will provide for access to the files for inquiry or updating at any hour. All batch data is to be processed at the Computer Center.

The registration system as proposed requires only minor changes in the forms which are used, but several significant changes in the procedures both at the county and State level. The most significant new concept introduced is that it will no longer be necessary to completely fill out the registration receipt each year during the renewal period. This concept is based on the ability of a central computer to retain all data about a vehicle in digital form in its memory. Only license numbers and owner addresses will need be changed. Another significant change at the county level is the elimination of the need for the present registration reports. These reports and billings to the counties will be prepared by the Texas Highway Department.

The title system which is recommended provides for significant internal changes in Motor Vehicle Division procedures but without major impact at the county level. As in the registration system no further county title reports will be required, because title transactions can be analyzed and summarized centrally. All accounting summaries and fee

billings will be prepared by the Texas Highway Department. Within the Motor Vehicle Division the most important procedural change is the computerized printing of the title immediately after receipt of the application and prior to examination by a title examiner. By performing many comparisons and edits within the computer before printing the new title, the title examiner is given more time for examining non-routine items. Following approval, the examiner will actually certify the title and send it to the owner. Of the total number of title applications presently received, 96 per cent are accepted and approved.

Inquiry procedures will remain essentially unchanged. The number of inquiries which must be handled manually, however, will be greatly reduced due to the installation of a direct inquiry station in the Department of Public Safety Headquarters in Austin. The reduced waiting time for inquiries, caused by direct access to the computer record should also reduce the inquiry workload.

Other computer applications which are recommended for the Motor Vehicle Division in addition to registration, title and inquiry procedures are as follows:

a. County Inventory
b. Rejection Analysis
c. File Purging
d. Financial Procedures
e. County Remote Stations
f. Production Analysis
g. Report Generator
h. Investigation Scheduling and Reporting
i. Department of Public Safety Support

The recommended system will affect all of the sections of the Motor Vehicle Division. Changes in the near future will result in increased cost due to the conversion activities and accompanying system development costs. Once the system is implemented, the following internal organizational changes may be expected:

a. Accounting Section - The inventory, registration auditing, and cashiering functions will be directly affected. For example, billing counties and receiving cash will be performed by the Fiscal Management Division. Motor Vehicle responsibility will be concentrated on document control. The registration auditing and inventory functions will be replaced by a smaller group of registration examiners who will work on exceptions only.

b. Records Section - Gradual elimination of the present paper files will have a direct impact on this organization. In addition, the inquiry workload will be reduced. The clerical nature of this section will be replaced by the need for highly skilled document analysts who can trace transaction records and solve special document problems.

c. Correspondence Section - Few changes will be noticed in this organization since it is now primarily concerned with handling exception transactions for the Motor Vehicle Division. Some minor changes in procedures will be introduced but no large change in workload is anticipated.

d. Title Examination Section - The essential function of title examination cannot be significantly changed by computing equipment. Some pre-editing and machine comparisons of data, however, will enable the examiner to concentrate on the legal aspects of the title transaction. Some minor procedural changes can be expected but no significant workload changes.

e. Dexigraph Section - Computer preparation of the title prior to examination of the transaction will almost eliminate the need for this section. The only remaining function will be the sorting of title inputs and the numbering of title applications.

f. Supply Section - No significant impact is expected in this section, but the computer will eventually be used to provide assistance in forecasting license plate requirements and distribution patterns.

g. Investigation Section - No significant impact is expected in this section. The system is expected to assist in improved field investigation operations by providing investigation scheduling and reporting on an automated basis.

5. Manpower Controls

We recommend that manpower controls be established to cover the construction engineering activities of the Department through a system of monthly staff workload estimates and project estimates. These would be prepared by supervising engineers on a standardized basis, and would serve to communicate future anticipated staffing problems to District Engineers and Division Heads in a manner uniformly understood. As sufficient data is collected for typical kinds of construction engineering work, standards should be derived for each work function.

For maintenance forces, we recommend that studies be made to determine the basic complements of personnel necessary to perform routine highway maintenance by first applying work simplification techniques to the present manner of doing the work, and then by assigning standard crews to the resulting standardized tasks. These standard crew sizes can then be used to determine the amounts to be budgeted for personal services at

each maintenance section headquarters. Routine budget variance reporting should be the control mechanism thereafter. We have suggested several specific projects for further study and as examples of the application of industrial engineering techniques.

For clerical and administrative employees, we suggest an interim procedure based on the self-reporting of employee productive time to be followed up by a full scale clerical work measurement program after the conversion to centralized data processing procedures. The interim system provides for periodic payroll reporting in the form of distribution summaries of productive vs. non-productive time by clerical organization unit within Divisions and Districts. The purpose of such reports would be merely for recognizing gross inequities of clerical workloads over an extended time period.

6. Plan for Conversion

We have recommended a plan for partial conversion to the new accounting system by September 1, 1966, and for full implementation of our accounting recommendations by September 1, 1967. In addition, we have developed a plan for converting the motor vehicle files to a computerized system by January 1968. These plans are documented in two Activities Networks with companion bar graphs showing details of the necessary actions. We estimate the total cost of these concurrent conversion programs will be about $1.8 million.

To do the actual systems work, employee training, and computer programming necessary to meet these ambitious schedules will require from 125 to 150 man years of effort from a task force of Highway Department employees guided by top management authority and control, and assisted by

continuous service from systems consultants. We recommend the immediate formation of a task force steering committee to begin the implementation at once in order to reduce the overall time and expense necessary for conversion.

7. Legislative Considerations

In our reviews of the current procedures we found several areas where legal impositions had been placed which, if lifted, would provide benefit to the Highway Department without detracting from the original intent of the legislation. In particular, we recommend that consideration be given to providing for on site audit by the State Comptroller's office of Highway Department voucher support, and for the preparation by the Highway Department of its own warrants under on site supervision by a representative of the State Comptroller's office. Similarly, some or all of the State Board of Control audit procedures might be performed by on site representatives in Highway Department offices. In addition, we offer several suggestions concerning specific acts regarding the detailed motor vehicle procedures, and also recommend that a long-term provision be studied for registering autos for a six year period. We noted that the salary structure of administrative positions in the Highway Department is considerably below that of industry, and we recommend generally higher pay for city-based employees.

C. HOW TO GET STARTED

The needs which have been pointed out, and our recommendations for meeting these needs cover a wide area. Some of these recommendations are general in nature, while others are specific. It is a difficult task to sort out the immediate from the long-term, and to formulate a plan for action which will avoid wasted effort and still provide for definite movement towards a goal. We feel, however, that some analysis and interpretation of these recommendations is in order, indeed necessary, to fulfill our obligation. Therefore, we are offering the following remarks as a series of suggested steps to be taken immediately upon receipt of this report.

1. We recommend the immediate appointment of a Task Force Steering Committee composed of several appropriate Division Heads and District Engineers to guide the implementation of new procedures. This committee should be requested to meet at least monthly to review the progress of the task force workers, and to take such administrative action as is necessary to implement changes. It should be an administrative council directly responsible to the State Highway Engineer for a period of approximately two years.

2. We recommend the appointment of a Task Force Coordinator to work full time guiding and directing the work of Highway Department employees. He should report directly to the State Highway Engineer, but should be required to prepare progress reports for review by the Task Force Steering Committee. All Administrative Orders concerning changes in procedures should be drafted by this man, and be submitted to the Task Force Steering Committee prior to approval and issuance by the State Highway Engineer.

3. We recommend that continuous consulting services be provided both to the Task Force Steering Committee and to the Task Force Coordinator in the technical areas of clerical systems and procedures, computer systems and programs, and accounting code design during the conversion period. The work of the Consultant should be restricted to an advisory capacity, and one of interpreting the refinements of systems design for the Task Force workers. The administrative moves which are necessary must emanate from Department personnel in order to be successful.

The appointment of the Task Force Steering Committee, the Task Force Coordinator, and the Consultant can be started at once. After this is done, their first act should be to prepare in joint session a list of events and probable target dates for the accomplishment of the first few activities shown on the Activities Networks which are associated with section II.F. of this report. One of these activities includes the formation of a Task Force.

We recommend that such a Task Force of Highway Department employees be organized to perform most of the actual work of conversion. This Task Force should include systems personnel, computer programmers, forms designers, manuals writers and others necessary to the implementation of new procedures. Employees would be borrowed from existing positions, on a temporary basis, and should be expected to work full time on assigned tasks. Replacement workers should either be hired, or as procedures were implemented excess personnel should be shifted to perform the daily work abandoned by the Task Force workers. The borrowing of Task Force workers, and providing for replacement workers could be one of the major problems to be solved by the Task Force Steering Committee and the Task Force Coordinator.

The Task Force workers would be logically assigned to Financial Management Division matters, Automation Division matters, and Motor Vehicle Division matters, but all would require close communications and coordination. The total number of workers should fluctuate from time to time, but should normally be between 30 and 50 people. The same people should not necessarily be required to work on the Task Force for the entire conversion period, but could be rotated in and out as needs for skills changed.

The Task Force Coordinator should prepare a list of the Task Force workers whom he initially desires, and in cooperation with the Consultant should prepare a proposed organization chart showing how these first Task Force workers will be used. This data should next be submitted to the Task Force Steering Committee and, with its concurrence, to the State Highway Engineer. The Task Force Coordinator should be required to contact all Division Heads or District Engineers involved, and attempt to secure their concurrence in his choices. In some cases, it may be necessary to hire new employees with special skills. This important work should be turned over to the Personnel Division.

The State Highway Engineer or his delegated representative should finally prepare any required Administrative Orders or Memos to initiate the required action.

With a nucleus of personnel and several immediate target dates to meet, the work of the Task Force should be underway, and the conversion process started.

Introduction

INTRODUCTION

Due to the broad general distribution which is expected to be made of this report, persons reading it will very likely have different degrees of exposure in the following areas:

1. A knowledge and appreciation of modern data processing techniques.

2. A knowledge of the background and history of the Texas Highway Department.

3. A knowledge of the present practices and procedures in effect in the Texas Highway Department particularly in the areas of accounting and financial control.

The informed reader may omit reading a section of this introduction in which he has knowledge. For those who need to be more fully informed, we have included background material and other general matters within the body of the report to assist them in appreciating our reasoning and recommendations in certain areas.

There is no intended consistency in the level and amount of detail which is presented in the report concerning the various topics. For example, considerably more attention has been given to documenting the present organization than has been given to documenting the present situation in other sections. The reason for this is that there was no general documentation of the functional realities of the organization within the archives of the Department, and this information should be of sufficient general interest to warrant including it in this report.

History Of The Department - The earliest roads in Texas were extensions of the pioneer trails which the first settlers carved out of the wilderness. The first vehicles which occasionally traveled these roads were carriages and wagons. When the automobile was invented about 1903, the traffic volumes on these widened trails increased and caused a need for some form of pavement. Crushed rock, gravel or other similar material was hauled into the countryside and spread over the deepening ruts in an effort to allow the traffic to travel more surely. The responsibility for these first efforts toward building roads was quite naturally assumed by the counties which were in those days the prevailing form of local government. However, the situation was not entirely satisfactory for the motorist of the time. A trip from Houston to San Antonio in 1915, a distance of 190 miles, took as long as three days through cow pastures filled with mud and across ferries of doubtful vintage and seaworthiness.

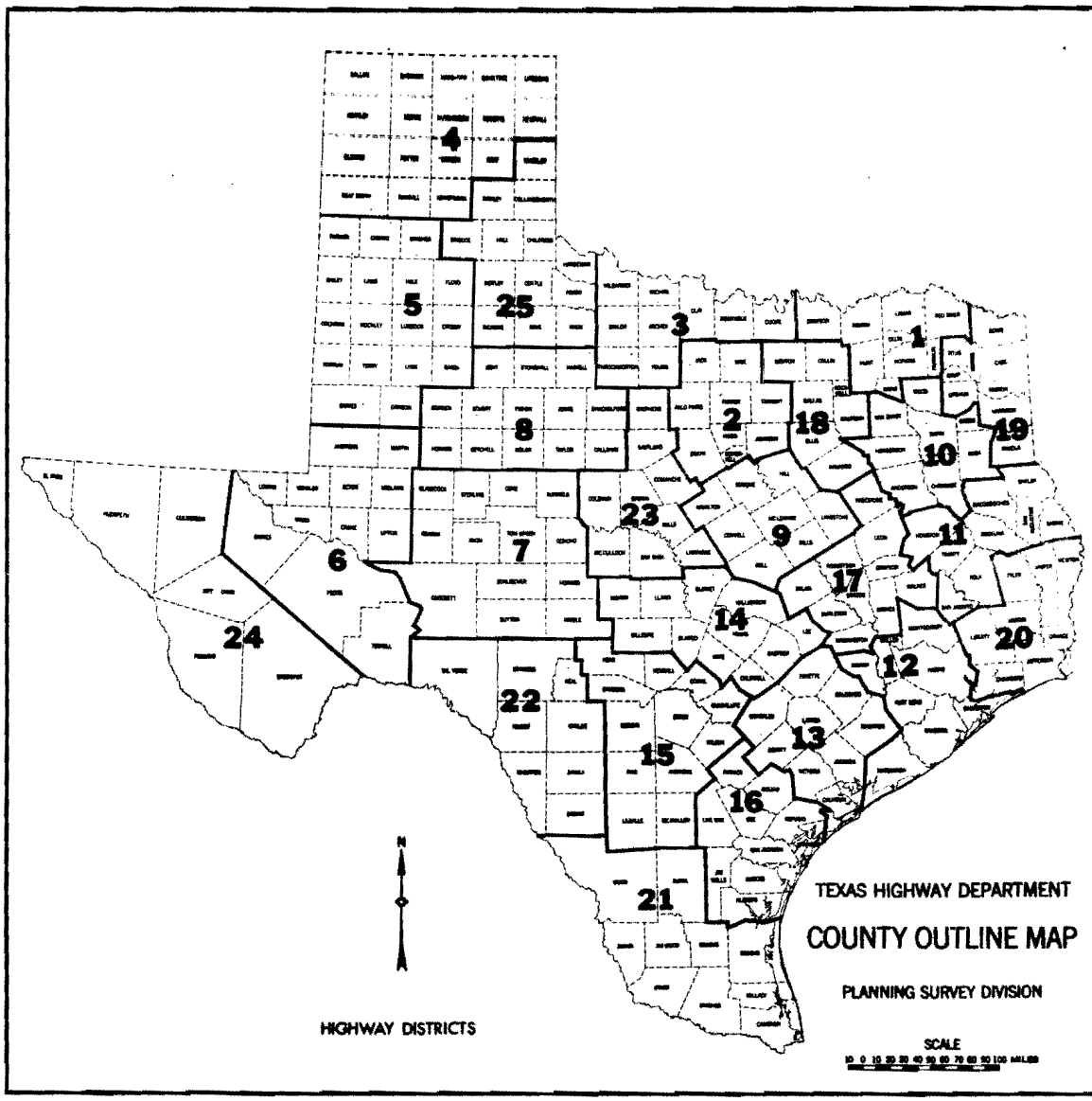
In 1916, the national congress authorized a program of Federal aid for highway construction to those states which had in existence an operating state highway organization to administer an official state highway system. As a consequence, the Texas Highway Department was formed in 1917. The Federal aid system has been a continuing program since that time. This program has always been for the construction of roads only. Maintenance and operating expenses have been entirely the State's responsibility on all highways.

In the period between 1917 and the mid 20's, the Texas Highway Department acted mostly in an administrative capacity with the actual design, building, and maintenance of roads still being done by county personnel and private contractors. But gradually the responsibility for through highways was shifted from the counties to the Texas Highway Department. This period saw the development of the highway department into the organizational form which it still basically retains today.

Because of the size of the State and the difficulties in the beginning with communication and transportation over long distances, the operations of the Texas Highway Department were decentralized and today are handled by 25 districts containing an average of 10 counties each (254 counties in the state). There have been several reassignments of some counties to adjoining districts over the years to equalize the workload. The last such change was made in the early 1950's. District boundaries were set to coincide exactly with the contained county boundaries so that no county was assigned to more than one district. The District Engineers, men appointed by the State Highway Engineer to administer the state's program in each district, virtually became the highway department in their districts. They were delegated the power and authority to carry out their assigned duties of designing, building and maintaining state roads in their area, and diligently set about acquiring the best engineers in the state to assist them.

Of course certain specialists developed in road and bridge design and construction, and these men were centralized in Austin, the State capital, in a series of advisory divisions which were set up to provide internal consulting service and backup for the work carried out by the districts. The Austin divisions also became the eyes and ears of the State Highway Engineer, the man responsible for administering the policies determined by a three-member Commission appointed by the Governor.

The original Highway Department began operations in the State Capitol Building in June of 1917 and moved to the Land Office Building in early 1918. The administrative personnel consisted of the State Highway Engineer, a Chief Office Engineer, a Chief Clerk, and three Division Engineers. The office of Bridge Engineer was created in 1918. It was at first in charge of supervising the counties in the bridge engineering and construction work which they performed. Later on these duties were changed so that the Bridge Engineer now assists the districts in performing these duties. The office of Aid Projects was also established in 1918. Originally the state reimbursed the counties for the construction work which they did, and this office handled the paper work involved. Later on, when the State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TEXAS HIGHWAY DEPARTMENT
COUNTY OUTLINE MAP
PLANNING SURVEY DIVISION
HIGHWAY DISTRICTS
SCALE

began doing its own construction engineering and handling of contracts, the duties of this office changed to include handling the collection of Federal aid reimbursements.

The Chief Clerk's job was changed in about 1918 from handling all clerical duties including registration of motor vehicles to an accounting oriented position. In 1919 the Assistant Highway Engineer's job was established. Originally he handled or routed almost all of the paperwork of the department. Also in 1919 the Materials and Test Division was started in order to better determine the resources in the state for suitable road construction materials. The Department originally used the labs at Texas University and A & M College for analysis work, but later set up labs of its own.

In 1923 the Maintenance Division was established and on January 1, 1924 the State took over the general maintenance of all state highways from the counties. Since the counties actually owned all the necessary maintenance equipment, they continued to do the work until 1927. Then the Highway Department took over maintenance with State forces and State-owned equipment. 1923 also marked the beginning of the Construction Division and the Equipment Division. The Construction Division assisted the district engineers in supervising the county construction activities, and then later on took over the bid letting procedures when the state started contracting construction itself. The Equipment Division gradually took over the purchasing activities of the Highway Department and the keeping of records relating to equipment owned by the Department.

In 1930 the office of Right of Way Engineer was set up. Under the authority of the legislature the Highway Department acquired the right to buy land needed for highways either by purchase or by powers of eminent domain. In 1929 the Road Design Engineer's position was established to supervise and coordinate the efforts of the districts in preliminary investigations and planning the location of highways. The acquisition of right of way was made a function of this office in 1942, and then separated again in 1956.

In 1932 the office of Assistant to State Highway Engineer was established to perform duties relating to personnel and administration and to assist the Highway Engineer in any capacity required, particularly on subjects in which the Highway Commission was interested. This post was changed to the Administrative Assistant Division in 1947. In 1932 the Research Division was set up to carry on special tests and studies which might lead to more economical design and construction. In 1933 the office of Landscape Architect was created for the purpose of improving and beautifying the roadsides. This office was later combined into Traffic Services and then into the Maintenance Operations Division.

1935 marked the beginning of the Administrative Assistant in charge of maintaining the highway building, reproduction equipment, and general files. This became the Operations Division in 1947.

In 1936 the Highway Planning Survey Division was formed to collect facts about the existing highway system, such as traffic data, and to keep records of fiscal data of the counties and cities for use by the Highway Commission. This year also saw the establishment of Tourist Bureaus on the main highways leading into the state to assist visitors to the Centennial Exposition in Dallas. These offices were made a part of the Travel and Information Division in 1953.

In 1937 the Insurance Division was created to administer the rules and regulations provided under the law for workman's compensation benefits to employees injured in the line of duty. This division also directed accident prevention and safety training activities.

In 1939 the Chief Clerk was designated the Chief Clerk of the Registration Division and in 1941 the legislature transferred the Certificate of Title Division from the Department of Public Safety to the Highway Department.

The office of Engineer, Land Service Roads, was created in 1945, and was changed to the Secondary Roads Division in 1957. It confines its activities to farm to market or land service highways.

The Motor Vehicle Division was established in 1945, merging the activities of the Registration Division and the office of Certificate of Title. The office of Traveling Auditors was made a part of this Division and is now known as the Investigation Section.

Engineer-Managers of Urban Projects were established in Dallas, Ft. Worth, Houston, and San Antonio in 1945 to coordinate the freeway projects in those cities. Only the Houston Urban Office remains today; the others have been merged into the district offices in their respective cities.

In 1950 a major reorganization of the Highway Department was undertaken. A Deputy State Highway Engineer was appointed to act as assistant to the State Highway Engineer. In addition two Assistant Highway Engineers were created to coordinate the work of the Highway Commission and the State Highway Engineer with the field organization. A Chief Engineer of Planning was set up to govern the functions of Planning Survey, Bridge, Road Design, Materials and Tests, and Secondary Roads divisions. A Chief Engineer of Construction and Maintenance was set up to govern the functions of Construction, Maintenance, Equipment and Procurement, and Traffic Services Divisions. A Chief Engineer of Operations was set up to govern the functions of the Operations, Claims, Accounting, Personnel, Motor Vehicle, and Aid Divisions. But in 1953 these positions were all abolished and the Highway Department returned to its former organizational pattern with all division heads reporting through the Assistant State Highway Engineer directly to the State Highway Engineer. An Administrative Division was formed at this time to serve as a clearing house for the business operations of the Department and to execute the official documents as directed by the Highway Commission in carrying out the work of the Department.

The Right of Way Division was organized in 1956 to handle right of way acquisition on the interstate highway system. Its functions were to maintain records on right of way and land costs and other items necessary to support claims to the Federal government for reimbursement.

Thus the organizational pattern of the Department has shifted with the times and conditions which faced it. Several types of organizational arrangements have been tried in an effort to best meet the particular needs of the era. Legislative acts have placed new or revised duties upon the Department and divisional responsibilities have been shifted to cover these as required. As new techniques and arrangements for building roads have been developed, they have found their place within the organizational structure. In the 30's the major road building efforts were pointed toward connecting the major Texas cities with all-weather highways. When that was accomplished, the Department next concentrated on improving safety features, widening roads, and building better bridges. Work was also started on constructing new roads into rural regions to connect the smaller towns of the State into the statewide network of highways. The larger cities of Houston, Dallas, Ft. Worth and San Antonio were all capable of lateral growth without geographical restrictions, and the inter-city highways were generally lightly travelled by today's standards. Most of the 25 districts shared very similar problems during this era.

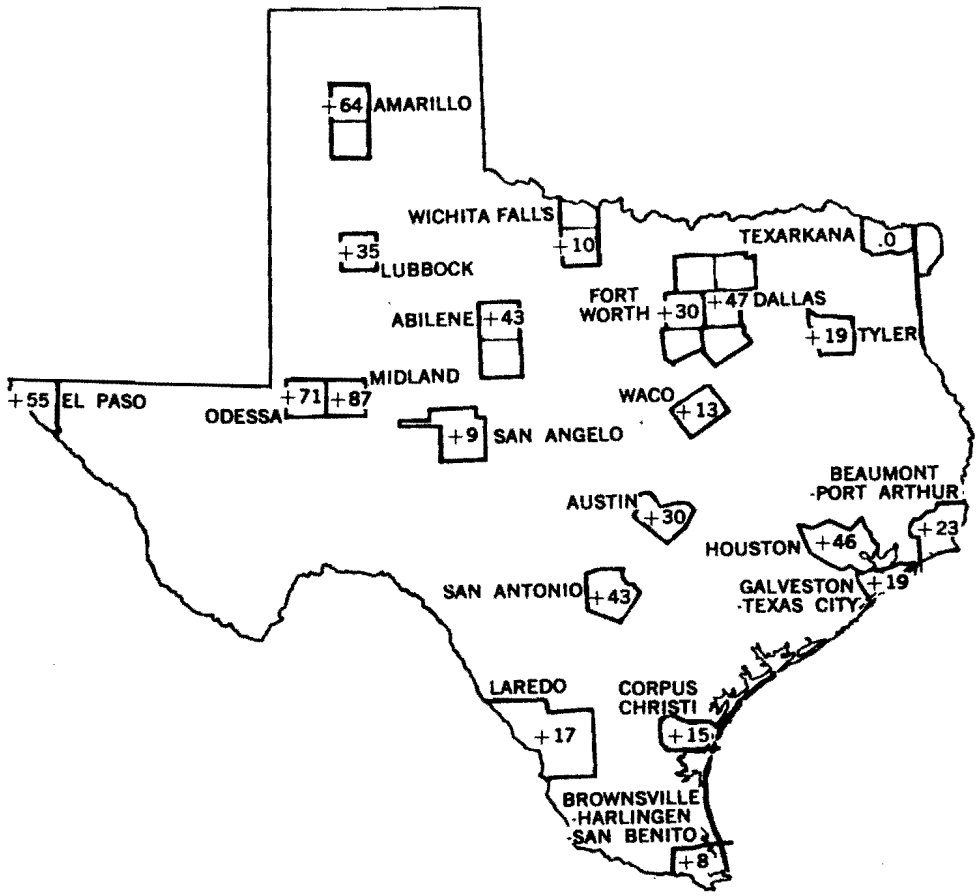
After World War II, the State moved rapidly towards urbanization. The relatively small differences between the operations of the various districts in rural and urban areas became more pronounced, but were partially counteracted by a rapid expansion of the Farm-to-Market program which was started in 1938.

The Farm-to-Market program anticipated an ultimate goal of 50,000 miles of rural highways designed to last for 20 years. The plan caused an increase in maintenance costs of about $1 million per year, and necessitated a substantial increase in the number of maintenance employees. The program is now about 68% completed, and is currently being constructed at the rate of about $23 million, and 800 miles, per year. At this rate it will be finished by 1984.

In 1956 the U. S. government started the Federal Interstate and Defense Highway System to cover the nation with high speed, multilane, limited access freeways at a cost now estimated to be $46 billion. Texas' share of this program was $2.2 billion for building 3,030 miles, more mileage than any other state. To date, 1,036 miles of this has been completed, and some 800 miles more is in varying stages of construction or partial operation. The Interstate Program is scheduled for completion by 1972. Texas' costs for the Interstate mileage constructed so far have been an average of $610,000 per mile which is well below the national average of $1 million per mile.

STANDARD METROPOLITAN AREAS

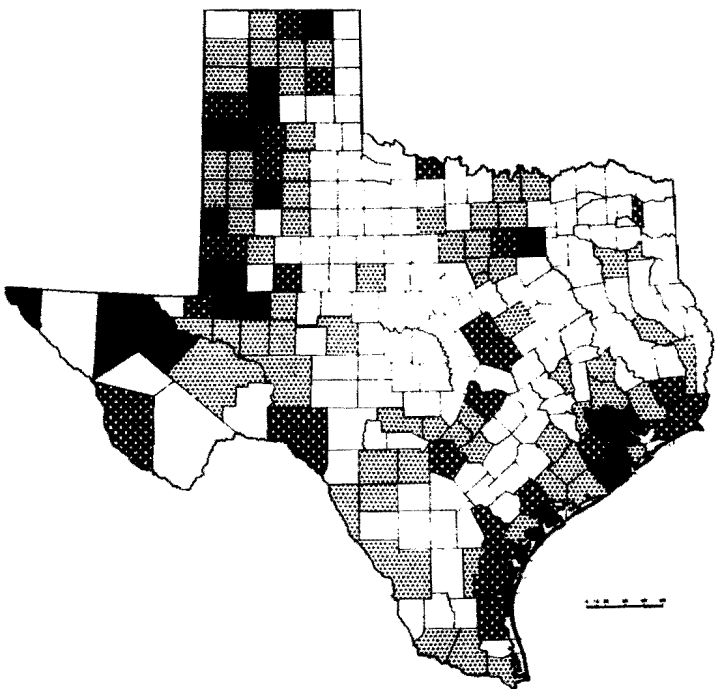
(Per Cent Growth Increase, 1954-1964)



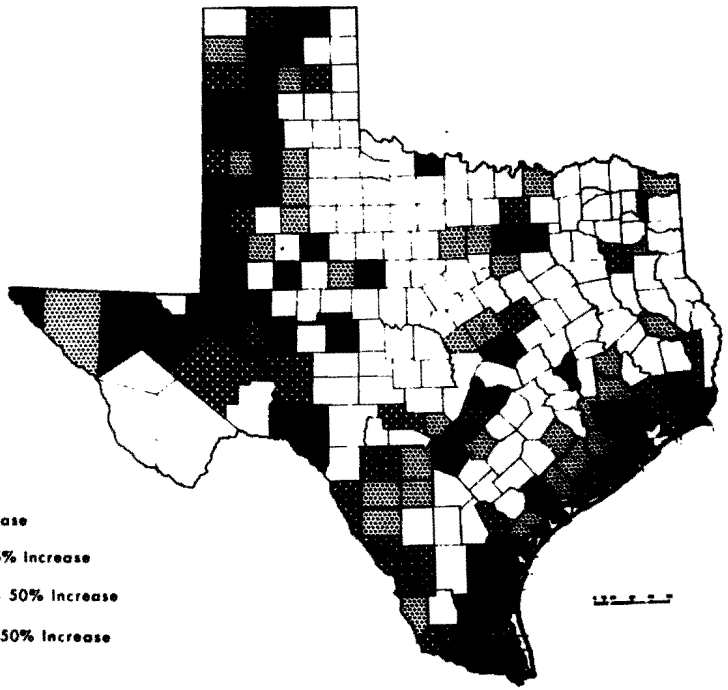
SOURCE: BUREAU OF BUSINESS RESEARCH, THE UNIVERSITY OF TEXAS

PERCENT INCREASE IN POPULATION

1950 - 1960



1940 - 1960



LEGEND

- Decrease
- 0 - 25% Increase
- 25% - 50% Increase
- Over 50% Increase

Source: U.S. Bureau of the Census

Present System Of Texas Roads - Not all of the roads and streets in the State, of course, are a part of the state highway system. Each county still constructs and maintains many miles of local roads in its jurisdiction through the activities of the County Commissioner's Courts. In fact, most of the total mileage in the State is still a part of the county road systems which are financed by local property taxes and a share of the State motor vehicle license fees and gasoline taxes. While the total mileage of the county roads is large, the proportion of the state's vehicular traffic carried on them is relatively small. Texans travel an average of 132 million vehicle miles per day on the State highway system, and an estimated 175 million vehicle miles per day on all systems, including state, county, and city streets. There are about 140,000 miles of county roads, but only about 10% of them are paved.

There are about 41,000 miles of city streets in the State which are also not a part of the State highway system. These streets are built and maintained mostly by the city public works departments or private contractors with funds provided by local property taxes or road and street bonds. During the 1950's city street mileage increased by almost a half. Most of the increase was in the larger cities of 50,000 and over in population, a further indication of the trend towards urbanization rapidly taking place in the State.

The official designated Texas Highway System administered by the Texas Highway Department contained 66,523 miles of road at August 31, 1965. This mileage was not all completed however, and some of it was maintained by cities under special agreement as is shown by the following tabulation:

Completed Mileage:	
State Maintained - urban	4,590
- rural	58,028
TOTAL STATE MAINTAINED	62,618
City Maintained	140
TOTAL COMPLETED MILEAGE	62,758
New Mileage Under Construction	1,294
Designated but Not Yet Under Traffic	2,471
TOTAL DESIGNATED MILEAGE	66,523

Total Texas road and street mileage at August 31, 1965 is as follows:

County Road Systems			
Paved roads	14,893		
Unpaved roads	125,044	139,937	56.4%
Designated State Highways			
Interstate	3,030		
State and U.S.	25,740		
Farm to Market	37,756	66,526	27.2
City Streets		41,665	16.4
		248,128	100.0%

By pavement types the total designated mileage is as follows:

PAVEMENT TYPES	FARM TO MARKET	INTERSTATE AND STATE	TOTAL
Asphaltic, under 1"	32,871	10,847	43,718
Asphaltic, over 1", flexible base	921	8,266	9,187
Asphaltic, over 1", rigid base	162	2,733	2,895
Concrete	159	1,351	1,510
All other pavement types	79	639	718
City sections	1,119	3,471	4,590
TOTAL STATE MAINTAINED	35,311	27,307	62,618
City maintained mileage		140	140
Designated - not maintained yet	2,445	1,320	3,765
TOTAL MILEAGE	37,756	28,767	66,523

Personnel - At present the Department employs about 17,500 people in the peak of the construction season, and about 1,000 less during the winter. In the districts, about half are salaried professional and administrative personnel, and the other half are hourly maintenance employees. About 1,900 employees work for the 17 Austin divisions and the rest work for the 25 districts and the Houston Urban office which may be considered a special district. The following schedule shows the number of employees in each of the divisions and districts:

APRIL 1965

DIVISION/DISTRICT	HOURLY	SALARIED	TOTAL
D Administration	1	20	21
D- 4 Equipment and Procurement			
Main Office	6	42	48
Camp Hubbard Shops	28	92	120
D- 5 Bridge Design	9	95	104
D- 6 Construction		29	29

	DIVISION/DISTRICT	HOURLY	SALARIED	TOTAL
D- 7	Aid	1	35	36
D- 8	Highway Design			
	Main Office	2	89	91
	Photogrammetry	1	50	51
D- 9	Materials and Tests			
	Office		12	12
	Laboratory	8	207	215
D-10	Planning Survey (122 O & D Studies)	147	154	301
D-11	Accounting		56	56
D-12	Motor Vehicle			
	Registration	6	173	179
	Certificate of Title		153	153
	Boat		13	13
D-13	Personnel	2	12	14
D-14	Secondary Roads		18	18
D-15	Right of Way	3	91	94
D-16	Travel and Information	10	60	70
D-18	Maintenance Operations	1	76	77
D-20	Insurance		17	17
D-21	Operations			
	Main Office	1	20	21
	Camp Hubbard Maintenance	11	11	22
	Highway Building	6	21	27
	Computer	3	31	34
	Reproduction	3	48	51
	Microfilm		4	4
	TOTALS	249	1,629	1,878
District 1	Paris	345	317	662
District 2	Fort Worth	297	390	687
District 3	Wichita Falls	200	176	376
District 4	Amarillo	294	211	505
District 5	Lubbock	317	210	527
District 6	Odessa	227	318	545
District 7	San Angelo	241	167	408
District 8	Abilene	285	226	511
District 9	Waco	329	355	684
District 10	Tyler	329	317	646
District 11	Lufkin	222	166	388
District 12	Houston	634	859	1,493
District 13	Yoakum	300	252	552
District 14	Austin	310	228	538
District 15	San Antonio	517	541	1,058
District 16	Corpus Christi	275	255	530
District 17	Bryan	267	228	495
District 18	Dallas	400	484	884
District 19	Atlanta	286	360	646
District 20	Beaumont	341	313	654

DIVISION/DISTRICT	HOURLY	SALARIED	TOTAL
District 21 Pharr	369	258	627
District 22 Del Rio	161	89	250
District 23 Brownwood	152	155	307
District 24 El Paso	172	221	393
District 25 Childress	178	95	273
Houston Urban Office	5	233	238
DISTRICT TOTALS	7,453	7,424	14,877
DEPARTMENT TOTALS	7,702	9,053	16,755

The Texas Highway Department has about 1,200 Registered Engineers, or graduate engineers, and about 3,400 Engineering Aides who work under the supervision of graduate or licensed engineers.

Equipment - The Texas Highway Department owns and operates about 14,500 pieces of equipment. At August 31, 1965, the equipment was valued as follows:

CATEGORY	QUANTITY	DEPRECIATED VALUE
Pick up trucks	2,605	$ 1,549,643
Trucks - all other	2,588	2,675,786
Station wagons	960	509,292
Automobiles	341	134,733
Front end loaders	556	1,800,361
Crawler tractors	68	258,411
Wheel tractors	561	394,172
Road rollers	669	451,191
Motor graders	663	2,252,363
Mowers	1,000	764,336
Portable pump and engines	530	17,223
Snow plows - attached and other	419	140,590
Other roadway equipment	3,533	2,447,806
	14,493	$13,395,907
Office machines		743,838
Engineering equipment		281,375
Shop equipment		480,863
		$14,901,983

Within broad types of equipment classifications, there is a four digit serial number assigned to each piece of equipment for accounting identification. This number does not identify the district to which the equipment is assigned. The number in some cases carries an alphabetic suffix, and is used for identification purposes in the accounting records.

Buildings - The Texas Highway Department at August 31, 1965 had 1,273 separate buildings to which serial numbers had been assigned. There are 376 sites which are controlled by the Highway Department, containing 2,164 acres of land, costing $2,225,500. The buildings on this land have an original cost of $41,212,223 depreciated to $29,800,000 as of August 31, 1965.

In Austin the Highway Department is located in the State Highway Building in the downtown area, and in several buildings at Camp Hubbard in the suburbs of the northwest section of the city about 5 miles distant. In addition there are about 50 employees located in leased space downtown in a building adjacent to the State Highway Building. The buildings at Camp Hubbard include a Headquarters Shop and Maintenance Building, a Materials Test Laboratory Building, a five story Office Building, a Reproduction-Computer Center Building, and several other smaller separate buildings for various other divisions.

District offices are typically located on several attractive acres on one of the main highways near the city of the district headquarters. The Department has almost completed a program for building or remodeling the district offices throughout the State. Located on the same site with the District Office Building are usually a District Shop and Warehouse Building, and often one Resident Engineer's Office Building. Other Resident Engineers are typically housed in small office buildings on the same ground with a Maintenance Section Headquarters. The Maintenance Section Headquarters buildings are usually metal frame, corrugated iron covered buildings which have office space in the front portion for the use of the clerical forces associated with maintenance activities. In the rear of these buildings is usually found a repair parts storage area, a small shop for minor repairs, and other general shop space. Equipment garages are often sheds or closed buildings specially constructed for housing maintenance equipment.

Financing - From September 1, 1964 to August 31, 1965, the Texas Highway Department received and paid out the following amounts:

	MILLION DOLLARS	PER CENT
Receipts:		
Net license fees	$ 99.9	19.78%
Motor fuels tax	161.9	32.05
Sales tax on lubricants	1.6	.33
Depository interest	1.9	.38
Certificate of title fees	1.1	.23
Office and sundry	3.5	.70
	$269.9	53.47%
Reimbursements on construction and aid:		
Federal aid	$211.6	41.88%
Farm to Market Fund	16.2	3.21
County Funds	1.6	.32
Other Funds	5.7	1.12
	$235.1	46.53%
TOTAL RECEIPTS	$505.0	100.00%
Disbursements:		
Construction	$347.9	76.99%
Maintenance	69.2	15.33
Equipment purchases	4.6	1.01
State Highway Patrol	7.4	1.64
Administrative expenses	4.3	.94
Other disbursements	18.5	4.09
	$451.9	100.00%

The balance of the Texas Highway Fund at August 31, 1965, the end of the state's fiscal year was $138.1 million.

In the fiscal year ended August 31, 1965, the amount of Federal aid actually collected was $211.6 million. However, this money had been apportioned in prior years and was being collected by the State for construction work already completed. Federal funds are not advanced to the State. The State must finance and build the highways first, and then collect from the Federal government when the work is completed. The State is reimbursed 50% of the eligible cost as determined by Federal regulations on the regular Federal aid highway, and 90% on the Interstate routes.

The amount that can be collected from the Federal government varies from year to year, depending upon the revenues of the Federal Trust Fund to which receipts of some Federal highway user taxes are allocated. The amount apportioned to any state is determined by an area-population-mileage formula set by Congress for the regular Federal aid program, and by periodic "needs" estimates filed by the states for construction of the Interstate system.

Texas was assigned the following amounts as its share of the total highway funds apportioned in Federal fiscal years ending June 30 as follows:

	MILLIONS OF DOLLARS				
	1958	1959	1960	1961	1962
Interstate	$ 97.7	$126.6	$112.4	$ 80.5	$ 97.9
Primary	24.6	25.4	25.9	25.0	25.3
Secondary	16.5	17.0	17.3	16.8	16.0
Urban	10.2	10.5	10.8	11.0	12.8
		$179.5		$133.3	$152.0
D Funds (1)		24.3			
L Funds (2)		7.5		(3.8)	(3.7)
	$149.0	$211.3	$166.4	$129.5	$148.3
	1963	1964	1965	1966	1967
Interstate	$108.2	$117.3	$121.2	$126.3	$148.8
Primary	24.6	25.8	26.1	27.4	27.7
Secondary	15.6	16.3	16.5	17.3	17.5
Urban	12.9	13.1	13.5	13.9	13.9
	$161.3	$172.5	$177.3	$184.9	$207.9

Note (1) D Funds were Emergency "Recession" Funds apportioned in 1959 only.

Note (2) L Funds were Loaned Funds repaid as shown in later years, by deducting from the regular apportionment.

The relatively low amount in 1961 was caused by Texas having previously used a part of its regular 1961 apportionment to finance earlier year's programs by special provision of the Bureau of Public Roads. Such borrowing against future year's apportionments is no longer possible due to a revision of procedures established in 1961 by the Bureau.

At any one time there are several hundred Federal aid projects underway in the State. A count of projects under Federal aid made in September 1965 revealed the following:

TYPE OF PROJECT	COUNT
Interstate:	
Construction	174
Right of Way	227
	401
Primary System - all construction	90
Secondary System - all construction	125
Urban System - all construction	47
Forest Highways - all construction	3
Military Access Roads - all construction	2
HPR - Research Projects	1
	669

Although only one HPR project number is used for billing purposes to the Bureau of Public Roads, there were approximately 70 separate projects underway for this single project number. These are projects for such research as illumination studies, asphalt mixes, piling behavior, creep in pre-stressed lightweight concrete, economic impact studies, urban planning studies, etc.

Besides Federal aid, the State also obtains highway money from other sources. A gasoline tax of 5¢ per gallon is collected from the major oil companies who in turn collect it from the motorist at the filling station pump. The oil companies remit their tax collections at periodic intervals into the state's General Fund. Transfers are made monthly to the Highway Department's funds. Gasoline consumption in Texas is around 5 billion gallons per year, second only to California.

However, not all of the 5¢ gasoline tax is transferred to the Highway Department. By law, one fourth of the tax or 1¼¢ per gallon is earmarked for public schools. One half of the tax, or 2½¢ per gallon is directed to the State Highway Fund. After deducting about $7,300,000 which is given to the counties for their road building programs, and $450,000 required by the Road Bond Board for debt service payments, whatever is left of the remaining one fourth or 1¼¢ per gallon is transferred to the State Highway Fund. About $8 million of this remaining 1¼¢ money is earmarked for spending in the Farm-to-Market program.

The Farm-to-Market program is paid for through the Farm-to-Market Road Fund. In addition to the $8 million received from the 1¼¢ gasoline tax allocation, this fund also gets an annual sum of $15 million from the state's General Fund. This money is stipulated to be for construction purposes only. The $15 million is compensation to the Texas Highway Department for the road revenues which it collects, but which go into the General Fund of the state.

The Highway Department is also the recipient of a portion of the fees collected each year for the sale of license plates and for transfers of title whenever a motor vehicle is bought or sold. Motor vehicle license plates are produced by State prisoners and fees are collected by the tax assessor-collectors of the 254 counties. A portion of the fees are retained by the tax collectors for the administrative costs of making these sales. There are about six million motor vehicles registered in the State, about one-fifth of which are trucks. Texas is second only to California in the number of trucks sold each year. The average automobile license plate fee is $20.61. One third of the motor vehicle population is concentrated in the four cities of Houston, Dallas, Ft. Worth and San Antonio. Because the renewal period is from February 1 to March 31 each year, a major portion of the revenue from this source is received during the late spring.

License numbers are reassigned each year unless (under a new program) the motorist pays an extra $10 fee to reserve a special number or letter designation of his choice. Auto registration records are maintained in Austin by the Motor Vehicle Division of the Texas Highway Department by manually filing duplicate license receipts by plate number and by vehicle engine number. The rate of growth of new registrations has been about 250,000 per year for the last few years.

The motor vehicle and its use was the source of about $382 million in taxes in 1964, but only 70% of this amount was available to the State highway system. The remainder was retained in the General Fund or transferred to the Available School Fund, or retained in the counties. A portion of the Texas Highway Fund is also allocated to the annual budget of the Department of Public Safety for salaries of the highway patrolmen and license and weight inspectors.

Over 75% of all money paid out of the Highway Fund goes for construction. About 15% is spent on regular and special maintenance of highways. The remainder is spent for administration, equipment purchases and other miscellaneous items. All highways are paid for on a cash basis. There is no deficit incurred in financing the State highway system, and no road bonds are sold by the State.

Programs for New Construction - Programs for new construction are prepared by the staff of the Highway Department and submitted to the State Highway Commission annually or biannually (depending on the highway system) for final approval. Prior to submission, the programs are compiled from preferential proposals for specific road building projects which are rendered by each of the 25 districts. These proposed projects are fully described and are supported by detailed cost estimates. Each district submits its preference of projects totaling an amount allocated to it by the central administration. The district choice of projects is reviewed by design, construction, maintenance and administrative personnel in Austin prior to being assembled by the staff of the State Highway Engineer.

Design - Preliminary design work for new highways is performed entirely by the employees of the Highway Department. Aerial surveys are made by a unit attached to the Automation Division as a service for the local Resident Engineer who is assigned to a specific design project by the District Engineer following program approval. Schematic location maps, and later construction drawings and specifications are made by the Resident Engineer's staff of designers. Consultation and advice is available from the District Office or from the Bridge, Design, and Secondary Roads Divisions in Austin.

Plans and specifications, when completed by residency personnel, are reviewed and checked by district and Austin personnel before submission to the Bureau of Public Roads for further review (where applicable). When approved, they are given to contractors for bidding. There are about 194 residency locations in the State.

Right of Way - The Texas Highway Department acquires right of way for Interstate highways using employees within the Department for preparation of right of way maps, deeds, and negotiations with property owners. Appraisals of property values are made both by staff employees and by independent fee appraisers. Right of way acquisition for other types of State highways, except farm to market roads, is handled by employees of the separate counties, with Highway Department personnel serving as review appraisers. Counties and cities negotiate and purchase right of way for non-interstate highways and are reimbursed 50% of the Highway Department's appraised value, or 50% of the actual amount paid by the county or city (whichever is the lesser amount) after the purchase has been made. Right of way for farm to market roads is acquired entirely by the counties and cities for the State.

Construction - Construction of new highways and major betterment projects is performed exclusively by commercial contractors. Generally the specifications call for all grading, structures, and paving to be built under one contract for a section of roadway, but some structures are contracted for separately. Contracts are awarded to the lowest financially responsible qualified bidder after public opening and reading of bids. Bidders submit only unit item bids for a list of items specified by the Highway Department. The estimated quantity of each item is shown in the specifications (as calculated by Highway Department employees). Bid prices are extended and added by the Highway Department through use of its computer center on the same day they are opened to determine the lowest overall bidder.

Contractors are required to submit their financial qualifications annually to the Highway Department for analysis and review prior to being considered eligible for bidding highway projects.

The determination of what the bid items are, and the method by which quantity will be measured for each item is made by the designing Resident Engineer. This same man in most cases is also the supervising construction engineer and inspector after the contract is awarded.

Payments are made to the contractor (less 5% retainage) each month based on the quantity of work performed to date, less previous payments. Measurement of quantity of work done is the responsibility of the Highway Department's project engineer.

Samples of roadway materials are taken during construction by the project engineer's staff for analysis and for quality control purposes to see that material specifications are followed. Most survey stakes during construction are placed by Highway Department crews who work closely with the contractor construction forces as the work progresses.

Time schedules are generally made a part of the specifications in terms of working days allowed for completion of the project. In most cases these time schedules are ample for performing the work, but liquidated damages provisions are made a part of the contracts. The determination of eligible and ineligible working days because of inclement weather, holidays, etc., rests with the project engineer.

Before accepting a construction project and making final contractor payment (including all retainage) a complete inspection is performed by the district staff. A final estimate is prepared which includes documentation of the project engineer's calculations of all pay quantities. Federal reimbursement is contingent upon an inspection and audit of this documentation by Bureau of Public Roads personnel.

Highway Maintenance - All regular and ordinary maintenance of the roads on the Texas highway system is done by employees of the Highway Department. These maintenance employees are responsible for specific sections of highway within their designated geographical areas, often a single county, but frequently more or less than a county. The maintenance crews usually report to their Maintenance Section Headquarters each morning to receive their instructions for the day from their foreman. The Maintenance Section Headquarters will typically include an equipment repair building with interior office space, and one or more garage structures for sheltering the trucks and equipment used on the roads. There are about 277 of these Headquarter sites.

After receiving their instructions, the crews will depart for their assigned work areas in State vehicles, perform their work, and return in the afternoon to bring in the equipment and prepare daily time reports.

The foreman patrols the roads in his assigned area daily looking for obvious maintenance needs. Supervisory district maintenance personnel also drive the roads periodically and lend advice and counsel to the foreman concerning maintenance projects beyond the scope of ordinary light maintenance. Standards of what constitutes a well maintained highway and the priority of needs is generally the responsibility of the local foreman, guided by a written policy manual prepared and issued by the Maintenance Operations Division in Austin. The local maintenance foreman is the Highway Department's main daily contact with the motoring public, and most requests for assistance or service are directed to him.

Maintenance equipment is serviced and light repairs are usually made at the Maintenance Section Headquarters where a small supply of replacement type parts are stored. More extensive repairs, such as engine overhauling, are performed in the district shops located typically at the site of the District Office.

Inventories of roadway repair materials are kept at strategic points along the highways, and in the yard at the Maintenance Section Headquarters. These materials are ordered, and their use is controlled by the local foreman. At each Maintenance Section Headquarters there is usually an employee who remains near the office during the day to monitor the communication radio. The radio is used for communications concerning maintenance needs between the Maintenance Section Headquarters, the District Office, the foreman, and one or more units or trucks. The employee who monitors the radio also checks out materials, supplies, and tools to the crews, keeps the grounds at the headquarter site, and performs some routine clerical functions.

A physical inventory of all roads comprising the State highway system was prepared by district personnel in 1932, and each major portion of highway was given a control number. Within the control numbers, subnumbers or section numbers were assigned wherever the pavement type changed, or a county line was crossed. These control and section numbers have been the basis for accumulating maintenance costs. Provision was made to add new numbers as pavement types changed, or new highways were added to the system. There are now about 7,200 of these control-sections Statewide.

Budgets and Forecasts - A formal budget request is prepared by the Highway Department staff each two years and is submitted to the State Legislature for the costs of certain administrative salaries. However, most of the operations of construction and maintenance are financed by receipts from gasoline taxes, license plate sales, auto registration fees, and Federal aid reimbursement for construction as mentioned earlier.

A departmental budget is prepared by the Accounting Division each year for the nonconstruction operations of the Department, and is submitted to the State Highway Commission for approval. Formal Minute Orders are prepared and signed at that time (and subsequently) which authorize the main categories of budget items. Thereafter detailed Authorization Forms are submitted to the Accounting Division for specific authority to make expenditures against budgeted projects and items. These are, in effect, official assurances that budgeted funds are available before purchases are made.

Revenues are forecast each year by the Accounting Division by using historical growth percentages applied to the prior year's revenues. Cash flow is anticipated based on the prior year's experience, and an effort is made to predict the amount of funds available for construction contract awards by month for the coming year.

The State Highway Engineer maintains a backlog of awarded but incomplete construction projects, and the backlog of authorized but incomplete design work which has been assigned to each district. Records pertaining to the status of these funds are maintained by the staff of the State Highway Engineer, and are not correlated with the official accounting records.

Personnel - District and division administrators are generally free to select new personnel as required. Salary ranges for most classes of personnel are prescribed by the Legislature each two years, but classification of workers within the legal salary steps is generally a local matter, subject to review by the Personnel Division.

Engineers are usually recruited by the local District Engineer in each of the cities with colleges. Pre-employment testing is not performed.

Supervisors and administrators are promoted from within the Department. Most District Engineers have worked the majority of their careers in the districts which they administer. Some Austin Division Heads are engineers including those over such nonengineering divisions as Personnel, Aid and Right-of-Way. Nonengineers head the Motor Vehicle, Accounting, Travel and Information and Equipment Divisions.

Personnel are not required to change locations and most transfers are initiated by the employees.

Training schools in technical and engineering subjects are held during regular working hours in some districts as a part of that district's own program. Occasional Statewide training seminars for district accounting personnel are held in Austin. No central training course or program is followed.

Some districts attempt to counsel employees and offer regular reviews of job progress. Informal merit systems exist in a few districts for the objective evaluation of employee performance, but no overall recognized plan is in existence.

Record Keeping - Record keeping is generally decentralized and performed in the district offices. The Accounting Division in Austin receives summarized account distributions from the districts each month and prepares punched cards from these. The punched cards are sorted together and listed in "posting runs" for manual posting to the Department's General Ledger. Payrolls are prepared in the districts and sent to Austin for audit and verification. The State Controller's Office issues all pay warrants, which are returned to the districts through the Accounting Division. Cost accounting ledgers are kept in the district accounting offices, and take-offs from these are used as a basis for billing the Federal government for Federal aid projects. A summarized project ledger is also kept manually in Austin for verification and control purposes. The Federal aid billing and collection is done centrally.

Each district maintains a complete filing system of source documents supporting all disbursements. In addition, the Accounting Division in Austin keeps files of all items supporting paid warrants.

Federal Aid Collections - Texas does not set up separate Federal aid projects for locating and designing highways (called preliminary engineering work). Instead, under rules and regulations of the Bureau of Public Roads, Texas collects for its preliminary engineering activities as a percentage of the construction cost amount after the roadway is built. To determine the rate or percentage allowable for preliminary engineering on Interstate projects, the Bureau of Public Roads audits the actual preliminary engineering charges made to several Interstate projects which were completed during the previous year. In these audits the Bureau eliminates any charges which it determines to be "nonparticipating" in nature according to the rules promulgated by the Bureau over a long period of time. Then the Bureau computes the percentage that these participating charges are of the total construction cost of the applicable roads. In 1964, the State computed its overall percentage of preliminary engineering to be 3.8%. The Bureau, after eliminating nonparticipating charges, calculated through its samples a rate of 2.9%. The maximum percentage allowable to a state which elects this percentage procedure is 5%.

Through special procedures worked out by the Commissioner of Public Roads soon after the Interstate program began, Texas was given a special dispensation to permit it to collect preliminary engineering costs on both the actual and the percentage method. If any preliminary engineering work is performed on a roadway prior to the date which the Bureau gives official program approval, then the percentage method, described above, is inoperative and the State must itemize in detail the specific charges for preliminary engineering. Texas follows this procedure only on a few projects.

For supervising and controlling the field construction activity, (called construction engineering) Texas uses the percentage method for all types of Federal aid. The percentage to be used for construction engineering is also calculated by the Bureau based on audits made of selected projects. At present the percentage used is 6%, which is the maximum percentage allowable to a state which elects the percentage procedure. However, if actual construction engineering costs were billed for each project, Texas could claim up to a maximum of 10% on Interstate routes under Bureau of Public Roads regulations.

No billing is made to the Federal government for either preliminary engineering or construction engineering costs of a roadway until the final construction voucher is submitted. This final billing includes a percentage of the construction cost for preliminary engineering and for construction engineering. These billings are held until the end of construction to preclude the collection of overclaims which have to be refunded.

Texas does not collect for preliminary engineering expenses on non-Interstate projects, but rather elects to use all of the Federal aid available under the Primary, Secondary and Urban Highway Apportionments for financing construction costs.

Texas is currently programming all of its Federal aid apportionments, and is collecting the full amount permitted by Federal Trust Fund controls. All construction contract progress payments made to contractors in one month are billed and collected from the Federal government the next month on Federal aid projects. The flow of cash into and out of Texas Highway Fund concerning Federal aid projects is very prompt.

Prior Consultants and Their Recommendations - Although there have been several consultants to the Texas Highway Department over the years, we will be concerned here only with those who were dealing with the broad subject of fiscal or accounting matters or general management of the Department.

Apparently there were some problems encountered in setting up an adequate accounting system for the Highway Department sometime soon after the State took over the complete highway construction and maintenance program. It is our understanding that the Governor of the State engaged a Public Accountant to set up a record keeping system for the Texas Highway Department and paid his fees from the Governor's own pocket. This consultant apparently spent a number of years working closely with the employees of the Department and developed the chart of accounts and the general ledger classification system in use today. The consultant prepared a manual of instructions for a new accounting system to be installed September 1, 1927, and in it illustrated a series of reports to be prepared from tabulating machine cards, some of which were actually prepared and some of which were apparently not carried forward or were subsequently dropped. His reports contained very detailed working instructions and forms for the immediate implementation of the sub-systems proposed.

One of the reports contains instructions for taking of a physical inventory of roads on the State highway system as of September 1, 1929. Apparently this was the beginning date for the present series of control-section numbers of the State highways.

In 1931 the State Legislature authorized a complete study of all phases of Texas government by a consulting firm. Part VI of the consultant's multi-volume report was titled "Highways and Motor Vehicle Registration; the State Highway Department" and is dated January 10, 1933. In this report the consultants described the organizational structure of the Highway Department as it then existed, paying particularly close attention to the operations of the various headquarters divisions. They pointed out that the system then in operation "resulted in establishing 25 individual highway departments linked together by the personality of the Highway Engineer and the need for drawing operating funds from a common source". They proposed, among other things, to transfer the Motor Vehicle Division to a Department of Tax and Revenue, and to transfer the Highway Patrol to a new Department of Public Safety.

The consultant's report recommended annual work programs for the construction of highways to tie into a major plan for a State highway system. It also recommended a centralized cost accounting system with all processing of data to be done in the headquarters offices and the central preparation of reports "for efficiency". It recommended the consolidation of the Aid and Accounting Divisions because they had overlapping functions.

Although it was prepared almost 35 years ago, the consultant's report mentioned many conditions which are recognizable today in the Highway Department. It contained a number of recommendations which were apparently carried out and others which were not followed for one reason or another. Prior consultants have not been entirely disregarded at the Texas Highway Department. Substantial benefits and gains were made from the recommendations of both the outside firms used in the past.

Texas Research League - In 1956 about the time that the Federal Interstate Highway Program was announced, the Texas Research League was invited by the Highway Commission to assist in the preparation of "A Program for Texas Highways". Their work was begun in the Spring of 1956 and was completed in September 1957. During this period they issued a total of six separate reports on the results of their studies which were mainly concerned with possible legislative action to remedy certain tax inequities dealing with highway user taxes. They projected the amount of total money that would be needed to construct all Texas highways through the year 1975, and offered various suggested plans for obtaining this money.

One of the Research League's most significant recommendations was for the State to pay for 50% of the right of way which was procured by the counties for constructing State highways. The Commission passed a resolution to adopt this policy. The Research League also recommended the use of punched card equipment in the paperwork for handling motor vehicle registrations. They mentioned possible methods for projecting the expected cash revenues from motor vehicle licenses, gasoline taxes and other revenues over a long term period for use in long term planning.

State Auditor's Reports - In or about 1962 the Computer Section of the then Operations Division, initiated a request to the Governor for permission to trade in their scientific computer for a larger model. They had obtained several bids on specifications which

they had prepared, and had settled on the size and type computer wanted. This request was channeled to the State Auditor's Office, and an investigation was made by that office of the needs in the computer section of the Highway Department. In a report directed to the Governor's Executive Budget Director, the State Auditor's Office concluded that the scientific computer requested by the Highway Department was within the present engineering needs but was probably in excess of the demonstrable uses to which it would be placed in the near future. It concluded that it was not the best in size, capability, configuration or price, but recommended that tentative approval be given to the request subject to taking new bids based on revised specifications. It stated that if the districts fully used the computer for engineering work a large scientific computer could easily be justified, and that if record keeping activities were coordinated on the computer, the field of general data processing would fully justify a large computer. The Highway Department considered the report of the State Auditor, and decided to acquire the computer originally requested.

Several other reports have been prepared which concern the Highway Department's record keeping functions. These are internal reports of the staff of the State Auditor's Office which were reviewed with Highway Department Officials.

One of these reports deals with the subject of project ledgers which are kept in the Accounting Division in Austin. Some of the conclusions of this report were:

a. That most of the data posted to these ledgers had been recorded elsewhere in detail 3 to 5 times previously.

b. That the ledgers did not carry balances and required detailed comparisons to machine runs for verification.

c. That the ledgers were hand posted twice, once in pencil, then again in ink.

The report recommended that mechanical tabulating equipment methods be substituted for these ledgers under proper "batch" controls, and that all reports from them be prepared mechanically, and be sent to the districts as project status reports.

Another of these reports was called the "Utilization of the Tabulating Equipment in the Accounting Division". It noted, after the completion of a month's sampling, that the equipment was used less than 25% of the time, and suggested either increasing the work load of the tabulating section or reducing the personnel and machinery.

A third report, more general in nature, pointed out that the Highway Department had had a 46% increase in the mileage it was responsible for during the 10 year period ended August 31, 1960. During this same period, the report stated, overall personnel in the Highway Department had increased 77%, and the headquarters personnel in Austin had increased 107%. This report mentioned a lack of accounting manuals for the headquarters functions, a lack of forms control, a lack of central cash control, and recommended a centralized accounting and personnel function with related record keeping built around "integrated electronic data transmission and processing methods". This report recommended an extensive general study of the Highway Department's accounting functions to be made by personnel of the Highway Department with possible outside assistance.

Internal Studies - In February 1964, the State Highway Engineer appointed a study committee consisting of the Aid and Accounting Division Heads, two of their assistants, and a fifth member from the Construction Division to look into the matter of accounting forms, paperwork, and the possibilities for using the Department's computer for accounting work. The committee reported in April 1964, generally as follows:

a. Forms designed for the present decentralized system are suitable for the present procedures although some modifications could certainly be made.

b. Full Federal reimbursement of all eligible items of engineering expense is not possible under the present cost accounting system.

c. Any decisions regarding Texas going to current billing and concurrent audit should be delayed pending further study of other states and the degree of Bureau of Public Roads involvement with the internal operations of the Department.

d. The volume of detail under a system compatible with concurrent audit cannot be adequately handled without the use of computer equipment, and this should consider the practical aspects of a separate computer installation for the Accounting Division.

In May 1964, the State Highway Engineer requested two of the committee members to take a trip to Colorado and California to consider their accounting systems. They filed detailed reports upon their return with the following general conclusions:

a. Texas would need to use a computer if it went to centralized accounting.

b. Serious consideration should be given to the existing computer management structure.

c. Both states visited indicated apprehension towards current billing-concurrent audit, although both were using or intending to use it.

d. At least 18 months would be needed to get ready for a central accounting system.

e. Changes in the accounting systems were not made to please the BPR, but to up grade the accounting practices so that they would be comparable with private enterprise.

f. Some doubts were raised as to the real value of more detailed cost information which the systems produced.

Minute Order Authorizing This Study - (No. 55189 passed by the State Highway Commission October 30, 1964)

"WHEREAS, the financial and accounting controls as well as the affiliated administrative procedures involved in the operation of the Texas Highway Department have proven most effective over a long period of years; and

"WHEREAS, due to the constantly expanding work volume of the Department, the task of accounting and auditing is increasing each year, office space is limited, qualified accountants and auditors are not readily available in the personnel market and computers and data processing machinery are being perfected to add efficiency as well as to substitute for additional manpower and office space; and

"WHEREAS, it is considered desirable that a review be made of the operating controls and procedures of the Department to determine whether or not modifications might be necessary or desirable to add to the efficiency of the work of the Department;

"NOW, THEREFORE, BE IT ORDERED that the State Highway Engineer invite proposals from at least five competent consulting firms with an established reputation in the field of fiscal, accounting and electronic data processing as well as the affiliated administrative controls involved in the operation of a Highway Department limited to the following conditions:

"1. The proposed study to give major emphasis to fiscal control, accounting and data processing with minor emphasis on management and personnel.

"2. The proposed study to be completed within twelve months.

"3. The proposed study to be a joint operation, both in finance and supervision, by the Texas Highway Department and the U. S. Bureau of Public Roads.

"4. The proposed study to bring forth recommendations to satisfy Bureau of Public Roads requirements for concurrent audit - current billing procedures as well as all requirements of State laws.

"At such time as the proposals shall have been received and reviewed they shall be brought back to the attention of the Highway Commission for study and consideration of award of contract."

Minute Order Selecting Ernst & Ernst to Perform Study - (No. 55655 passed by the State Highway Commission February 26, 1965)

"WHEREAS, Minute Order No. 55189 directed the State Highway Engineer to invite proposals from at least five competent consulting firms with an established reputation in the field of fiscal, accounting and electronic data processing as well as the affiliated administrative controls involved in the operation of a Highway Department for the purpose of making a financial management study of the Department; and

"WHEREAS, invitations were addressed to eight competent firms to submit proposals by February 19, 1965; and

"WHEREAS, six of the firms have submitted the requested proposals following personal interviews with representatives of the Department; and

"WHEREAS, a thorough review and analysis of each proposal has been made;

"NOW, THEREFORE, BE IT ORDERED that the firm of Ernst & Ernst of San Antonio, Texas, be selected to perform this study on the basis of their proposal dated February 15, 1965. The State Highway Engineer is authorized to enter into negotiations with said firm leading to the development and execution of a formal contract."

Contract - Based upon the Ernst & Ernst proposal and the original specifications, and by authority of the above Minute Order, a contract was drafted and signed on April 13, 1965.

Extent and Duration of Our Work - The Consultant began work on April 13, 1965, after having made a trip to the State of Pennsylvania the week prior to review the status and nature of the Ernst & Ernst Financial Management Engagement there. The first two weeks were spent in touring all of the Austin Divisions, gathering and reviewing many of the Texas Highway Department's existing procedures manuals, and in the detailed development of the Project Schedule. The Steering Committee members assisted in introducing the consultants to the various people in each Division who would be working with them in the study. A visit was made to the Austin District (District 14) for preliminary familiarization with the work done and organization pattern in one district.

During the month of May 1965, the following was accomplished:

1. A plan for Federal reimbursement of matching FICA and State retirement costs during the present interim period pending implementation of a current billing system was drafted by the consultant for presentation by the Highway Department to the BPR. This plan was accepted (subject to audit of the submitted payroll rates) on June 14, 1965, by the BPR.

2. Plans for submission of specifications to computer manufacturers for price quotations by the Motor Vehicle Division were reviewed and discussed by the consultant and the Steering Committee. It was agreed that the Motor Vehicle Division's study should be completed before the consultant begins work in this area.

3. A request for additional tape and card-reading units to supplement the existing central computer of the Texas Highway Department was briefly reviewed by the consultant. It was determined, based upon this short review, that this type of interim measure would not materially affect the consultant's overall recommendations regarding the use of data processing equipment for financial management.

4. One of the consultant's representatives attended the BPR regional conference for Financial Management held at Little Rock, Arkansas on May 17 and 18 as a listener. Representatives from the State Highway Departments and BPR in Texas, Louisiana, Oklahoma and Arkansas presented talks and discussions on various topics related to financial management of their respective highway departments.

5. Three of the consultant's representatives conducted interviews and discussions with various Division personnel in Austin for the purpose of drafting procedures flow charts pertaining to the areas of study outlined in the Project Schedule. These were drawn to document the existing practices and procedures. Wherever District operations were encountered, the consultants documented the procedures in use in the Austin District (14) offices.

6. A two day program for use by the consultants in visiting other districts was developed, and put into use beginning on May 31 at Houston (District 12).

7. Tentative recommendations concerning revisions in organization, data processing, and reporting practices were formulated for presentation to the Steering Committee at the June 7 meeting.

During the month of June 1965, the following was accomplished:

1. Three of the consultant's representatives visited six district offices following the planned schedule in order to compare the operations of several districts. At each district, interviews were held with key personnel, and visits made to typical construction sites and maintenance locations to observe the problems and practices in the field. Sample internal reports were gathered for further study and review.

2. At the June 7 Steering Committee meeting several tentative findings and recommendations were presented and discussed.

3. A draft revision to the chart of accounts and related code structure was prepared. This was accomplished after consideration and study of the AASHO Manual and several other states' code structure.

4. A tentative financial management organization chart was drafted and discussed with key accounting personnel and Steering Committee members.

5. Several alternate plans for processing financial data were studied and estimated costs were developed for each plan.

6. A tentative list of desirable management reports was drafted.

During the month of July 1965, the following was accomplished:

1. A review of the work and duties of the present internal audit group was performed.

2. A review of the computer center operations was made and the status of present programs in progress was discussed with computer center personnel.

3. Prior research by other consultants in connection with operations of the Texas Highway Department was obtained, reviewed, and discussed with various personnel.

4. Preliminary data pertaining to organization and personnel policies was obtained and discussions were held concerning central office administration of personnel matters.

5. A half-day meeting with the State Highway Engineer was held to discuss various accounting and fiscal matters and to exchange views on an approach for improvement.

6. A one-hour presentation was made to the semiannual assembly of District Engineers and Division Heads telling them of our work thus far, and exchanging ideas and suggestions with them for improved accounting procedures. This was later followed by written suggestions from several districts.

7. Data processing machine usage reports were started in five separate data processing locations in the Austin divisions.

8. Further data was collected concerning the feasibility of data communication from the districts via telephone or teletype lines. An approach to source recording of accounting information with plastic plate imprinters was explored, developed, and presented to the Steering Committee.

9. Discussions were held with the Assistant Highway Engineer concerning the necessity for futher in-depth study of the Motor Vehicle Division's data processing requirements.

10. Suggested operational classifications and corresponding codes were presented to and discussed with Maintenance Division personnel. Other accounting codes including function and object codes were presented to and discussed with District administrative personnel in the San Antonio District.

During the month of August 1965, the following was accomplished:

1. Data processing machine usage studies were completed, and reviews were made of the various office machine applications throughout the Austin divisions.

2. Detailed analysis was made in the Accounting Section of the Motor Vehicle Division. In addition, the entire functions of the Motor Vehicle Division were reviewed sufficiently to prepare a budget for further in-depth study of this Division's data processing and information storage and retrieval requirements.

3. Visits were made to two more district offices with a member of the internal audit staff to check out the proposed method of entering data into a central computer system, and to discuss how such a system might work most effectively.

4. A network diagram in "gross" form was prepared depicting the events necessary for conversion from present methods to those which are proposed.

5. A draft outline of the consultant's final report was prepared, and several sections were written in first draft. These were not presented to the Steering Committee, however.

During the month of September 1965, the following was accomplished:

1. Organization charts of the present functions of each of the Austin divisions were prepared with the assistance of division heads or Steering Committee members.

2. Parts of the final report draft were typed and put into the hands of Steering Committee members for review and comments.

3. A review of the present information storage and retrieval system in use in the Motor Vehicle Division was started.

4. Further refinements were made to the plan for setting up a central cost accounting system employing the computer.

5. Field studies were initiated by an Industrial Engineer for surveying the possible means of controlling and scheduling field manpower.

During the month of October 1965, the following was accomplished:

1. Representative of consultant attended a national conference in New Orleans, of the Motor Vehicle Administrator's Association to gather information about the status of data processing in other states relative to Motor Vehicle Division problems, and to review solutions to many of these problems.

2. Prepared and presented flow charts and statistics covering the present procedures in the Motor Vehicle Division, and gave our preliminary recommendations concerning the requirements for an automated system.

3. Prepared and published sections of the final report in draft form covering Organization and Personnel, Accounting Systems, Data Processing and Manpower Controls.

4. Sections of the final report draft were reviewed by the Steering Committee in weekly sessions, and notes from these meetings were made for the consultant so that further work or clarification of points could be made.

5. Contacts were made with several representatives of manufacturers to gather latest information relative to data processing techniques applicable to highway work.

During the month of November 1965, the following was accomplished:

1. Notes taken from Industrial Engineering field studies were incorporated into the final report draft section covering Manpower Controls.

2. Sections of the final report draft covering Conversion, Cost Accounting, and the Motor Vehicle Division were written, and were reviewed by the Steering Committee.

3. Further refinements to previously written sections of the final report were made and reviewed.

4. Discussions were held with the Administration concerning implementation of several recommendations concerning Organization and Personnel before the release of the consultant's report.

During the month of December 1965, the following was accomplished:

1. Consultant's final report draft was completed and placed in the hands of the Steering Committee for review and acceptance.

2. Draft copies of the accepted final report draft were submitted to the BPR for their review.

3. A presentation was made to the Highway Department Administration of our report and its major recommendations.

4. Further discussions were held relative to implementation of the recommendations in this report.

General Accounting

II. DETAILED COMMENTS AND RECOMMENDATIONS

A. ACCOUNTING SYSTEMS

1. General Accounting

a. Introduction

The present general accounting system of the Texas Highway Department is adequate to serve in the capacity for which it was designed almost 35 years ago. A study of the intentions of the original plan for this accounting system reveals a remarkable degree of understanding of and insight into the accounting problems which are peculiar to the state highway field. Many of the recommendations made by the original systems architect have long since been implemented, and have resulted in good procedures for recording revenues and disbursements and for safeguarding the Department's assets. However, several recommendations were not put into effect mainly because of a lack of data processing capability within the Accounting Division at the proper point in time for their implementation. These recommendations principally concerned the development of certain "management reports" for the use of high Department officials regarding the status of funds, programs, and budgets, as well as various analyses of past transactions.

The accounting system has therefore evolved into its present form which is primarily concerned with the adequate documentation and control of revenues, expenditures and past events, rather than with the control and management of present and future events. The changes which we are recommending in this section of our report will continue to provide for adequate audit trails, good documentation, etc., and will, in addition, allow for a moderninzation and expansion of the concept of "management reporting". It is our intention to retain all of the sound features of the present system, and add to it as well the routine presentation of analytical reports to several levels of management to assist in the overall direction of the Department's activities. Another benefit and by-product will be the ability to prepare current billings to the Bureau of Public Roads by further processing of the same data. The responsibility for using the "management reports" for their intended purposes rests, of course, with the persons receiving them. It is not our intent to attempt to influence the development of a report oriented management philosophy, but merely to insure that the most modern tools for decision making, in terms of accounting matters, are made available to the highway management.

To overcome the previous lack of data processing power, we have recommended, in Section II.C. of this report, a configuration of data input and computing machinery which will adequately serve the needs of the Department for several years, for accounting and business data processing.

This section (A.1.) is devoted to a review of the Department's present general accounting system, and a presentation of the recommended changes.

b. Financial Statements

The three principal financial statements prepared now by the Accounting Division of the Texas Highway Department are:

1) Statement of Cash Receipts and Disbursements
2) Balance Sheet
3) Current Fund Balance Sheet

Statements of Cash Receipts and Disbursements are prepared daily, in summary, for Administration; monthly, for the month and year-to-date, for the Administration; and quarterly, as a report to the Governor covering the quarter of the fiscal year reported. Annual Statements of Cash Receipts and Disbursements are included in the State Auditor's Report and in the Department's Biennial Report to the Governor, Legislature, and State Highway Commissioners.

The Balance Sheet of the Department is prepared annually as of August 31, which is the end of the State fiscal year, and is published in the Biennial Report and in the State Auditor's Annual Audit Report.

The Current Fund Balance Sheet is prepared monthly for distribution to the Highway Administration and is published annually and commented upon in the State Auditor's Report. The Current Fund Balance Sheet is not included in the Biennial Report.

Each of the financial statements are matters of public record and are available for inspection by interested parties. The Department's Biennial Report and the State Auditor's Report include extensive other financial information in addition to the financial statements.

The Texas Highway Department, like all other departments and agencies of the State government is forbidden by law to borrow money. This restriction is reflected in the Department's financial condition as indicated in Exhibit II.A.1.b.-1. The only liability item on the Balance Sheet is vouchers payable. This is equal to approximately one month's expenditures, and is due largely to contractors for work placed during the last month. The Balance Sheet does not reflect, of course, contingent liabilities under contracts for work not yet performed.

The following will describe how each of the other major account categories shown in the Condensed Balance Sheets of Exhibits II.A.1.b.-1 relate to the financial condition and financial characteristics of the Department:

1) Cash - The cash balance includes the State Highway Fund which is available without restriction for accomplishing the Department's assigned responsibility for maintaining and constructing highways, and the Farm-To-Market Road Fund which receives $15 million annually of tax revenue to be used only to construct farm to market roads. The usual balance in this latter account is from $14 to $20 million. The State Highway Fund balance has a seasonal pattern, typically with its minimum balance in February just before motor vehicle license sales start and with its maximum balance in May or June after license fee renewal sales and collections are completed. This is illustrated in the following schedule:

	MILLIONS OF DOLLARS				
	1961	1962	1963	1964	1965
End of February balance	43	29	34	40	67
End of June balance	77	72	91	96	151

2) Accounts Receivable - The amounts receivable from others are almost entirely reimbursements on construction from other governmental bodies such as cities, counties, and the Federal government. In recent years approximately 90% of the cash received from other governments has come from the Bureau of Public Roads for construction and Interstate right of way reimbursement. These reimbursements generally are collected within thirty days of billing.

3) Material and Supply Inventories - This asset which has been valued at from $12 to $14 million in recent years is largely devoted to supporting the Department's maintenance function. Maintenance materials and maintenance equipment replacement parts constitute most of items kept on hand. Some construction materials, such as paint, are also stocked and supplied by the Department for contract construction. Approximately one-seventh of the inventory value is in regional warehouses at Post, Seguin, and Athens, Texas; with the other stocks in the district headquarters warehouses and small stocks at each maintenance section headquarters. District inventories range from under $200,000 to over $1,000,000.

4) Equipment, Buildings and Land (Fixed Assets) - This account category includes office, shop, and warehouse buildings (1,273 buildings on 376 sites totaling 2,164 acres), some 15,000 pieces of roadway equipment, and all office, engineering and shop equipment owned by the Department.

5) Resources (Surplus) - This represents the total of Cash, Receivables, Inventory and Fixed Assets, decreased by the amount of unpaid vouchers which are claims against the Department's assets.

The Balance Sheet which shows the balances of the above described accounts is referred to as the "General Balance Sheet" and the accounts are referred to as the "Proprietary" accounts.

The overall financial function within the Department can be described as that of administering a cash flow from taxpayers either directly to the Department or indirectly through city, county, and Federal governments which are financial participants in the underwriting of highway progress. Because its major financial management problem is the management of a cash flow, the Department prepares monthly a financial statement which deals only with cash, cash sources (resources), and cash requirements (commitments). This financial statement is prepared from a group of accounts known as the "fund" section of the general ledger. The "Current Fund Balance Sheet" shows as Resources:

1) Cash balances
2) Accounts receivable
3) Estimated tax collections through the end of current fiscal year
4) Amounts of money definitely earmarked by other governments for participating in right of way and construction costs incurred by the Department

The total of these resources are classified into these kinds of Commitments:

1) Liabilities (vouchers)
2) Projects underway (remaining work)
3) Operating budgets for the remainder of the fiscal year
4) Uncommitted resources (available resources)

Exhibit II.A.1.b.-2 shows in detail one of the Department's Current Fund Balance Sheets. These are prepared monthly.

Exhibit II.A.1.b.-3 shows comparative summary balances from Current Fund Balance Sheets as of August 31, for six recent years. These statements are for the close of fiscal years, at which time the estimated tax collections for the remainder of the year is zero. This fact, plus the inclusion of long-term project appropriations within "current" commitments, explains the book deficit or apparent over commitment of State funds. A series of comparative statements for September 30, rather than August 31, of the same years would not show deficits but would show an availability of State funds. This is caused by the recording in September of the new year's estimated tax revenues of roughly $250 million as a resource. This resource would more than offset the new year's budget commitments of roughly $100 million, and thus wipe out the deficits reflected as of thirty days earlier.

There are some significant accounting conventions adopted by the Department which affect the financial statements and their interpretation. For example, the Department does not capitalize and carry as a Balance Sheet asset the original cost or depreciated value of the State's highway systems. Instead, completed project costs, as well as the cost of projects in progress as of Balance Sheet dates, are charged into surplus. In its Planning Survey Division, Road Life Section, the Department maintains detailed historical cost data on all construction, reconstruction, special maintenance and abandonments undertaken.

The Department computes depreciation costs on its highway equipment every month, on its buildings and shop equipment every three months, and on its office and engineering equipment once a year. These costs are charged into current budgets and projects. Net or depreciated book values only are maintained on the books of accounts, and are reported on internal and published financial statements.

The Department does not accrue its accounts receivable and accounts payable on the central books of account at the end of each month. This is done only at the end of the fiscal year. The Department avoids the use of encumbrance procedures in its official accounting records whereby budget balances would be reduced prior to the completion of transactions such as at the time purchase orders are issued. However, such procedures are in use in the accounting systems of the Equipment and Procurement Division and the Right-of-Way Division. These satellite bookkeeping systems serve to prevent making commitments in excess of appropriations.

The Department carries material and supply inventories in the expenditure accounts rather than in asset accounts. Similarly, buildings and equipment acquisitions during the year are carried in expenditure accounts, and then are closed into asset accounts at end of the fiscal year.

The Department follows the general practice of recording commitments in its fund accounts only when no further Highway Commission action or authority is required to make expenditures. Thus, programmed construction, for which districts are authorized to proceed with planning, is not booked as a commitment until a construction contract is awarded by Commission action. Then an appropriation is made and funds are obligated. The annual equipment acquisition budget is recorded as a commitment in monthly increments only when the Highway Commission makes appropriations for each month's specific equipment requisitions. The Statewide budget for contingent or disaster maintenance is recorded as a commitment at beginning of the fiscal year, inasmuch as the State Highway Engineer may approve expenditures of this fund without further Highway Commission authority.

The financial statements as presently prepared are serving adequately their intended purposes. Reporting of financial condition and reporting of the funds received and expended is handled in timely and thorough manner. However, in order to accomodate other recommendations covered in subsequent sections of this report, some changes in the statements and the underlying general ledger accounting will be required. These changes will affect the interpretation which could be placed upon the statements, and are described as follows:

1) The accounting policy will need to be changed so that all transactions completed by the end of a month will be processed with that same month's batch of data even though not paid or collected until a subsequent month. The need for this change arises in connection with expenditure or cost accounting rather than financial condition reporting. The central accounting office will be preparing all budget status reports, cost ledgers, and cost reports. These ledgers and reports will be much more useful if they take into account, as nearly as practical, all of the completed transactions of the period covered. This applies especially to the month's payroll transactions for salaried personnel and to contractor earnings. Material and supply purchases are less critical, because most tangible (Board of Control) items which are purchased are charged to cost accounts as they are used via the warehouse issue procedures. Utilities, travel expenses, and other service purchases are important cost factors and also should be recorded as of the month incurred. The procedures and mechanics of accrual accounting and calendar month cut-off are not burdensome. They are performed routinely by many large organizations, and should be adopted by the Department.

2) A series of general ledger accounts, as reflected in Exhibit II.A.3.-2 will be needed in order to develop and use additive rates as a means of distributing free time costs and matching fund costs in the payroll processing procedures. These new accounts, as such, will have little effect upon the financial statements, but they are essential for the accurate determination and reporting of costs, and for the current billing and concurrent audit program.

3) Modifications of the budget and budget code number structure are recommended so that the accounts structure will more closely match the organizational structure. This should help make budget control more effective and facilitate budget status reporting to middle management personnel. However, this also will cause some changes in the long established format of the Statements of Cash Receipts and Disbursements. This statement will continue to satisfy statutory requirements, and will be flexible as to the levels of detail which may be reported.

Many record keeping and reporting activities for determining available budget balances, program status, design progress, and distribution of costs to accounts are now being handled by organizational units other than the Accounting Division. Changes in the general ledger and cost accounting procedures can relieve these persons of the need for preparing reports of their activities in dollar terms, when such reports can be prepared from data available in the accounting system. The account balances in many such cases would only slightly affect or not affect the financial statements. These added benefits are provided in the recommended system of accounts as follows:

1) A cash forecasting system is provided which eventually will be integrated with the general ledger and cost accounting procedures and will utilize disbursement account balances in forecast updating procedures.

2) Modified general ledger accounts are provided to include data on programmed projects by program, system, and district all on a memo basis. These accounts should be used to prepare reports to assist the Administration in analyzing and updating information that presently is being produced manually outside the Accounting Division. This modification should include new plans for assigning project designator numbers so that identification and accurate reporting of projects can be made from planning stages through appropriation and expenditure stages.

3) Modified general ledger accounts are needed to maintain data for reporting the status of Federal aid apportionments in terms of amounts apportioned, adjustments, project agreements spent this year and prior, project agreements unspent by let and not-let categories, projects authorized, projects programmed with the BPR, and unobligated and unprogrammed balances, all by federal fund types (I, F, S, and U.). This work is presently handled manually outside the Accounting Division.

4) Modified general ledger accounts are provided for to accomplish encumbrance accounting as a service to operating and planning divisions which need this kind of budget status information.

c. Budgeting and Budget Status Reporting

This section contains considerable material which explains the present budgeting and budget status reporting procedures of the Texas Highway Department as well as our recommendations for changes. The explanatory material is included in this report, because we believe it is necessary to carefully explain these present procedures to reinforce the need for making the recommended changes. Additionally, we have not found thorough understanding of the overall budgeting procedures within the Department, and feel that this explanation will be beneficial to many who may wish to expand their comprehension of the total process.

Exhibit II.A.1.c.-1 is a summary picture of the Department's budget of operations. As the note to this exhibit states, all other income not budgeted here is used for construction and reconstruction of highways and roads. Construction and reconstruction is "budgeted" under program control.

The items in the Budget for Department Operations are either annual budget items or "cuff" budget items (marked A, on the exhibit). The annual budget items are appropriated by the Texas Highway Commission at beginning of year. This gives authority for spending the entire item during the budget year without further Commission action. For the "cuff" budget items, the Commission makes specific appropriations each month covering such items as individual contracts, construction projects or acquisitions under the items for buildings, equipment purchases, and highway betterment projects. For these items, the actual expenditure of funds may fall into future years beyond the budget year during which they were appropriated. Therefore, the "cuff" item amounts shown in the Budget are guideline totals which the Commission expects to appropriate, and usually does, during the year.

The Preliminary Engineering Budget (Item number 5 in the exhibit) is essentially an annual budget. Twice annually the Commission appropriates approximately half of the total amount.

The Budget for Department Operations for 1965-1966 (Exhibit II.A.1.c.-1) can be summarized in terms of the frequency with which the Commission appropriates budget funds as follows:

1)	Cuff Items, appropriated monthly	$ 15,602,600
2)	Preliminary Engineering, appropriated semiannually	17,000,000
3)	All Other Spending for the Year, appropriated annually	93,535,561
		$126,138,161

The major sections of the Budget for Department Operations are rearranged for purposes of explanation as follows:

	SECTION TITLE	BUDGET ITEM NUMBER	1965-66 AMOUNT
1)	Buildings Section	#2	$ 2,322,600
2)	Equipment Division	#4	6,351,300
3)	Preliminary Engineering	#5	17,000,000
4)	Austin Headquarters and Divisions	#6	12,168,411
5)	Maintenance Section	#1	72,227,850
6)	Other Costs Required by Law	#7	15,468,000
7)	Landscape Section	#3	600,000
			$126,138,161

1) Buildings Section - This budget section is the estimated ultimate cost of all expansion and improvement work to be started during the year. At the time the Budget is prepared prior to the beginning of the fiscal year some of the line items are supported by detail lists of proposed buildings (Exhibit II.A.1.c.-2). Each spending project which is undertaken after the budget is approved will be reviewed and acted upon twice by the Commission; first by an authority minute order which instructs the Department to proceed; and later by an appropriation minute order. The Buildings Section of the Maintenance Operations Division does practically all of the architectural design, and handles planning and administration of the building programs.

2) Equipment Division - This budget section covers all capital equipment to be acquired during the year (see Exhibit II.A.1.c.-1, section 4., lines a, b, and d). It also includes warehousing and repair functions carried on at Camp Hubbard in Austin (line c). Each month the Commission is presented a list detailing needed equipment acquisitions as requested by various divisions and districts. These requests are reviewed by interested Division Heads prior to presenting the request to the Commission for the monthly appropriation. After funds are appropriated, the Equipment and Procurement Division coordinates the purchase of the items through the State Board of Control.

3) Preliminary Engineering - This budget section covers salaries, travel, facilities, and other cost items for all personnel in the districts and in some divisions who are assigned to the highway and bridge design function. The annual amount is estimated by the Highway Design Division based upon the amount of charges to the prior year's budget, modified by experience and other general factors. The Highway Design Division keeps up with monthly spending for preliminary engineering in the districts by reviewing special ledgers which are posted from copies of the District Status Reports. By keeping up with spending rates, the Highway Design Division is able to allocate the total Preliminary Engineering Budget among the districts. Twice each year, or more often if necessary, each district is allocated a sum to meet its needs. The Highway Design Division must approve each design project, issue an authorization, and assign an IPE (Investigation and Planning Expense) account number. The Highway Design Division also monitors progress and publishes monthly Status Books (Exhibit II.A.1.c.-3) which report the physical status of all design authorizations.

4) Austin Headquarters and Divisions - Each division prepares estimates of budget needs for the year, supported by staffing charts of authorized employment and salary schedules. These estimates or recommendations are incorporated into the Budget for Department Operations by the Assistant State Highway Engineer assisted by the Head of the Accounting Division. Additional information as to the content and purpose of items under this budget section is shown in Exhibit II.A.3.-3.

5) Maintenance Section - Since highway maintenance is one of the Department's major responsibilities and constitutes the greater portion of its annual budgeted expenditures, the preparation and administration of maintenance budget components is of major importance. The distinction between construction and maintenance has often been an indefinite matter in highway management. Where does one activity end and the other begin? There is no clear cut distinction which will always apply to specific situations. The question is perhaps academic, and has been handled by the Department through its own approach to financial management of maintenance expenditures.

Contracted construction work is planned or scheduled by periodic construction programs, each of which covers one or more highway systems. In the process of developing these programs, each district is alloted a fixed portion of the total program amount, and is asked to fill in a form which shows the cost of each of the proposed projects comprising its allotted share. The project costs are supported by detailed cost estimates for each project.

In recent years the Department also has prepared annual programs using the same approach for the "betterment" of highways. These annual betterment programs typically have amounted to $20 million for U. S. and State, and $18 million for farm to market highways. This work includes such items as leveling, widening and strengthening shoulders, adding asphalt, etc. Each such program, once approved, gives the district authority to proceed. The work may be contracted or may be performed with State forces. As is true with the other construction programs, the sum of each district's betterment program is in reality a proration of tax money to its area of the State, based on need. For that reason, program allocations are almost never cancelled or reduced. Specific projects may be deferred or substituted, but total program money remains available to the district as originally allocated.

Betterment work which is specifically programmed is supplemented by two items in the Budget for Department Operations totalling $6.6 million (see Exhibit II.A.1.c.-1, section 1., lines g. and h.). These funds may be transferred to district budgets on a job basis during the budget year when districts request additional money for such items as erosion control, bridge painting, seal coating, flood damage, and base repairs. This money is intended for emergency needs and work which was not anticipated in the annual programs. It is handled according to "cuff" budget procedures.

Similar to these annual betterment "cuff" budgets are the Traffic Safety and State Maintenance Contingent Fund budgets (see Exhibit II.A.1.c.-1, section 1, lines i. and b.). These funds are intended, in part, to finance unanticipated or emergency needs for which the districts may seek work order approval and financing authority from the State Highway Engineer.

These funds are not allocated by the "cuff" budget procedure, however, but instead are approved annually by the State Highway Commission, and are transferred to the districts by authority of the Administrative Division in Austin as needed.

In addition to the emergency funds provided at the State level, each district is required to reserve 10% of its regular or light maintenance budget as a District Maintenance Contingent Fund which may be used only with headquarters approval for "special" maintenance jobs. This reserve fund also automatically absorbs any overrun (and benefits from any underrun) of the ninety percent remainder of the district's regular maintenance budget.

The District Maintenance Contingent Funds are included in the total amount shown on the Budget for Department Operations for Regular Maintenance (see Exhibit II.A.1.c.-1, section 1., line a.). The Regular Maintenance (or light maintenance) funds are allocated to the districts by a procedure which will be described later in considerable detail. The funds are used for traffic services such as sign and signal repair, traffic assistance, and right of way maintenance and planting; and for minor repairs to the highway base and surface; all of which is clearly not construction work. In addition, these funds are used for all district overhead and administrative expenses which cannot be related to or charged to specific construction projects.

The other categories of the Maintenance Section of the Budget for Department Operations are allocated to the districts by various similar procedures, or are used for the functions of the Maintenance Operations Division in Austin.

Exhibit II.A.1.c.-4 groups the annual maintenance amounts to show the overall sum ($56,239,019) for which headquarters in Austin exerts some control by either reviewing work plan submissions and cost estimates before work is started or, in the case of pavement marking, specifically defining the kind of expenditure intended. This represents 51.8% of total maintenance expenditures. The Regular Maintenance Budget is the remaining 48.2%, and is expended largely at the discretion of the District Engineer and his staff.

In terms of the question raised previously as to what is or is not maintenance, as opposed to construction, it can be seen that different budgeting procedures and different administrative practices are used. Construction, and work which is similar to construction but which may really be maintenance, is reviewed, approved, and "financed" on a line item or project basis. Routine maintenance, on the other end of the scale is budgeted centrally only to the extent of allocating maintenance money to the various districts.

To allocate the total Regular Maintenance Budget which is shown in Exhibit II.A.1.c.-1, section 1, line a., the Maintenance Operations Division determines the total mileage of the State highway system broken down by each district. This inventory of mileage is made as of May 31 each year. Part of the information is supplied by the Accounting Division, and part is supplied by the districts on forms prepared and sent out from the Maintenance Operations Division. This information is requested to be supplied by the middle of May on forms as illustrated in Exhibits II.A.1.c.-5, 6, and 7.

The mileage data for each district is compiled according to the following classifications: (see Exhibit II.A.1.c.-8, 2 pages)

1) U. S. and State Highways
2) Farm Roads
3) Controlled Access Highways - Urban
4) Controlled Access Highways - Rural
5) Multi-lane Highways - U. S. and State
6) F. M. Multi-lane

Comparative data is compiled showing the per-mile amounts budgeted for the past several years for each classification of road in each district. Using this data, the Division Head of the Maintenance Operations Division and his assistants review each per mile budgeted amount and assign new per-mile amounts to each classification in each district. Then clerical personnel extend and add these amounts to derive the district total budgeted amount. (see Exhibit II.A.1.c.-9) The total amount of $58,390,190 is then placed on the Maintenance Operations Division budget request which is sent to the Director of the Accounting Division for inclusion in the budget (see Exhibit II.A.1.c.-1, line 1.a.).

At the time the Budget for Department Operations is reviewed before the State Highway Commission, a Minute Order is submitted asking for the funds to be distributed to the districts according to the mileage computation (see Exhibit II.A.1.c.-10).

After the Commission has approved the Minute Order, the Maintenance Operations Division notifies the district (see Exhibit II.A.1.c.-11) that its budget has been approved and shows the mileage and rates used to compute the budget. In addition to the total amount, the Maintenance Operation Division also shows as a separate amount, 10% of the total, which is to be set up in the District Maintenance Contingent Fund, and asks the District Engineer to return a separate form (see Exhibit II.A.1.c.-12) allocating the remaining 90% of the total to various accounts and counties in his district. The Administration does not require or request any specific evidence of planning or programming to support the particular county amounts established by the district in each authorization account. In many cases the current year's breakdown is the previous year's spending with minor adjustments made by the District Accountant.

There is in the Department a strong tradition that budgets and budget authorizations are not to be exceeded and further that requests for budget increases during the budget year are to be avoided if at all possible. In the area of maintenance operations the risk of budget overruns and increase requests are minimized through the reserving of 10% of the light maintenance budget (District Maintenance Contingent Fund). This fund exists to absorb overruns and for small special maintenance projects, but can be charged only with Headquarters approval. Also, the District Special Job Contingent Fund was set up under a special act of the State Highway Commission in 1958 for the purpose of balancing overruns and underruns in funds appropriated for Day Labor Projects and Maintenance Contract Projects (see Exhibit II.A.1.c.-13). Any underruns or overruns within 20% of the original estimate are transferred to this account. See Exhibit II.A.1.c.-14 for a statement of balances at October 1, 1965, in these accounts. In addition, the State Maintenance Contingent Budget covers all new roads added to the system during the year, and all unusual maintenance requirements caused by floods, tornados, and other natural disasters.

Because all maintenance budget over or underruns are carried forward into the following year's budget for each district, and because the districts' programmed funds for betterment are not on a period basis, the State Highway Commission effectively controls the distribution of maintenance money by the betterment program and light maintenance budget minute orders. An exception to this might be considered to be the $8.1 million annual "cuff" budgets for betterment and traffic safety which are not necessarily transferred to the districts on the basis of overall need.

District applications (over 600 in fiscal 1965) for work under these budgets are evaluated on a specific case basis. However, memo records are maintained (see Exhibit II.A.1.c.-15) of the cumulative amounts authorized for each district during the year from these "cuff" budgets. In the 1964-65 fiscal year, funds transferred to seven districts from these "cuff" budgets amounted to 20% or more of those districts' regular light maintenance budgets. In one district the "cuff" budget transfers were 33.6% of the regular light maintenance budget. In five districts the "cuff" budget transfers were 4% or less of the regular light maintenance budget.

The Accounting Division of the Department maintains records of amounts appropriated, amounts passed for payment, and balance to spend for each budget. The budget numbers used for this purpose are shown in Exhibit II.A.3.-3. Each budget is broken down into one or more authorizations which serve as budget subsidiary accounts, each of which may carry a portion of the related budget's spending authority. The use of these accounts for budget accounting, and budget status reporting will be reviewed below for the Equipment Division, Preliminary Engineering, Austin Headquarters and Divisions, and Maintenance Section budgets:

1) Equipment Division - The acquisition cost of equipment is posted to authorization accounts by the Accounting Division as vendors are paid. The budget recorded in the accounts is increased each month by the amount appropriated by the Commission. The books show at all times the balance; that is, appropriated amounts less amounts paid.

The Equipment Division maintains a separate bookkeeping system to provide data related to the budget for equipment as to budgeted amount, amount appropriated, amount not appropriated, amount of approved purchase orders, amount of not yet approved purchase orders, amount cancelled, plus payment difference and outstanding balance all by monthly minute order. These records are reconciled to the Accounting Division's cash basis balances. Status of the equipment "cuff" budget is reported to the Administration and State Highway Commission with each monthly request for appropriation.

2) Preliminary Engineering - Approximately half of the $17 million budgeted is appropriated in September. In January or February when the remainder is appropriated, the Highway Design Division advises the Commission if additional money may be needed to complete the fiscal year.

Expenditures of the Preliminary Engineering budget are charged to Investigation and Planning Expense Authorizations approved by the Highway Design Division (see Exhibit II.A.3.-8). The district's monthly Status of Authorizations report (refer to Exhibit II.A.1.c.-16, page 2) shows the amount spent to date on each IPE, the total for all IPEs in the district, and the budget balance. Districts also report to the Highway Design Division each month the percentage of work completed to date by phase on each design project.

Expenditure information other than total-to-date is not reported for Investigation and Planning Expense Authorizations. The district ledgers show the amount of charges for each payroll, and these can be analyzed only by search of source documents to determine which person's salary, travel, etc., constitute the expenditure total. This information is not available in Austin. The scope of design work to be undertaken under each IPE is rather carefully defined by the Highway Design

Division. However, expenditure limit is not made for each IPE. The Highway Design Division has a manual ledger system wherein monthly charges and status percentage movements are compared for each IPE, of which there are approximately 1400. When IPE accounts are charged and the reported increase in percentage of completion is not consistent with the amount of charges made, the Highway Design Division sometimes asks field personnel for an explanation of the apparent inconsistency.

3) Austin Headquarters and Divisions - This section of the Budget for Department Operations is accounted for in budgets numbered 31, 33, 37, 40, and 49 as described in Exhibit II.A.3.-3. These five budgets accumulate part of the expenditures of each division.

Status of these budgets and authorizations is monitored by the Accounting Division and reported to Division Heads as requested or on reports typed monthly from ledgers. Divisions which operate service facilities such as reproduction, computer, material test lab, and photogrammetry maintain their own duplicate ledger systems for their budget authorizations, from which operating reports are prepared.

4) Maintenance Section - When the District Engineer returns the Light Maintenance Budget for the Fiscal Year (see Exhibit II.A.1.c.-12) to the Maintenance Operations Division, this Division prepares separate authorizations forms (see Exhibit II.A.1.c.-17) for each item submitted. These forms are sent to the Accounting Division which sets up separate accounts on its budget ledger, and passes a copy of the forms to the District Accountant so that he can do likewise. All light maintenance costs incurred during the year are hand posted by the district accounting staff to the District authorizations ledger. A Monthly Report on Status of Authorizations (see Exhibit II.A.1.c.-16) is prepared from the district ledger balances and sent to the Accounting Division in Austin for comparison to and reconciliation with headquarters ledgers. The headquarters ledgers are kept by county and class of highway for direct maintenance charges. The classes are:

U.S. and State Highways	Authorizations 20 through 39
Controlled Access Highways - Urban	Authorizations 40 through 49 (types 88-90)
Controlled Access Highways - Rural	Authorizations 40 through 49 (all other types)
Farm to Market Roads	Authorizations 50 through 99

These classifications of costs do not separate multi-lane mileage as a class and therefore differ from the classifications used originally by the Maintenance Operations Division in making the allocation of light maintenance budget money to the various districts.

The Status of Authorizations Report serves to inform the District Engineer and his staff as to the annual budgeted amount, amount spent to date, and balance to spend for each authorization and in total. The comparison of percent of total budget spent to percent of year elapsed, as shown on page one of the report, gives a gross measure of overall budget condition. (see Exhibit II.A.1.c.-16) In some instances, additional budget status data are prepared in the districts. Many of the Maintenance Section organizations are responsible for all or some of the roads in three or more counties. In this case it is necessary to reconstruct the Status Report data in terms of responsibility assignments (rather than county) to determine how individual Section Foremen are doing with respect to budgeted amounts. Exhibit II.A.1.c.-18 is an example of a District Maintenance Budget Status Analysis. This report shows the average per month spending available for the balance of the year compared to recent spending rates. Various cost data, such as daily and year-to-date expenditure records are often prepared manually by clerks in the Maintenance Section Headquarters and in District Maintenance Engineer's office.

After the close of each fiscal year, the Accounting Division prepares for each district a tabulation of regular maintenance expenditures for each county, control section, control number, operation, type, structure, and authorization. (refer to Exhibit II.A.1.c.-19) These tabulations also

include the district's undistributable expenses or overhead costs for the year. Such costs average about 11% of the direct light maintenance expenditures for all districts Statewide. The tabulations are used very little for future budget planning or analysis of past results, although that is their intended purpose. Our findings were that the tabulations are used mostly to answer inquiries from outsiders, and this only on a very limited basis.

Special, as opposed to regular, maintenance which requires Administrative or Commission approval for financing is accounted for similarly. An authorization account is established for each job or project. Requests to Austin for authority to do these jobs are accompanied by a statement of estimated cost in lump sum or by work items which correspond to the unit bid items on contracts. Records of actual item costs are kept in the district during the progress of the work. These are submitted to the Maintenance Operations Division when each job is completed. Monthly, each district submits a status report on all special maintenance jobs using State Forces only to the Maintenance Operations Division (see Exhibit II.A.1.c.-20). These reports are reprinted on a computer run for the entire Department, by district (refer to Exhibit II.A.1.c.-21).

Reports which are prepared from records kept in the Maintenance Operations Division also show the current status of each maintenance "cuff" budget. The current status is reported to the State Highway Engineer with each request for an additional appropriation.

In summary, the budgeting function in the Highway Department is presently used to serve the following purposes:

1) To limit and control expenditures in the amounts and at the times as set forth by the State Highway Commission and the State Highway Engineer.

2) To allocate available highway funds to areas of the State in proportion to need.

3) To guide District Engineers and their staffs, and Division Heads and their staffs as to the scope of their operations.

Our observations of the Department's present practices concerning budget preparation, administration, accounting, and status reporting are that the last two purposes can be better achieved more effectively by making several changes in procedure as follows:

1) Detailed estimates of maintenance work to be performed should be prepared in the districts prior to the beginning of each new fiscal year, and these should be reviewed and compiled into the annual light maintenance budget. These estimates should be prepared to coincide with the roadway network assigned to each Maintenance Section Foreman rather than by County. The estimates should emanate from the maintenance section headquarters level, and should cover all forecast light maintenance, special maintenance, and betterments which will be performed with State Forces. They should also provide for new roads scheduled for completion during the coming year. This recommendation is based on the fact that all work can be planned, it should be accomplished more economically if planned in advance, and will be planned adequately only when planning is required. Weather and other unpredictable factors are planning problems, but should not preclude planning.

2) The use of maintenance "cuff" budgets should be considerably curtailed, and used only for true emergencies; work which cannot have been anticipated and which does not qualify for finance under any of the State maintenance contingent budgets. This recommendation refers to the Betterment and Traffic Safety "cuff" budgets which total $8.1 million annually.

   More careful planning of the work needed should largely do away with the need for this particular financing procedure. These budgets are presently used for work items such as cleaning and painting bridges, seal coats, and base repair; which for the most part can be anticipated and included in the annual work plan. The Betterment "cuff" budgets are used in effect to supplement the annual budget for regular maintenance. In fiscal year 1965, one district needed a 33.6% supplement, another needed 0.06% supplement. This may reflect the fact that allocations of the regular maintenance budget of the districts were not based upon a work plan, but simply on the previous year's budget amount increased for changes in broad economic factors and new roads added.

3) The maintenance cost accounting codes and procedures should be modified in order to provide a detailed monthly cost analysis for the network of roads assigned to each Maintenance Section Foreman. These cost data should include display of the amounts spent for materials, labor, equipment and other items for each classification of operation, for each highway or section for the preceding month and for the year to date. These actual costs should be compared to planned expenditures for the same period, and variances shown. The cost analysis should be reviewed by field personnel. This is needed to place emphasis upon the important issue of what was accomplished with dollars spent rather than how many dollars remain to be spent by responsible supervisor, rather than by political subdivision and for each month rather than for the entire year.

4) Similar responsibility budgeting and cost accounting procedures should be applied to district indirect cost centers and organizational units. District administrative, office, and other indirect costs should be budgeted and reported separately from direct highway maintenance costs. Further recommendations and detailed systems for implementing this concept are provided in the suggested chart of accounts and data processing procedures.

5) Detailed annual work plans and the current and detailed cost analysis described should be available for review and examination by both district and Headquarters officials. Budget increases should be related to changes in work plan, planning errors, or performance errors.

The Department's present policy is to allocate money to a district and leave it up to the District Engineer to maintain the roads in his district, seeking consultation from Headquarters if needed. The effect of these recommendations is not to change this basic approach, but to improve upon its execution by requiring more budget planning and by providing more useful current cost accounting data which can be related to the plan.

6) Preliminary engineering activities also should be subjected to better planning through the preparation of detailed work estimates prior to the start of each project. In effect, the preliminary engineering budget procedures are established so that each district may spend whatever funds are deemed necessary to bring to contract those projects which it is authorized to do through program controls. Control of preliminary engineering from Headquarters is exercised by restricting design work to authorized and financed tasks, and by reviewing the end products of design; the plans, specifications, and cost estimates.

This basic approach to the budgeting of preliminary engineering is adequate, and is consistent with the decentralized organization of autonomous districts which characterizes the Department.

Our recommendation for preliminary engineering is similar to that stated earlier for maintenance budgeting, in that a required level of manpower planning and forecasting should be enforced starting with the supervisors of engineering residencies. Cost accounting data which will serve to regularly apprise each supervising engineer and his superiors as to manhours expended, direct cost, and indirect cost for each design function and design project, also should be provided.

The effect of these recommendations is not to change the basic approach to engineering budgeting, but to improve upon its execution by requiring evidence of adequate planning and by providing more useful cost accounting. Our visits with engineering officials in the districts indicated that this kind of assistance is desired, especially in the urban districts that have very large operations.

7) For budgeting and cost accounting purposes, the existing budget numbering system should be revised so that there is a separate budget for each Austin division, and subcodes for identification of other responsibility centers within the divisions. Each responsible supervisor should receive on a current basis all cost accounting data needed for performance analysis. Provision for implementing this recommendation has been made in the account coding system.

d. Cash Forecasting

One of the most difficult problems facing the administration of the Highway Department is the determination of how to best utilize its available funds. There are many interrelated factors applying pressures for the cash funds of the Highway Department, and there also are many variable responses to the alternate actions which can be taken in spending money.

The Texas Highway Department is in the position of having a generally "good" cash position. This is not to say that there is an abundance of funds, but that there are not pressing shortages of funds, or deficits which cause the need for finding new sources of money.

Most of the money on which the Texas Highway Department operates comes from the collection of license fees, gasoline taxes, and Federal aid. The collection of license fees and gasoline taxes is predictable and can be forecast by month of the year to a rather fine degree of accuracy. But the timing of Federal aid collections is difficult to predict in advance, because besides being limited and controlled it depends upon the mixture and extent of current construction and preconstruction activities within the Department itself. Thus, as construction activities increase in the Interstate program, the amount of Federal aid collected also will increase because the mixture of reimbursements shifts from 50-50 money to 90-10 money. A similar condition exists in right-of-way procurement activities. A problem arises in keeping track of what money will be coming into the Highway Fund in future months in order to direct the design activities of the Department toward contract letting dates of specific construction projects.

The goal of a cash forecasting effort should be to accurately predict several months in advance, or longer if possible, the balance of the Highway Fund. This simple information, if accurately forecast, could provide for more definite and earlier instructions to be issued to districts and divisions as to what projects could be advanced to construction and at what time. This, in turn, would allow the districts and divisions to better plan and coordinate their work, and to see that scheduled projects were ready for contract letting at the appointed time. Knowing the anticipated balance of funds ahead of time should also give the person or group responsible for determining priority some latitude to try various combinations of project mixtures before definitely setting up a fixed schedule. If a definite sum were known within reason to be available at the end of each month in the future, several alternate mixtures of pure state, 50-50, and 90-10 projects could be tried in an attempt to best balance the work load of the Department, to achieve the desired allocation of projects among the districts, and to conform to the Bureau of Public Road's quarterly reimbursable obligations schedule for Federal aid programs.

The plan to be described combines the work papers of accounting, columnar projections, and the use of a computer for providing certain key data which, if handled manually, would extend the time required beyond the limits of practicality. In short, the computer should be used to calculate the month-by-month effect of the existing and contemplated projects on cash flow. Then work papers should be completed manually to summarize the remaining data. It has been estimated that between 600 and 700 separate Federal aid projects are in progress at any one time which could require the detailed analysis of cash flow. In addition, there are at least as many unstarted projects which are either already programmed or are merely contemplated but not formally recognized.

Under the present system, a formal cash forecast is made once each year. This forecast is traditionally quite accurate with respect to State tax income or cash receipts, and it also is reasonably accurate with respect to expenditures for administrative salaries and other budgeted items. But in predicting the expenditures for right-of-way and construction, the present forecast is inaccurate. The forecaster has no way of knowing how the mixture between 50-50, 90-10 and pure state projects will be contracted and paid out during the coming year. His best guess is last year's payment history, and it is academic at best to assume that the same pattern will follow during the coming year. The answer is to forecast more often, and with better and more accurate information.

The expected payout of all projects under construction or agreement as of the date of forecast can be reasonably predicted. This can be done by listing all the current projects by types or classifications which identify their pattern of cash flow. For example, by study, it can be determined that Interstate projects with few structures and with a certain type of terrain have customarily called for cash payments which follow a similar pattern. Another type of project with many structures and another type of terrain will call for cash payments along a different pattern. Projects can be grouped by type of payment pattern once the basic types of patterns have been identified and classified. The patterns must take into consideration the contractor retainage and the elapsed time between the last regular monthly estimate payment and the payment of the final voucher. This involves merely an analysis of the payment history of several hundred past and completed projects. Then the expected payout patterns of the present unfinished projects can be estimated month-by-month.

Once a project was started its payment projection would have to be tempered by the facts relating to the payments already made. If the actual payments did not conform to the forecast payment pattern, then some adjustment would have to be made in predicting the remainder of the payments. This could be done by injecting into the procedures the amount of the actual payments made. The remaining estimated balance could be projected through time on a month-by-month basis predicted on the original payment pattern, assuming that the duration of the project had neither been shortened nor lengthened.

To do this, it would be necessary to capture and use the actual payments made on all projects currently under way. These payments would be accumulated and subtracted from the original estimated total amount; and the remaining balance would be spread out over the remaining life of the project according to the original payment pattern.

Under the proposed method for gathering payment data monthly for payments to contractors, the total payment amount for each construction project will have already been gathered in machine processable form, and will be available for further computer processing of cash forecasts.

It also becomes necessary to forecast what new projects will be started during the forecast period, and to inject the predicted payment patterns of these projects into the expected expenditures. This is the most difficult part of the forecast. But, if all contemplated projects had also been classified by payment pattern, and were arranged in priority sequence for the forecaster, it would be possible to hypothetically "start" new projects each month up to the limit of available funds, stopping at a predetermined minimum cash balance which was desired. Thus the forecaster could use up any available unreserved funds on a month-by-month basis by "starting" new projects from his supply of backed up projects in priority order. He would be able to see the effects of his paper "starts" by observing the size of the available cash fund balance several months after the hypothetical starting date. If cash deficits became apparent, he should know that another mixture of "starts" would be necessary to preserve future cash. On the other hand, if cash surpluses developed, he should know that a "richer" mixture was called for early in the schedule. On a trial and error basis, he should be able to fit on paper the best mixture of projects to the available cash funds. Once determined, an advance schedule of these projects and their starting dates could be circulated to the necessary personnel so that action could be taken to put the planned schedule into effect.

The computer could be used to run out the payments of current projects for a period of several years. It could also be used to run out the payments of forecast new "starts" for the same period. To do this it would be necessary to know the priority of many projects which, under present procedures, are not even programmed for construction. This would call for the districts supplying the forecaster with a priority listing of new projects as new projects were developed instead of waiting for the annual program submission as at present. In other words, as soon as a project was originated in the district it would be reported to the forecaster together with a priority in relation to all other projects for that district which had already been turned in. In most cases, the priority would simply be the next project in line, but occasionally there may be a need to jump a new project ahead of several preceding ones. The forecaster, in making new starts, would have to achieve some balance between the districts so that all new projects would not be started in one place to the exclusion of all others.

Admittedly this method has flaws. It is subject to the ability of the forecaster to find the best fit of projects to funds. It could be theoretically correct, but practically wrong in many respects. Some project priorities could be wrong and subject to changes for one reason or another. The speed at which actual projects pay out may not fit the historical pattern because of wet winters, contractors strikes, material shortages, etc. For these and other reasons, it is necessary to rerun the cash forecast at frequent intervals, and more important, to recognize that it is not infallible. If rerun once a month, there is every reason to believe that the near run accuracy of the method described should soon be very good, and the long run accuracy should be improved in time.

In order to begin a definite program to implement these suggestions, we recommend that the following steps be taken:

1) An analysis should be started of the cash payout history of contracts completed during recent years to develop typical payout curves for each common term of contract, for each type of work performed, for each highway system or for other classification factors which are found to be associated with payout characteristics.

2) Computer programming effort should be assigned to the task of writing programs to perform the detailed forecasting by project. A variety of programs are presently in use in other states. These should be reviewed and studied to determine which, if any, can be adapted.

3) Procedures should be further developed which will provide for data concerning contemplated new projects to be communicated at once to a central point in Austin. This would be in addition to the annual programs prepared by the districts. These procedures should include a method of priority assignment so that the districts can indicate the precedence desired when submitting new projects.

Full implementation of a cash forecasting plan requires a great deal of systems work. In addition, the merit of the undertaking will be in question until after all this work is done and a reasonable period of forecasting results can be examined and evaluated. The benefits would come after enough confidence has been developed to justify relying upon the balances forecast and thereby making earlier management decisions and carrying a smaller average cash balance.

The potential benefits outweigh the costs associated with development and testing of the plan. Informal and relatively undocumented cash management decision making practices now used are heavily dependent on the personal skills of the Administration. We feel that it is to the best long-term interest of the Department to reduce the degree of this depencency, and that these recommendations would be a move in that direction.

Cost Accounting

2. Cost Accounting

a. Sub-Systems of Input

1) General

The cost accounting system which is described in this section does not represent a complete change from the system presently in effect except in the method of processing input data, the level of detail information provided, and in the location where costs are recorded and accumulated. The recommended system contemplates the use of electronic data processing in Austin to process and summarize data which will be gathered from the various sources of physical activity throughout the State. These sources of activity are, in general terms, as follows:

a) Maintenance Section Headquarters
b) Residencies
c) District Warehouses and Shops
d) Construction Project Sites
e) Division Offices
f) District Offices

2) Central Processing by Computer

Costs will be accumulated in accounts maintained on magnetic tape by the computer in Austin, replacing the cost accounting ledgers now kept by hand in the district accounting offices. Summarization of data will be performed by the computer, and monthly print outs of cost status will be mailed back to the districts for analysis and management action. Duties of many district and division accounting personnel will be gradually changed from clerical functions to analytical functions. These persons will serve as interpreters of the reports and data returned to the districts from Austin. In addition, district and division accounting personnel will perform a key role in gathering, editing and controlling the source data submitted to Austin for machine processing.

The plan calls for district accounting office employees to continue to supervise the gathering of all accounting source documents, and to set up and maintain controls over such items as total payroll hours, equipment rental miles and hours, vendor payment dollars, contractor estimate quantities, etc. in the district offices. After editing and reviewing, all accounting source documents would be forwarded by mail or bus to Austin for conversion into machine processable punched cards, either through optical scanning and punching or manual key punching. Punched cards would be read into a small computer maintained by the Fiscal Management Division and would be written onto magnetic tape while control totals for balancing to the district accounting office controls would be developed simultaneously. At month-end, or more often as required, the magnetic tapes thus produced could be processed against master tape records of employees, equipment, contracts, vendors, etc. to produce payment

warrant writing media and distribution tapes for updating computer ledgers. The monthly billing to the BPR would be an important by-product of centrally printing out project ledgers for all projects under construction, and all sub-ledgers in which costs are accumulated.

3) Methods of Input for Data Processing

The recommended system of recording expenditures contemplates using paper forms as the basic source documents, and converting data from these forms to punched cards through one of two methods. In the case of employee and equipment payrolls, and issues of materials from stock (all high volume transactions) distribution cards could be imprinted, with optically scannable characters, by district personnel at various field offices using plastic plate imprinters similar to those commonly found in commercial automobile service stations. In the case of other transactions such as vendor payments, right-of-way payments, and cash receipts, copies of source documents could be mailed to Austin for key punching into cards by conventional manual key punch equipment, at least in the first operational phase of the system recommended. Further systems refinements at a later time can prove the desirability using the same plastic plate imprinters to eliminate manual key punching of almost all paper forms.

The advantages of the plastic plate imprinter method are:

a) Source coding is more accurate due to the entire code for a project, employee, or piece of equipment being pre-embossed into the plastic card. Transposition and code writing errors are virtually eliminated.

b) Key punching is reduced substantially at the central processing point. Conservative estimates state that the scanning punch equipment can perform the work of 20 key punchers working continuously and making no mistakes.

4) Reasons and Benefits

The principal reasons and benefits of centralizing the cost accounting procedures in Austin, and using a computer for processing data are to:

a) Increase accuracy of processing and speed the summarization process at month end through mechanization.

b) Increase source data accuracy through use of precoded input data.

c) Increase accuracy through the use of machine processing to check for erroneous codes and inconsistencies of codes.

d) Provide for further breakdown of data into finer classifications in spite of growth in the volume of transactions which occur.

e) Provide an opportunity for the analyzation of data and reports rather than simply processing and preparation of them.

f) Provide for a more consistent and uniform series of accounting reports which will be more sensitive to changes from external causes and less sensitive to changes caused by processing techniques.

g) Provide all of the above benefits at substantially the same or a reduced overall cost in spite of continuing growth of processing volumes.

5) Cost Benefits

The proposed system also has a benefit in its theoretically reduced overall cost. While it is difficult to accurately forecast the exact operating costs after conversion, we have made an estimate of the major elements of such costs in Exhibit II.A.2.a.-15. In addition we have prepared a schedule which attempts to compare present estimated costs to the estimated costs after conversion. (see Exhibit II.A.2.a.-16). This exhibit shows an estimated net savings of the recommended system over the present system of $1 million annually. Of course, we must immediately point out the danger of reading too much from such estimates. They are subject to wide variances in the degree of realization mainly in the area of personnel savings.

For example, we have shown in Exhibits II.A.2.a.-1 and 2 the approximate costs of present district and division personnel associated directly with accounting functions, and in Exhibit II.A.2.a.-15 our estimates of the required personnel to operate the recommended system. Our estimate of the required staffing for district accounting functions was based on the premise that at least 50% of the effort now expended in district accounting offices is directly spent on paperwork processing which the recommended procedures would handle mechanically. Other similar reasoning supports the remaining staffing estimates. We appreciate that the Department will not wish to realize these potential savings through drastic personnel changes. There exists every possibility that few, if any, direct personnel reductions will actually be made. What often occurs under such circumstances is that normal attrition of personnel (turnover) provides ample opportunity to reduce staff, but the requirements for new skills in other areas takes up all the slack, and recruiting remains critical.

A personnel savings, therefore, can be difficult to identify in practice with the change in systems. Without personnel savings, the recommended operating system can actually cost more than the present system, because of increases in machine rental and other costs.

Cost benefits are important, and we wish to handle this delicate matter in a straightforward manner by stating simply that we believe considerable potential savings exist in the recommended system.

6) Sub-Systems for Presentation

Since the accounting systems are presently divided into several distinct types of "payrolls" for processing, and since these payrolls will continue to maintain their present identity, they will be used to further describe and discuss the proposed system. Each of these payrolls will be presented separately with the suggested procedures outlined in detail. It should be understood that the detailed procedures are not intended to be restrictive, and that actual implemented procedures would be expected to vary considerably from those shown herein. For example, input forms should be subjected to a careful and exacting test and trial period in actual operation before installing them in all locations. Output reports should be tried and adjusted as indicated on a test or pilot district before complete installation.

For purposes of illustration the input forms have been designed around the format of one particular manufacturer's imprinter equipment. However, this in no way should be interpreted as an endorsement of or restriction to this type of machinery. There are several alternate and equally fine types of input imprinters which will work with several other types of optical scanning equipment, and these should all be examined in depth before placing any orders for equipment. The equipment shown is compatible with the optical scanner illustrated in the flow charts, however, and care should be taken to assure that compatible equipment is selected, to insure a complete operating system.

7) Employee Payrolls

a) Exception Principle for Gross Pay

The payroll system proposed is intended to use the exception principle to arrive at the gross pay of each person each pay period. This system operates very simply.

Nearly all employees earn substantially the same amount of money each pay period. Hourly workers are supposed to work a standard 45 hour week. Salaried workers are not paid for overtime and a variation in their pay is even more exceptional. The procedure is designed to provide a simple routine for reporting the people who do not work the regular amount of time, and to pay everyone else their regular amount. The exceptions only are handled by payroll clerks, and the computer generates the payroll warrant media for a standard amount unless instructed differently.

This method is used extensively by governmental bodies and many large industries for paying employees. It reduces the amount of calculations necessary, and makes the payroll much simpler to administer.

b) Time Reporting

Time reporting is still necessary however in order to distribute to the proper accounts the charges for payroll. But, in order to increase the speed of preparing the payroll warrants after the close of a pay period, the time reports can be balanced and entered into the computer system after the pay checks have been written. We propose to pay based upon attendance exceptions, and to use the time distribution which can be reported on a less urgent basis for making accounting entries to charge authorizations and project cost records. Any differences between paid time and distributed time will be evenly shared by the adjustment of the labor rate to be used when extending the hours distribution. The differences should be caught, however, through computer processing, and should be adjusted in the following accounting period. This procedure also should use a payroll clearing account. The gross pay of all employees should be charged to this account, and the payroll distribution of hours worked should be credited to this account. Any balance at the end of the fiscal year should be closed to surplus, and the account should be reopened for the following fiscal year. Inasmuch as the computer will be used to balance each employee's total hours worked to total hours distributed, and corrections will be made in the next payroll period, the balance in the payroll clearing account should be nominal.

For completeness, every employee of the Highway Department should be required to fill in and file some type of time report which shows what he was doing during the payroll accounting period. This should include everyone from common laborers to the State Highway Engineer. Of course, the top administrative and management level time reports could be filled in by the secretaries to these men. In many cases the distribution of payroll time could all be charged to a single account, and the completion of the payroll report form could be routine.

c) Payroll Period Cut-Offs

A major benefit of using this method is that it allows the payroll records to remain open until the payroll period actually closes. Under the present plan, the maintenance section clerks and residency clerks close their payrolls several days before the end of the official payroll period. They do this because they and the district accounting staff need several days to manually process the payroll data. Any changes in attendance which occur in the field are supposed to be telephoned into the district accounting office before the payroll is sent to Austin. Any changes in payroll distribution also are supposed to be reported, but what can actually happen is that attendance changes are reported but changes in the distribution are not. This creates an inaccuracy in the payroll distribution.

Under the new system, all payrolls could be kept open at the source point until after the payroll period is terminated. Then the Payroll Attendance Register could be closed and forwarded to Austin through the district accounting office on the day following the end of the period. Since manual processing would not be required, the district accounting office could send the attendance report on to Austin the same day. In Austin, only the items marked as exceptions would need to be key punched. These exceptions, in punched card form could be passed against a master tape containing all employees and their regular pay. The regular pay could be printed out and simultaneously written onto a tape or punched into cards for use by the State Controller's Office unless one of the exception cards instructed the computer to increase or decrease (or delete) the regular pay. The State Controller would receive the payroll data for each employee in tape or card form, and could use this to immediately write payroll warrants, assuming that certain clerical steps in the State Controller's Office could also be automated to take advantage of computer capability.

All of this process should take only two or three days, not having been started until the close of the payroll period. This should mean that warrants could be on their way back to the districts for distribution to the employees by the fourth working day after the close of the payroll period. In order to assure that employees would always receive their pay on the same day of the month, several additional days should be allowed for holidays and weekends before determining the exact pay dates.

d) Advantages

The exception payroll principle is sometimes dismissed when considering its use for hourly employees because hourly people work more variable numbers of hours and more exceptions are created. However, the exception type payroll does not require more work for these people than would the conventional type which requires the reporting of hours for every employee. The important advantage of the exception payroll is that it allows a minimum amount of reporting in the case where most employees work the standard length of time. If a large number of people do not work the standard number of hours, no more work is required to report this fact than would be necessary under the conventional system.

e) Master Payroll Data

In addition to carrying the earnings record for each employee, the master payroll tape should also be programmed to carry certain personnel data on each employee. For example, the status of each employee's sick leave, compensatory time, and vacation time should be a part of the master payroll record. It would no longer be necessary for this information to be posted and kept by district accounting personnel. Instead, it could be printed out in each Payroll Attendance Register, and could be available for reference in the field at any time. If a person wanted to know the status of his sick leave, for instance, he need simply call the payroll clerk responsible for his records and ask. The payroll

clerk could look up the person's name on the latest Payroll Attendance Register and read from it the latest status of that employee's sick leave.

Also, a part of the master payroll record should include the employee's State classification code. This will allow payroll analysis to be run on the computer by employee within the division, and also show the State classification within the division. Such information can be useful when preparing budgets and other data for presentation to the State classification office.

The master payroll record should carry a code for each employee to indicate whether or not the employee is eligible to perform work which can be classed as participating in Federal aid reimbursement. In other words, some levels of administrative management are, by the very nature of their positions, not eligible for making labor charges to Federal aid projects which the Bureau of Public Roads may consider reimbursable. Such employees should be so identified on their master payroll records that even if they make charges to Federal aid projects, the computer, through its program, will override such charges and classify them as "non-participating". This delineation will require a careful inspection of all employee duties to determine whether or not the employee can possibly be eligible for making charges to Federal aid projects.

A suggested master payroll file is shown in Exhibit II.A.2.a.-3.

f) Hourly Payroll

Almost all hourly employees are employed in the maintenance activities of the Highway Department. Each maintenance section location presently has an employee who performs the activities of the "clerk of the works". Under the proposed system, each maintenance section would have one plastic plate imprinting machine which can imprint two plastic plates plus seven digits of variable (lever set) data onto an 80 column card set (original tissue plus one card weight copy). For each employee, there would be prepared a plastic plate embossed with his name and employee number (social security number). In addition there would be prepared a series of plastic plates, one for each section of roadway maintained by the group of men working in the maintenance section. There would also be a few extra plates for the categories of indirect work such as sick leave, vacation, compensatory time off, cleaning up the warehouse, etc. All these plates would be precoded with the proper accounting codes (in embossed numbers) so that when imprinted the codes would properly classify charges to roadway sections and indirect accounts.

The men would continue to fill in gang type time reports as at present after work. The foreman would examine and approve these time reports, and pass them along with the clerk the next morning. The clerk would prepare the card sets using the plastic card imprinter. He would choose the plastic plate corresponding to the employee, and another corresponding to the roadway section on which the employee had worked, and set these two plates into

the imprinter. Then he would lever set the function code which describes the type of work performed on the roadway, and also lever set the number of hours worked by the man. With these data set up in the imprinter, the clerk would insert a set of forms into the imprinter, close the platen, and print all the data from the plastic cards and the levers onto the card form set. This action would closely resemble the work done at a gasoline station when the attendant records a credit card purchase. (See Exhibit II.A.2.a.-4).

After the clerk had made card sets for all the time worked the previous day, he would run adding machine tapes of the hours recorded on the card sets and balance these to the hours reported on the time reports. The exceptions to standard hours would be posted by hand to the Payroll Attendance Register. This would be a form supplied by the Austin computer center each pay period for posting attendance exceptions by employee. (See Step 1, Exhibit II.A.2.a.-5).

At the end of the payroll period, the clerk would total the number of hours on the Payroll Attendance Register, record the total, and submit the Payroll Attendance Register to the district accounting office. There it would be reviewed, and mailed to Austin for preparation of the employee payroll checks (See Step 4, Exhibit II.A.2.a.-5).

The punched card sets, meanwhile, would be sent to Austin on a weekly basis directly from the maintenance section warehouse in preaddressed and postage paid envelopes. The total hours for each batch of cards would be carried on a batch control card set, also prepared on the plastic card imprinter, so that the cards can be controlled in terms of total hours at the computer center. When received in Austin, the card sets would be passed through an optical scanning punch which would simply convert the printed numerals on the face of the cards into punched holes in the same cards. Certain edit steps also would be performed mechanically to see that the proper numbers were punched into the card sets. Any cards failing to punch, for any reason, would be stacked in a separate output hopper, and would be keypunched by referencing the original time reports which would have been sent to Austin along with the batch of punched cards. (See Step 2, Exhibit II.A.2.a.-5).

After all cards were punched, either by the scanning punch, or manually, they would be sorted together according to the employee number and run against the employee master tape on the computer for the purpose of extending hours times standard rate for each employee, and to balance the number of hours distributed to the number of hours paid for each employee. (See Step 3, Exhibit II.A.2.a.-5).

g) Hourly Payroll Volumes

Assuming there are 9,500 hourly employees (including mower operators, etc.) who are paid twice each month, there would be 19,000 warrants to write for these employees. Assuming in any payroll period that 50% of the employees would work unusual hours (non-standard) this would require 9,500 exception cards per month to be key-punched. Assume these cards would be punched as follows:

Number of digits:	
SS#	9
Hours	2
District -	duplicate
Section -	duplicate
	11 x 9,500 = 104,500 KS

at 5,000 KS/hr. = 20.9 hrs. of keypunching per mo.

Distribution cards for these employees would be prepared daily using plastic embossed cards. Assuming 2 cards per man per day, there would be 19,000 distribution cards per day to be processed. If these were mailed or sent by bus to Austin once a week for processing, a schedule could be worked out whereby <u>five</u> districts sent their cards on Mondays, <u>five</u> on Tuesdays, etc., to effectively level the workload in Austin. Assuming this was done, and that the effective reading speed of the scanning punch was 150 cards per minute (actual speed is 180 cards per minute regardless of the number of digits punched), there would be 19,000 cards per day ÷ 150 cards per minute or 127 minutes per day required to scan and punch the hourly distribution cards (2.2 hours daily). If 11% of the cards read were rejects and required subsequent key punching, the necessary key punch time would be as follows:

19,000 x 11% = 2,090 cards per day

Number of digits:	
SS#	9
Acct. code	11
Hours	2
	22 x 2,090 = 45,980 KS

at 5,000 KS/hr. = 9.2 hrs. of keypunching per day.

After all cards were punched, they would be card sorted to employee number sequence within district and read by the small computer onto magnetic tape. If 5 tapes were used for this process; one for each day of the week; these tapes would be updated 4 times per month, and would become progressively larger. At month-end the five daily tapes would be combined on the large computer. Daily processing time on the small computer will be assumed to be at an effective speed of half the card reader's rated speed of 800 CPM or 400 CPM for all passes. If this is achieved, the daily processing time can be computed at 19,000 ÷ 400 or 47 minutes (.9 hours) daily to read these transactions onto tape (already sorted by

account within district). (See Exhibit II.A.2.a.-6 under Employee Payrolls - Hourly for a summation of these calculations).

h) Salaried Payroll

Salaried employees include non-maintenance personnel in the districts (construction and administrative forces) and almost all division personnel in Austin.

Salaried personnel in the districts who work for the residency organizations would continue to prepare monthly time reports which should be redesigned to provide space for coding accounts according to the recommended revised chart of accounts. Each residency or other organizational subdivision such as Austin divisions would use a copy of the Payroll Attendance Register on which to record by hand all exceptions and changes to the regular pay of each employee. This register would be closed after the end of the month and forwarded to Austin via the district accounting office for use in preparing the employees' payroll checks. (See Step 4, Exhibit II.A.2.a.-5).

Shortly after the end of the month, the residency clerk or the designated payroll clerk in the division offices would prepare imprinted cards from the monthly time reports using a plastic plate imprinter. Plastic plates would be prepared for each employee embossed with his name and payroll (social security) number. In addition there would be plastic plates embossed with the description and proper account codes for each construction project and for certain indirect accounts such as vacation, sick leave, stand by time, etc. The payroll clerk would insert these cards into the imprinter, and lever set the number of hours worked and the function code indicating the type of work performed. In addition the clerk would set one lever to indicate whether the charge was participating or non-participating for Federal aid reimbursement. (See Exhibit II.A.2.a.-7 for a sample salaried distribution card).

The cards would be totaled as to hours and balanced to the total hours shown on the time reports. Then the time reports and cards would be sent to Austin for entry into central computer system in a manner similar to that used for hourly paid employees. (See Steps 2, 3, and 4, Exhibit II.A.2.a.-5).

In some cases it would be possible for a residency clerk to share the plastic card imprinter with the clerk of the adjoining maintenance section headquarters. Both offices could use the same machine at different times. The same imprinters would also be used to record material issues and equipment rental accounting entries using similar techniques to be described.

In Austin, plastic plate imprinters would be used in the division offices to record the payroll distribution of those employees who worked on many projects and required more than one accounting distribution. However, most employees in Austin could have their payroll distribution charges generated from the payroll master tape (See Exhibit II.A.2.a.-3, Division-Budget Code).

i) Salaried Payroll Volumes

Assuming there are 9,500 salaried employees who are paid once a month, there would be 9,500 warrants to write for these employees. Assuming in any payroll period that 20% of these employees would work unusual or non-standard hours this would require keypunching 1,900 exception cards per month. Assume these cards would be punched as follows:

Number of digits:	
SS#	9
Hours	2
District	duplicate
Section	duplicate
	11 x 1,900 = 20,900 KS

at 5,000 KS/hr. = 4.1 hrs. of keypunching per mo.

Distribution cards for these employees would be prepared using plastic embossed cards for field employees, and by computer from a master payroll tape for most Austin office personnel. Approximately 20% of salaried employees would have fixed distribution stored on the master tape. Assuming an average of 5 distribution accounts each month for 80% of the salaried employees, to be processed by the scanning punch, the load in time on this equipment each month is computed as follows:

9,500 x 5 x .80 = 38,000 cards

at an effective speed of 150 CPM, conversion of these cards would require 4½ hours once each month.

If 11% of these cards were rejects, the necessary keypunch time required to manually convert these would be:

38,000 x 11% = 4,180 cards

Number of digits:	
SS#	9
Acct. code	11
Hours	2
	22 x 4,180 = 91,960 KS

at 5,000 KS/hr. = 18.4 hours of keypunching per mo.

After all cards were punched, they would be read onto magnetic tape in random order and would then be tape sorted to employee number on the large computer. Reading time at 400 CPM would be 1.5 hrs./month.

See Exhibit II.A.2.a.-6 under Employee Payrolls - Salaried for a summarization of this data.

8) Issues of Materials from Warehouses

a) System of Data Collection

Almost all materials purchased are charged to the district stock account. When used, the material is credited to the stock account and charged out to the roadway control and section number, or to a construction project, or to a specific equipment number through the use of a meterial issue slip prepared by the warehouseman and signed by him and the employee receiving the goods. Under the proposed system, issues of material from district or maintenance warehouses also would be recorded using plastic plate recorders. Basically the same type of card form would be used. The cards would contain spaces on their face to hand write perhaps a half dozen lines or items all of which would be charged to a single accounting code. The line items would be individually priced and extended, and total dollar amount of the tab card would be hand calculated on the face of the card set. Then the appropriate plastic plates would be pulled and inserted in the recorder. Object code, function code, participating/nonparticipating code, and total amount would be lever set. (See Exhibit II.A.2.a.-8).

Charges to equipment would continue to be posted on separate equipment forms, and these would be hand summarized at month end, and the summaries would be transferred onto scannable cards for each category of equipment expense (See Exhibit II.A.2.a.-9).

Computer preparation of perpetual inventory records for district or maintenance section stocks is not contemplated. The individual issue items, hand written on the face of the issue card sets, would be posted to stock cards manually as at present.

Issues from the general warehouses at Post, Athens, and Seguin are now summarized on a computer prepared distribution which results from processing by-product punched paper tape produced when issue (warehouse transfer) forms are typed in the general warehouses. This distribution and/or punched cards with the summary data therein would be sent to central computer for entry into the accounting system.

b) Warehouse Issue Volumes

If 4 issue forms are prepared for each line item on the warehouse stock distribution summaries at present, the total number of stock issue transactions can be estimated as follows:

41,000 line items x 4 = 164,000 cards per month.

These cards would be sent in weekly batches from the districts on a staggered basis (as for employee payrolls) to level the Austin workload. Therefore the daily load on the scanning punch would be as follows:

7,450 ÷ 150 = 1 hr./day

Assuming an 11% rejection rate, the key punch load can be computed as follows:

7,450 x 11% = 820 cards per day

Number of digits:

Account	11
Amount	5
Other data	4
	20 x 820 = 16,400 KS/day

assuming 5,000 KS/hr. = 3.2 hrs. of keypunching daily.

For warehouse charges to equipment, if we assume an average of 4 distribution cards per piece (many will have none), there will be 15,000 x 4 = 60,000 charge cards per month. If these cards are scanned, the monthly load on scanner and keypunch is computed as follows:

60,000 ÷ 150 CPM = 6⅔ hrs./mo.

11% x 60,000 = 6,600 rejects/mo.

Number of digits:

Equipment	# 5
Account data	5
Amount	5
	15 x 6,600 = 99,000 KS

at 5,000 KS/hr. this would require 19.8 hours of keypunching per month. (See Exhibit II.A.2.a.-6 for a summarization of this data).

9) Equipment Rental Payroll

a) System of Data Collection

Maintenance employees would report the use of highway equipment by completing equipment rental reports on each piece of equipment as at present. These reports would be used by the maintenance section headquarters clerk to prepare imprinted distribution cards using the plastic plate recorder. (See Exhibit II.A.2.a.-10).

Instead of a man's plastic plate being inserted in the recorder, the equipment's plastic plate would be used together with the control-section plastic plate and lever settings to indicate the function code and hours or miles of use. All data would be imprinted in machine and human sensible form in one pass of the recorder platen. The clerk would prepare cards for static, monthly, or non-operator equipment used, would edit all cards, and would establish hour and miles control totals for transmittal to the district office with the cards. (See Exhibit II.A.2.a.-11).

Cards would be batched at the district office and sent by bus or mail to Austin for optical scanning and automatic entry into the central computer system.

Salaried employees, or those involved with construction activities would continue to prepare the present equipment report form which stays with the equipment and has space for eight separate days or users of the equipment. As the forms are filled, and at the end of the month, the forms will be sent to the residency or district office for the preparation of distribution card sets using the plastic plate recorder with a plastic plate for each piece of equipment and for each project, IPE, or authorization to be charged.

In Austin, the distribution cards would be converted to punched cards and then to magnetic tape. The magnetic tape would be used to update separate usage accounts maintained for each piece of equipment, and then extended times the particular piece of equipment's rental rate to post charges to cost account records and budget accounts. (See Exhibit II.A.2.a.-12).

b) Equipment Rental Payroll Volumes

Assuming 15,000 pieces of equipment and an average of one distribution per piece per day, there would be 15,000 x 22 = 330,000 distribution cards per month. If the distribution reports were transcribed onto cards using the plastic card imprinters and sent to Austin for conversion weekly (again on a staggered daily schedule), the daily workload would be computed as follows:

15,000 ÷ 150 = 1.75 hours/day to convert cards on the scanning punch.

If 11% of the cards read were rejects, manual keypunching on a daily basis would be required as follows:

15,000 x 11% = 1,650 cards/day

Number of digits:

Equipment #	5
Account code	11
Hours	2
	18 x 1,650 = 29,700 KS/day

assuming 5,000 KS/hr. this would require 5.9 hours of keypunching daily.

The monthly credits to rental accounts for each piece of equipment would be made by summarizing the distribution charges for each active piece of equipment. For inactive equipment, a single distribution card would be prepared by the computer program for the minimum time, charging the minimum time to a clearing account for further allocation to active projects. (See Exhibit II.A.2.a.-6 for a summarization of this data under Equipment Payrolls).

10) Contractor Payments

a) System Description

At present, separate cards are punched for each bid item for each bidder. These cards are used on "letting" day for computing the low bidder on each project. Under the proposed system, this procedure would be continued except the bid item cards of the successful bidder would be read onto magnetic tape, and would constitute a master file for use in machine computing the amount due to each contractor monthly. This would be performed by having each project engineer submit to Austin an estimate form containing the total quantity of completed work at month-end. This estimate form would be preprinted by the computer each month, and would show the quantity of each item paid for through the end of the preceding month. In Austin, only the items which changed would be keypunched into cards, and these cards would be used to extend and complete the contractor's estimate for payment for the current month based on work done, and to prepare warrant writing cards for the State Controller. Charge distributions would also be prepared for subsequent posting to project ledgers on the computer, and a tape would be written for use in updating the monthly cash forecast for actual project payments. (See Exhibit II.A.2.a.-13).

b) Volumes of Contractor Payments

Approximately 600 contractor estimate vouchers are prepared each month. If 2 distribution cards are keypunched for each voucher, this means 1,200 distribution cards must be prepared each month under present procedures. However, if work item counts are used to compute centrally the amount of the contractor's estimate, then a card must be punched for each change in work done during the month. Assuming an average of 30 work items per estimate per month requiring keypunching, then the monthly keypunch load can be computed as follows:

600 x 30 = 18,000 cards

Number of digits:

Work code	4
Quantity	5
Descriptive data	6
	15 x 18,000 = 270,000 KS

assuming 5,000 KS/hr. = 54 hours of keypunching per month.

In addition, new contractor master cards must be punched. This will require an estimated 5 hours per month. (This data is summarized in Exhibit II.A.2.a.-6 under the caption Contractor Estimates).

11) Material and Supply Payroll

a) System of Data Collection

The Material and Supply Payroll represents payments to outsiders such as material vendors, utilities, suppliers, and employees for travel expenses.

In the proposed system, employees would continue to prepare travel expense reports as at present (modified only to accomodate changes in account coding). These vouchers when properly reviewed and approved in the originating organizational unit would be forwarded to Austin for payment. In Austin the vouchers would be checked for coding and would be keypunched and key verified into distribution cards showing the employee's number, account codes and amount. Documents would be forwarded to the State Comptroller's office together with a computer tape or cards suitable for writing the expense warrants. The distribution cards would enter the central computer system as direct charges to expenditure and budget accounts. The analysis of travel expense presently prepared manually by the districts could be generated by the computer and sent to the District Engineers.

Present purchasing procedures and forms are planned to remain substantially unchanged, except for modifications in code blocks to fit the recommended account coding. Vendor codes would be placed on all payments for computer preparation of vendor payment indexes periodically, and to facilitate the computer preparation of warrants by the State Comptroller. Batches of approved requisitions, invoices and statements would be sent to Austin as soon after receipt as the district accounting offices could prepare the necessary paper work. After review, edit, and vendor coding the documents would be keypunched into vendor payment and distribution cards. A vendor payment tape, containing the full vendor name would be sent to the State Comptroller, together with supporting documents (after clearing the State Board of Control as required). Distribution cards would be sorted to account and project code, and would be used to update project ledgers where direct charges were made, or to make charges to stock accounts. (See Exhibit II.A.2.a.-14).

b) Material and Supply Payroll Volumes

Assume that a voucher numbering system similar to the present system is retained for referencing such payments to permanent files. Assume additionally a vendor number assignment is made centrally. There are about 12,500 material and supply warrants written per month for the Department by the State Comptroller. Samples showed that, at present, there are about 1.7 invoices per warrant, and about 2.4 account distributions per warrant. Assuming the same ratio of invoices to warrants, but 3 account distributions per warrant (because of a slightly more detailed account structure) the projected card volumes would be as follows:

1 card per invoice = 12,500 x 1.7 = 21,250 cards per month ÷ 22 days = 966 cards/day. Assume the following data in each card:

Vendor code	6
Vendor name (in 20% of cards 25 digits x .20)	5
Payment type codes	4
Due date	6
Amount	7
Discount percentage	3
Voucher number	6
	37 digits x 966 cards = 35,742 KS ÷ 5,000

KS/hr = 7.2 hours per day keypunching.

For distribution, assuming 3 distributions per warrant, volume is computed as follows:

12,500 x 3 = 37,500 cards/mo. ÷ 22 days = 1,700 cards/day

Assume the following data in each card:

duplicate vendor code, payment type, date and voucher number.

Account code	15
Amount	7
	22 digits x 1,700 cards = 37,400 KS/day ÷ 5,000 KS/hr. = 7.6 hrs/day.

Under this plan, vendors' invoices and all expense vouchers would be passed into Austin for payment on a daily basis, so volumes may be assumed to be fairly level with only a slight increase once monthly for month-end billings from certain vendors such as utilities and other regular suppliers. (See Exhibit II.A.2.a.-6 under caption Material and Supply Payrolls for a summarization of this data).

12) Payments to Property Owners for Right of Way

Payments to property owners for right of way are planned to continue to be paid through the material and supply payroll procedures after receiving special review and clearances from the Right of Way Division.

Because of the necessity for careful legal examination of support for vouchers submitted to the Austin office for payments for right-of-way, these vouchers would be keypunched centrally. Coding of the vouchers would be entered manually by district personnel, and would be checked and edited carefully once in Austin before being keypunched. Entries into the central computer system would generate warrant writing media for use by the State Comptroller's office in actual printing of the warrant. In addition a distribution charge tape would be used to post the payments to project cost records by parcel number (function code) and object of expenditure within each parcel.

In order to maintain control over the amount of funds being obligated by district right-of-way buyers, approved appraisals or recommended values could be processed immediately when received in Austin and set up as "passed for payment" charges to the project ledgers and as payables prior to the detailed examination, review, and checking of support for the payment voucher. This will provide districts more current information on whether additional spending authority needs to be secured to complete buying right-of-way for a project, and should lessen the need for memo records on right-of-way spending by project in the district right-of-way office.

Volume of payments for right-of-way are included in the volume calculations of the Material and Supply Payrolls.

13) Cash Receipts

Motor Vehicle cashiering would be routinely handled on the small computer. Daily receipts from tax assessor-collectors would be keypunched into accounting cards. Each week the tax assessors would be billed and sent statements of their account with the State. Estimated volume is 8,000 daily cards which would be keypunched with an average of 20 digits each. Keypunch time is calculated as follows:

8,000 x 20 = 160,000 KS/day

160,000 ÷ 5,000 KS/hr. = 32 hrs. of keypunching per day.

All other cashiering, such as permit accounting would require an estimated 400 cards/day.

14) General Journal Entries

General Journal entries would require an estimated 1,000 cards per month which would be keypunched from journal entry forms, properly signed and authorized in Austin.

15) Transaction Volumes

Each of the types of transactions has been discussed in detail together with a calculation of the estimated volumes to be handled. These volume calculations have been summarized in Exhibit II.A.2.a.-6.

Based upon the volumes shown the times calculated in each section, 68.2 hours of daily keypunch time and 128.2 hours of monthly keypunch time will be needed. On a daily basis, this is equivalent to 9 keypunches. At month end, this is equivalent to about 5 keypunches working for 3 eight hour days. Therefore, approximately 14 keypunches would be needed in the Fiscal Management Division at the end of the month, and 9 would be needed full time during the month. The 5 extra keypunches could be used for other work on all days except the month-end three day period.

Exhibit II.A.2.a.-6 shows that about 5 hours of scan punch time will be needed daily to convert the imprinted card sets to punched cards. At the end of the month, about 11 more hours will be needed to handle the peak load. Because there are 3 extra hours available each day, relatively little, if any, extra shift time will be required for the scan punch at month-end, assuming that the 11 month-end hours can be stretched out over a four day period.

Exhibit II.A.2.a.-6 also shows that the small computer which is recommended for the Fiscal Management Division will require about 3.4 hours per day to handle the routine task of reading cards on to magnetic tape, and creating balance totals. At month-end, an extra 28.5 hours will be needed. If the month-end work is to be compressed into no more than a four day period, then it may be necessary for the small computer to work some second shift time at month-end.

We believe these time estimates are conservative in most respects. In practice, many unforeseen events occur which cause times to run higher than estimates, and it is usually wise to allow liberal tolerances when computing machine run times. Keypunch estimates are usually more reliable. In any event the proposed equipment should be able to handle the work loads as shown with enough spare time for many other operations which are either now being performed by the tabulating shops, or are contemplated. We feel that further efforts to project exact timings would be academic at best, and subject to a great deal of speculation especially with regard to computer run times which depend upon programming efficiency.

b. Processing

We have been concerned in our study more with the design of a structural system for gathering information and presenting it in a useful manner for management purposes, than with the mechanics of data processing. However, certain gross processing steps and methods cannot be overlooked. For example, after some consideration, we believe that conventional batch processing of the Department's accounting transactions will better serve the Department's overall needs than will random access processing.

The batch processing concept implies that all transactions which occur during an accounting period, or month, are processed in one batch at the end of the month to update and report all account balances. Typically, current transaction data are gathered during the month and recorded on punched cards or magnetic tape files. The alternate concept, random access processing, implies that account balances are to be updated "at random" as soon as the transactions and events are converted to machine language. Transactions are processed continuously all during the month.

Our observations of the Department's needs indicate that the less expensive "batch" approach to business data processing is adequate, and that random access cannot be justified economically at the present time for this work. With few exceptions the Department has operated with a monthly cycle of ledger balances and cost-budget status reports.

The Department's two largest expenditure transaction types, contractor earnings and salaried employee earnings are recorded on source documents generated only on a monthly cycle. Other types of transactions are now entered on the books from district distribution vouchers prepared monthly and received in Austin from the fourth to not later than

the fifteenth of the following month. The exceptions, where interim balances are needed, are the daily cash balance, Interstate right of way project balances, and maintenance budgets during the final month of the fiscal year. In some cases daily maintenance section expenditures are needed. These and other minor needs for interim balances can be met as they now are, by maintaining selective memo records manually, or by making interim updating runs on the computer for selected accounts and transactions, such as for right of way project balances.

Field personnel expressed a need for cost and budget status data more promptly following the close of the month. This need will continue and will generate pressure to further shorten the time for processing.

The flow chart shown in Exhibit II.A.2.b.-1 is an overall general plan of the data processing steps required to prepare the output reports described in the next section.

Page one of the exhibit represents the gathering and editing of input transactions. The sub-systems of field input, discussed in the preceding section, are generalized on the left at the top, and other central office inputs, also discussed more briefly in the preceding section, are shown on the right at the top. Transactions would generally be converted to machine language, that is magnetic tape, on a daily basis either through scan-punched cards or keypunched cards.

Page two of Exhibit II.A.2.b.-1 depicts the monthly processing of general ledger, expenditure detail ledgers, middle management expenditure reports, budget status reports and summary trial balance.

Page three of Exhibit II.A.2.b.-1 shows, in a little more detail, the production of outputs for the Federal aid current bill. The upper portion of this page is also a generalized input conversion of other data needed for automatic preparation of the current bill such as project agreement data, audit citation data, etc.

It should be pointed out that detailed computer runs or passes would not necessarily follow the ones shown; there may be more or fewer separate runs required. With the type of computer recommended, the monthly processing should be almost entirely automatic under the control of an "executive routine". This means simply that batch processing passes would proceed from one run to the next without computer operator intervention. Control of an entire series of runs would be monitored by an internally stored program which would do such tasks as rewinding tapes, shifting output tapes to an output channel for printing, and calling for new master files to be placed on the system through console messages. This capability should materially speed the time required for the monthly batch processing of accounting data on the large computer at Camp Hubbard. Additionally, it will substantially reduce the opportunity for operator errors, and increase the chances for balancing computer outputs to pre-established controls.

Although we have generally treated all daily processing as small computer work, and all other processing as monthly work for the large machine, needs may arise for semiweekly, weekly or biweekly processing on the large computer. The frequency of preprocessing certain files, such as raw input file sorting and merging, cannot be accurately forecast until implementation is underway and some further study is made. However, the large third generation computer to be located at Camp Hubbard (described in section II.C.) would be available on a second shift basis at any time for such work, and scheduling of such tasks should not present a serious problem.

c. Output

We have prepared several samples of the output reports and ledgers which the proposed system would produce. These samples are illustrative only, and should not be considered as more than preliminary designs which would require refinement. However, the principles, such as printing cross reference data, are shown to give an idea of what can be expected. Output forms designs are seldom static for very long, except when concerned with basic ledgers and journals. As management needs change, the form and content of reports also should change. Special purpose reports can be developed to answer specific one time questions from available data through the use of computer "report generator" programs. These are relatively inefficient running but easily written programs which are prepared in a short time, perhaps less than one day, to process previously recorded data in a new and different way to answer a single request. If the need continues on a regular basis, then a more efficient program can be written, and systems modifications made to produce the desired data by alternate means.

The output reports selected for illustration are as follows:

1) Expenditure Detail Ledgers

Exhibit II.A.2.c.-1 is a blank Expenditure Ledger form. This one form is intended to serve not only for detail ledger listings, but also for higher levels of summary reporting. It also will function in a dual capacity as project ledger and budget ledger. The columns headed "Expenditures This Month" and "Expenditures to Date" are intended to contain dollars and man-hours used in the month being reported and since the beginning of either the project or the fiscal year depending on whether the form is being used for a project or budget ledger.

The account and name columns near the left margin are used to identify budget accounts or projects to which the amounts, hours, and percentages apply.

The columns headed "Transaction Reference" are applicable only when the form is being used for a detailed transaction listing as shown in Exhibit II.A.2.c.-2. Such a detailed transaction listing for a month is here referred to as an "Expenditure Detail Ledger." The first page of this exhibit starts with District 02, and IPE number 101 which is the immediate responsibility of manager number 20. Within manager 20, each function account (310-route location studies; 320-locate and determine r.o.w. requirements, etc.) is listed in numeric order. Within each function, the various object of expenditure accounts are listed in number sequence. Each of the month's individual expenditure transactions is printed within the object accounts. The transactions are described by transaction reference codes as to charging district, kind of transaction, document serial number, man or equipment number, state group and class codes, and entry month. Totals are shown for each object account (one asterisk), for each function account (two asterisks), and for each IPE authorization (three asterisks). Man-hour completion percentages are calculated and printed for each function and for the entire IPE authorization. The dollars completion percentages are not applicable (na), based on the assumption that only man-hours would be planned at the function level. Man-hour percentage reflects the percentage that actual hours used are to the planned hours required for this function.

All expenditures of the Department would be printed out on this type of Expenditure Detail Ledger, in duplicate. The copies would be sent to the responsible districts and divisions and the original would remain in the Fiscal Management Division. Summary reports prepared from the same transactions that are in the Expenditure Detail Ledgers would be more compact and probably would be used more extensively. However, the Expenditure Detail Ledgers would be referred to for the following purposes:

a) It will be possible to start at the Expenditure Detail Ledger and trace all transactions from there backward in the system to the underlying vouchers and file support. This will facilitate in-depth audit examinations which may be made. In addition, samples may be selected from the transactions to test the operating effective and validity of coding and classifying procedures.

Because each applicable transaction will be coded as to participating and nonparticipating classification for current billing to the Bureau of Public Roads, the Department's basic ledgers will support these billings.

b) Engineers and managers will be able to find a more complete explanation of the nature of the charges made to cost accounts for which they are responsible, and which are reported to them in summary.

The preparation and distribution of the Expenditure Detail Ledgers should focus more attention on conscientiously charging expenditures to the proper account. Source document coding and the resulting detail ledger balances will be exposed to more people as well as to computer processing. It can be expected that these circumstances will encourage care and propriety in initial transaction recording and thereby will have many beneficial consequences. The Department's personnel should learn to make more use of cost accounting information when they develop confidence in the reliability of initial recording.

2) Middle Management Cost Reports

Exhibit II.A.2.c.-3 illustrates the same form used to show only totals of object, function, and authorization accounts. This printout is in sequence by manager number so that all the expenditure authorizations and projects assigned to one manager, such as a resident engineer or maintenance foreman, will be grouped and printed together. This report does not show detailed transactions for the month, but otherwise reflects all the information on the Expenditure Detail Ledger. The report will be distributed through division and district channels to the responsible middle management personnel. A copy will be provided to the districts or divisions and the original will be retained in the Fiscal Management Division for reference use. The middle management cost reports are intended to serve the following purposes:

a) Managers will be able to review the status of the budget as it relates to their operations without "keeping books." They can do this by reviewing an official and compact excerpt of the Department's accounting records.

b) This same data also will be available for review by district and division level executives, and others, who may need to look at expenditure rates of subordinates at the function and object account level.

3) Budget Status Reports

Exhibit II.A.2.c.-4 is the same form used as a status report. It is similar to the "Monthly Report on Status of Authorizations" presently prepared in the districts from manually posted ledgers (See Exhibit II.A.1.c.-16). However, current month expenditures and completion percentages are shown on the new form in addition to expenditures to date and budget balance shown on the old form. This report will be prepared for all budgets, and distributed to the responsible district and division executives, and to administrative officials. This report in effect summarizes the account balances shown on the two expenditure output forms discussed immediately above, and will inform each district and division executive monthly as his overall budget condition.

The expenditure ledgers and status reports described and illustrated would be basic products of the accounting system and would replace the authorization and project ledgers presently being maintained throughout the Department. Although these outputs have a great deal of merit in terms of economy, auditability, detail documentation, and reporting facility, there is typically some objection to the inherent characteristic that ledgers are period separated. In other words, a twenty-four month project would be in 24 monthly parts each showing one month's transactions and new balances. This is now a rather universally accepted characteristic of computerized accounting. The monthly ledger runs can, if necessary, be separated and manually filed into binders by project, so that the entire history of a project may be found in one place to facilitate study or review. This procedure is not necessarily impractical, but is seldom used. Ordinarily monthly printouts are bound and filed intact.

The next level of expenditure summarization will be the financial statements of the Department which reflect the unexpended balances of groups of budget accounts and construction accounts by fund, plus the balances of asset, resource, liability, and surplus accounts.

4) Project Status Reports

The Department now prepares monthly five reports which are illustrated and described as to content, format, and method of preparation as follows:

a) Refer to Exhibit II.A.2.c.-5. This is page 1 of the April, 1965, "Construction Report" which is printed monthly from offset masters typed in the Construction Division. It shows various data concerning construction contracts in process by district and county. Work days used and estimated cost amounts come to the Construction Division on special monthly estimate forms and on resident engineer's monthly contractor time statement.

b) Refer to Exhibit II.A.2.c.-6. This is a page from the "Status of Maintenance Operations Projects" report which is reproduced monthly from offset masters printed on the computer. The Maintenance Operations Division receives each month a typed listing from each district showing all maintenance operations projects (refer to Exhibit II.A.1.c.-20). Changed data items from these typed district reports, plus completions of old projects, and new projects are all edited by the Maintenance Operations Division and sent to the computer center for automatic file updating on the computer prior to each monthly printing. This report is distributed to all districts and interested divisions.

c) Refer to Exhibit II.A.2.c.-8. This is page 1 of the September, 1965, "Status of Interstate Projects" report which is reproduced monthly from computer printed offset masters. This report includes all Interstate projects programmed by the State Highway Commission as well as the unprogrammed, or advance planning projects on the Interstate system.

d) Two other reports contain comparable data on non-Interstate programmed construction projects, and non-Interstate advance planning projects. The latter are projects on which planning is authorized, but construction money has not been earmarked. The Highway Design Division coordinates the preparation of the last three reports. Printouts of the data in each report are sent to the districts each month in county, highway number, and IPE number order. The districts mark all changes in completion percentages and dates, and other remarks on this form and return it to the Highway Design Division. The changes are transcribed onto coding sheets which are keypunched for computer file updating. These three reports are distributed to districts, divisions, and administrative officials.

We recognize the value of these Project Status Reports and recommend that they be continued. However, we believe that all of the data they contain can be gathered in the due course of recording accounting transactions, or with very little additional effort. Accordingly, we recommend the following:

a) That the account master record file on magnetic tape for IPEs and projects, including maintenance, construction, and R.O.W., be designed to include the ""nonaccounting" data items of the status records and reports. Such nonaccounting data includes time used to date, percent complete, event dates (hearing, plan submission, bid), remarks, project limits, and length.

b) That these amended master project account records be substituted for the present project master status files kept on magnetic tape.

c) That all status updating transactions be processed with the substituted master project account records.

d) That the updated master project account records, or copies of them, be sorted as required and listed to print the status books onto offset masters.

The "% complete" columns illustrated on the sample Expenditure Detail Ledger forms (see Exhibit II.A.2.c.-1) contain three subheadings ($ - dollars; MH - man-hours, and A - actual). These are intended to reflect this same concept of integrating physical status reporting with expenditure reporting on projects.

Subsequently, in section II E., Manpower Controls, it is recommended that managers and professional personnel of the Department who supervise organizational sections prepare estimates of the man-hours planned for each authorized undertaking. The new illustrated form would reflect these planned man-hour figures at the function or project level. The "% complete" figures would be calculated by the computer for dollars as a percentage of actual to authorized expenditures. For man-hours, they would be calculated as the percentage of man-hours used to

those estimated. However, under the column marked "A" (for Actual), the computer would merely print a percentage completion figure which had been reported from the field based on an opinion or overall estimate of the actual work done in comparison to the entire job. This estimate should be prepared by a person on site. The benefits of this integrated project status reporting system are as follows:

a) Economy. Each design, maintenance and construction project covered by the status reports will be represented on a master record in the cost accounting and related data processing system. This master record will necessarily include most of the indicative data and all of the dollar data maintained in the existing status reporting systems. It will be more economical to integrate additional physical status and schedule data into the proposed cost accounting system than to maintain two systems which are almost identical.

b) Efficiency. Present procedures for preparing status reports and the related review functions in the monitoring divisions involve multiple manual handling of dollar data, and involve some duplication in the reporting requirements for the districts. This would be eliminated by the recommended extension of the cost accounting system to include status report preparation.

c) Improvement of Reporting Quality. Combining actual physical status and dollar-man-hour data will make the status reports more useful and informative. In addition, the routine control and balance procedures in the regular accounting system should increase the reliability of these important management reports or at lease reduce the human effort now required to maintain reliability of separately prepared Status Reports.

5) Service Center Cost Reports

a) Present Situation

The Department now operates a number of service facilities for the benefit of districts and divisions. Such facilities include, among others, the Reproduction Section, Computer Section and Photogrammetry Section of the Automation Division and entire Materials and Test Division. Each of these facilities provides to districts and divisions technical services which could not be performed economically on a decentralized basis. Characteristically, the service unit costs are accumulated in a series of memo accounting records maintained by a small accounting staff associated with the service unit, and are billed out to the users monthly. All costs of the service center including administrative overhead are allocated to the users by one of the following methods:

(1) Unit cost basis where many similar units are produced (computer hours, material tests, etc.).

(2) Work order cost basis where jobs are large, dissimilar and of longer duration (aerial surveys, etc.).

Regardless of method, the service unit accounting staff generally develops two costs; one for Federal aid participating cost of the work done or items produced, and another for total cost, including nonparticipating elements of the work performed or items produced. The total costs only are billed to the districts, and are recorded there as costs to specific projects or other authorizations. The participating and nonparticipating elements of the service center charges are used by the BPR to set an annual percentage rate for preliminary engineering and construction engineering based on the audit testing of selected project cost.

The service center records characteristically have a clearing account through which all accumulated costs for an accounting period (month) are distributed to the districts and divisions. Monthly entries to record these billings are made by the service unit staff. Copies of the billings are sent to the user, and the original to the Accounting Division for recording on the Department's general ledger.

In addition, the 192 residency organizations can be thought of as performing a service center function in the design and supervision of highway construction work in their area. Under present procedures, all residency costs are charged directly to some project cost account; either an IPE Authorization or a Construction Project. No overhead or indirect cost accounts exist for the accumulation of this type of cost in residencies on the theory that the residency exists solely as an operating unit and all of its costs are directly attributable to specific projects. In practice, indirect costs are charged to projects as determined by the local Resident Engineer, and the allocation method is solely his responsibility.

When utilization of a service center is low the unit billing rate to users is comparatively high because many of the service center costs are fixed and do not fluctuate with volume. Under the present plan of billing for computer center usage, for example, this practice penalizes the user, and acts as a deterrent to maximum use of the center. Inasmuch as volume is needed to lower the rate, the billing system tends to defeat its purpose at a low level of utilization.

b) Recommendations

Under the proposed centralized accounting system with the general ledger being prepared monthly by computer, there would be very little need to continue to operate separate bookkeeping systems in the service centers. All time reports, vendor invoices, etc. of a service center operation should be handled centrally in exactly the same manner as the accounting for direct activities such as construction and maintenance. Account coding and editing for these service center

transactions would, however, call for one or more full time clerks associated with each center. Additional duties would be to collect production counts of the service units produced in the service center, and to prepare the monthly interdistrict billings for services rendered.

Provision has been made in the recommended account structure for setting up a unique series of accounts for each service center. All income and costs would be recorded in this series of accounts. For example, for the Materials and Test Division a series of accounts is provided which closely follows the suborganizational break down within this Division. (See Exhibit II.A.2.c.-9). Both income and expense for the service unit would be recorded in this same series of accounts.

Service centers should be compared to their commercial counterparts in order that management may continually evaluate the propriety of keeping the service unit in operation. Although other intangible factors such as convenience, scheduling, and control of quality are valid reasons for maintaining a service facility, a prime consideration should also be its cost saving feature. If it is not more economical to perform the service within the Department, then the other reasons for keeping the service facility should be weighed against the added increment of premium paid to do the work internally. To do this effectively, that is, perform a continuous management review of the service center's cost, we suggest that all units of service be extended by commercial rates so that the cost of "buying" services can be compared to the Department's cost of providing its own. Periodic analysis reports to management for each service center should show the computed commercial cost of services rendered in comparison to the in-house (actual) costs of the units produced, so that an improving or deteriorating situation may be easily identified (See Exhibit II.A.2.c.-10).

We also recommend that the engineer residencies, district headquarters design sections, laboratories, equipment shops, sign shops, and reproduction sections be considered as separate cost centers. Expenditure accounts should be set up for indirect items of cost which cannot easily be charged directly to work in progress. For instance utility costs at the residency offices should be charged to these indirect cost accounts; and so should the salaries of the resident engineers. These indirect cost accounts could be cleared through monthly accounting entries or billings to the projects, IPEs, etc. (Refer to Exhibit II.A.2.c.-11).

The total amount of indirect cost incurred in the current month and for the year-to-date is shown in ledger or report form by function and object. Thus the responsible engineer knows what his indirect costs are and what it is that he is to control. A necessary control procedure is to know the status of indirect expenses and compare them to what had been planned.

The indirect expenses should also be allocated to work in process. Direct salary dollars is the simplest basis for distributing or allocating indirect costs to benefiting work such as IPE and projects. The accounts system would keep the responsible engineers apprised of man-hours expended on their various operations. Through computer calculated entries and processing, the cost ledgers for each IPE or project could be charged with prorata indirect cost as a percentage of total direct salary charges. The indirect cost allocations can be revised periodically through clearing accounts to avoid recalculation every period.

The direct man-hour data derived from the accounting system and used in the engineering organization's account system would also be utilized in connection with the manpower planning, control, scheduling, and status reporting procedures.

6) Current Billing

The output reports and support data which are required to facilitate Federal reimbursement for expenditures under the Federal aid programs are as follows:

a) Federal Aid Billing Summary (see Exhibit II.A.2.c.-12). This report is a monthly listing of the cumulative Federal aid charges, cumulative Federal aid receipts; and the unpaid balance on every open Federal aid project. It includes the following data:

(1) Federal and State Project Numbers
(2) Phase of Work
(3) Total Project Costs
(4) Total Nonreimbursable Cost
(5) Total Reimbursable Cost to Date
(6) Percent Participating
(7) Federal Aid Share
(8) Agreement Amount
(9) Adjustment Amount
(10) Amount Billable
(11) Previously Billed
(12) Net Amount Claimed

b) Federal Aid Billing Detail. This is a required listing of all expenditures and deductions which occurred during the month being billed. This listing would be provided after a machine sorting of detailed project expenditures by object and project number. At the end of the listing there would be printed a summary of expenditures and deductions by function code.

c) Voucher Support. This support includes a Right-of-Way Certificate and Tabulation of Appraisals to cover the month's billing. These would be referenced to the project and phase codes, and would show parcel number, parcel cost, credits by parcel, net claim by parcel, and incidental costs by project. There would also be prepared a final Tabulation of all Appraisals as projects were completed. The Right-of-Way Certificate and Tabulation of Appraisals are presently being prepared on data processing equipment in Texas, and reports similar in layout and content to these would be transferred to the proposed system.

The underlying cost accounting system needed to produce the required current bill outputs is otherwise needed by the Department's management personnel as an aid to improved efficiency in Departmental operations. The recommendations of this report as regards cost accounting, data processing and related matters, should be more than sufficient to produce a satisfactory current bill monthly for Federal aid reimbursement.

The detailed data processing systems design and programming undertaken to produce the current bill will need to include several automatic features for screening nonparticipating charges such as those incurred prior to project agreement data, those in excess of project agreement amount, invalid account code combinations, and other tests. These can be performed by the computer to insure that concurrent audit citations due to human error are minimized.

Similar computer audit test practices could be applied to the Department's non-Federal aid accounting entries in order to improve the quality of management information generated.

Accounting Codes

3. Accounting Codes and Coding Structure

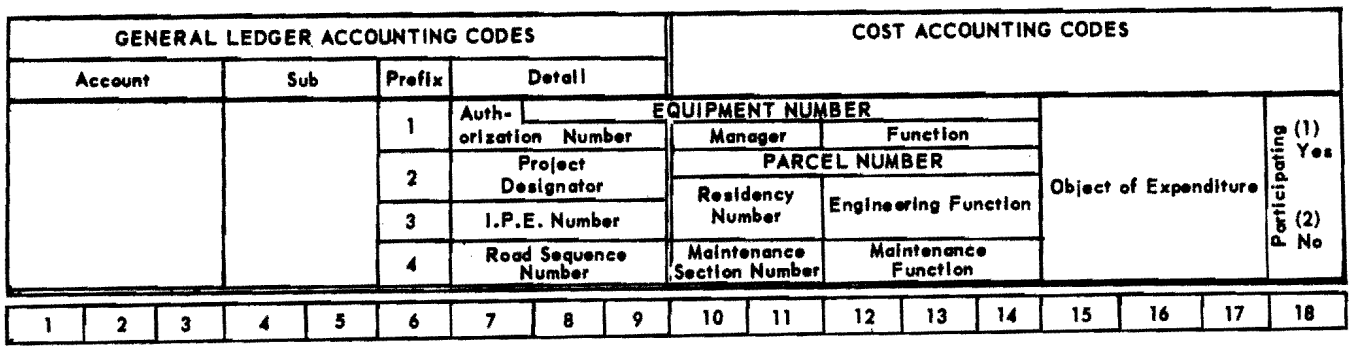
a. Introduction

An account coding structure provides the means for identifying and classifying the quantitative results in dollars, hours, etc., of individual transactions and events so that all transactions for a period of time can be summarized. The summary data can be arranged in different classifications for historical record keeping purposes, and for comparison with plans and budgets.

Planning and control of an operation is accomplished by reviewing the operation in several ways, such as what is to be done, who is responsible for doing it, and what kinds of resources are needed. Any one transaction may effect several different summaries.

All of the accounting summaries and reports of an organization are based on and limited by the coding applied to individual transactions. Therefore, it is essential that the codes and coding structure be well planned. Accordingly, we have devoted a great deal of effort to the design of the coding structure presented in this section. We believe that it provides for the proper classification of events and transactions of the Department.

The coding structure is compatible with our other recommendations regarding financial statements, budgeting, cash forecasting, cost accounting, current billing, and data processing.



b. Coding Structure

The diagram shown above is a layout of the recommended coding structure.

Coding positions one through nine, the left half of the diagram, are general ledger accounting codes. Coding positions ten through eighteen, the right half of the diagram, are cost accounting codes.

Accounting entries which affect the balances of nonexpenditure accounts (balance sheet items) will be coded in positions one through nine, only.

Accounting entries which affect expenditure accounts will be coded in all eighteen positions. However, a substantial portion of the actual writing of codes on source documents will be eliminated by preembossed printing on plastic plates, by preprinted forms, and by automatic computer processing procedures which will generate missing or omitted codes.

Following is an explanation of the coding structure in terms of the diagram, proceeding from left to right, from position one through position eighteen:

1) Positions 1, 2 and 3; General Ledger Account

This is the major accounting breakdown and is quite similar to the Fund Section of the Department's present chart of accounts (refer to Exhibit II.A.3.-1). Exhibit II.A.3.-2 is a listing of the recommended coding and titles for general ledger accounts. The general ledger account codes are shown in the extreme left column of this exhibit.

The general ledger account for appropriated surplus-construction (Account 600, see page 5 of Exhibit II.A.3.-2) and the general ledger account for appropriated surplus-unexpended budgets (Account 700, page 6) will control all expenditures, since expenditures can be made only after construction or budget funds are appropriated by the State Highway Commission or Legislature.

GENERAL LEDGER ACCOUNTING CODES									COST ACCOUNTING CODES								
Account			Sub		Prefix	Detail											
					1	Auth-orization Number			EQUIPMENT NUMBER		Manager		Function		Object of Expenditure		Participating (1) Yes (2) No
					2	Project Designator			PARCEL NUMBER								
					3	I.P.E. Number			Residency Number		Engineering Function						
					4	Road Sequence Number			Maintenance Section Number		Maintenance Function						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

In actual operation, the general ledger account code normally will not be written when recording expenditure transactions because accounts 600 and 700 will be used only to summarize groups of general ledger subaccounts. The groups of subaccounts will be summarized by data processing procedures.

The general ledger account master records on magnetic tape will carry a fixed code to indicate for each account whether it is a fund account, a proprietary and expense account, (P & E) or both. These classifications are marked in Exhibit II.A.3.-2 in the columns headed "Fund and P & E". The purpose of this accounting concept is explained in Exhibit II.A.1.b., Financial Statements.

2) Positions 4 and 5; General Ledger Subaccount

This area of the account structure will provide subclassifications of the general ledger accounts where needed. Subclassification will be needed for most of the general ledger accounts. The State Highway Fund (cash) is an example of an account which will not need subaccounts.

Subaccounts for the general ledger expenditure accounts (600 and 700) will in actual operation consist of two records for each subaccount as follows:

a) A record of the amount originally authorized, all increases and decreases, and the resulting net amount authorized for the subaccount.

b) A record of the amount expended, any reductions, reversals, or corrections of expenditure which are recorded, and the total balance expended.

The two records will be combined on budget and project status reports to show the status of a subaccount in terms of the amount of authorized expenditure which is not yet expended.

GENERAL LEDGER ACCOUNTING CODES									COST ACCOUNTING CODES								
Account			Sub		Prefix	Detail											
					1	Auth- orization Number			EQUIPMENT NUMBER					Object of Expenditure			Participating (1) Yes (2) No
									Manager		Function						
					2	Project Designator			PARCEL NUMBER								
					3	I.P.E. Number			Residency Number		Engineering Function						
					4	Road Sequence Number			Maintenance Section Number		Maintenance Function						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

Subaccount numbers for the general ledger expenditure accounts will be budget or district numbers. Presently the Department has separate budget numbers for some divisions, budget numbers covering several divisions, and budget numbers covering a portion of a division's responsibility (see Exhibit II.A.3.-3). Authorization accounts are included within each budget. The recommended chart of general ledger subaccounts for budgeted expenditures conforms to the Department's organization into districts and divisions (see Exhibit II.A.3.-4). This is to allow the preparation of budget status and cost reports which can be distributed to and used by operating executives, and is not a change in the Department's basic policy for internal budgeting.

3) Positions 6, 7, 8, and 9; Prefix and General Ledger Detail Account

The prefix position in the account code structure is needed to indicate for machine processing the kind of general ledger detail account effected by each expenditure entry. Prefix codes 6, 7, 8 and 9 also will be used by the Fiscal Division only to record budgets and authorization of funds for general ledger detail accounts. Thus, the one-digit prefix entry will define which of the four possible kinds of general ledger detail accounts is affected, and will indicate whether the entry is recording an expenditure of authorized funds or is recording a change in the amount of funds authorized.

The general ledger detail position in the account structure corresponds to the "authorization" account presently used in the Department for budget and project accounting. Authorizations are issued for specific purposes, are reviewed and approved at one or more points in the Austin offices, and are cleared through the Fiscal Management Division for approval and official setup on the records of the Department. (refer to Exhibits II.A.1.c.-17 and II.A.3.-5). With minor exceptions all authorization of funds is the result of State Highway Commission action.

The headings shown in the diagram above positions 7, 8, and 9 are (1) authorization number, (2) project designator, (3) I.P.E. number, and (4) road sequence number. The project designator and road sequence number would be used differently from present Department practices.

GENERAL LEDGER ACCOUNTING CODES						COST ACCOUNTING CODES											
Account			Sub		Prefix	Detail											
					1	Auth-orization Number			EQUIPMENT NUMBER Manager		Function			Object of Expenditure			Participating (1) Yes (2) No
					2	Project Designator			PARCEL NUMBER								
					3	I.P.E. Number			Residency Number		Engineering Function						
					4	Road Sequence Number			Maintenance Section Number		Maintenance Function						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

The project designator account is designed to be an accounting label or code for each project. This three digit number can be manipulated more efficiently by data processing equipment than the numbers which traditionally have been used such as control, section, job, and Federal project numbers. Therefore, we are recommending that this simple three digit designator code be used as the accounting key for projects and also that a single designator code be used for an entire construction contract or right of way project rather than using separate accounts for each control section in the contract or project. Cost breakdowns by control section can be computed after completion of the work for inclusion in historical cost files maintained for each control section of highway. Of course, the magnetic tape master record for each project designator will include indicative data such as federal number, control numbers, control section numbers, federal program number, kind of project, fund codes and amounts, stage of construction, type of highway, geographical limits, county, headquarters division, highway system, authorization dates, federal participation percentage, program year and code, etc. However, this descriptive master record data will not need to be recorded and entered with each transaction. Some of this data is recorded with each transaction under existing procedures. Up to 1,000 project designators may be used at the same time in any district. Designators will need to be blocked, for example 001 through 699 for construction, 700 through 799 for special maintenance, 800 through 899 for right of way, and 900's for research and all other projects.

The road sequence number is intended to be an accounting label for each discrete section of road or bridge maintained by the Department. Control numbers and control section numbers are presently used to identify regular maintenance cost entries. However, this numbering requires seven digits of information (refer to Exhibit II.A.3.-7 for an explanation of the control and section numbering system). The three digit road sequence numbers would be assigned to control and section lengths within each district. However, the numbers can be duplicated if a district should have over 999 control sections, so long as number duplication does not fall within the assigned road network of any one maintenance section headquarters.

GENERAL LEDGER ACCOUNTING CODES									COST ACCOUNTING CODES								
Account			Sub		Prefix	Detail											
					1	Auth-orization Number			EQUIPMENT NUMBER					Object of Expenditure			Participating (1) Yes (2) No
									Manager		Function						
					2	Project Designator			PARCEL NUMBER								
									Residency Number		Engineering Function						
					3	I.P.E. Number											
					4	Road Sequence Number			Maintenance Section Number		Maintenance Function						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

Other data which describes each section will be recorded systematically as indicative information on magnetic tape, such as county number, type of surface, highway number, highway system, control, section, structure number, length, standard maintenance cost, etc. However, this descriptive information will be handled as master record data for each road sequence number, and will not need to be recorded and entered with each transaction.

The primary emphasis of the accounts system recommended is toward efficient and simplified data entry and responsibility oriented output. Therefore, maintenance costs are to be accumulated by Highway Department organization unit - for management control and budget analysis. However, the accounting system also will be able to produce annual tabulations of maintenance cost by county for legislative reporting and by class of highway such as primary, secondary, multilane, controlled access-urban, and controlled access-rural for use in maintenance fund allocation between districts, or for other analytical purposes.

The heading "I.P.E. number" above code positions 7, 8, and 9 means investigation and planning expense which is the expense involved in the proper execution of all preliminary work, such as reconnaissance and location surveys, and the preparation of right-of-way data, plans, specifications, and estimate (PS&E) in the development of any improvement project up to the time of contract award (refer to Exhibit II.A.3.-8 for further explanation).

The general ledger detail accounts for expenditures will, like the corresponding general ledger subsidiary accounts, consist of two dollar accumulation records, one for the amount of spending authority, and the other for the amount of spending. Combined, the two records will reflect each account's status in terms of "balance-to-spend" within budget control.

In addition to the above described system for expenditure accounting, the general ledger detail positions (7, 8, and 9) will provide additional subclassification for nonexpenditure accounts. This is illustrated in Exhibit II.A.3.-2, page 1, where general ledger account 146 "Reimbursements Receivable - primary Federal aid" has a subaccount for each district, and a detail account for each project in the

GENERAL LEDGER ACCOUNTING CODES									COST ACCOUNTING CODES								
Account			Sub		Prefix	Detail											
					1	Auth-	EQUIPMENT NUMBER										
						orization Number			Manager		Function						
					2	Project Designator			PARCEL NUMBER								
					3	I.P.E. Number			Residency Number		Engineering Function			Object of Expenditure			Participating (1) Yes (2) No
					4	Road Sequence Number			Maintenance Section Number		Maintenance Function						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

district. General ledger accounts 520 and 521 also illustrate the use of three level coding in the clearing accounts for additive and free-time costs of personnel services.

4) Positions 10 and 11; Manager Code

The manager code positions will provide capability within the accounting system to identify a first line supervisor with the cost of carrying out the responsibilities assigned to him. Because the various districts are not all organized the same (refer to Exhibit II.A.3.-9), and because each Austin headquarters division is unique, the specific coding for this position will have to be designed for each district and division - so that every expenditure made can be identified as the responsibility of only one person. This person should be the supervisor or official who has direct first-line responsibility for the operation. Examples of other manager or engineer accounts in terms of organizational role are; District Right-of-Way Engineer, District Laboratory, District Accounting Section, Computer Center, Traffic Section, Warehouse Operating Section, Resident Engineer, and Maintenance Section Foreman.

5) Positions 12, 13, and 14; Function Code

The function code positions will be used to accumulate charges from month to month for various personnel and other direct expenditures devoted to a particular purpose or function. Uniform Functional accounts and codes will be promulgated by the Department for the major work areas of roadway maintenance, construction engineering, preliminary engineering, and district headquarters functions (refer to Exhibit II.A.3.-10). Function codes will have to be set up on a customized basis for nonrecurring work such as special maintenance jobs, research projects, and division operations. Function accounts will be used within each authorization (general ledger detail account) to reflect a logical breakdown of operations by location, crew, or technical area as needed for cost control and cost accounting purposes.

GENERAL LEDGER ACCOUNTING CODES									COST ACCOUNTING CODES								
Account			Sub		Prefix	Detail											
					1	Auth-orization Number			EQUIPMENT NUMBER					Object of Expenditure			Participating (1) Yes (2) No
									Manager		Function						
					2	Project Designator			PARCEL NUMBER								
									Residency Number		Engineering Function						
					3	I.P.E. Number											
					4	Road Sequence Number			Maintenance Section Number		Maintenance Function						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

6) Positions 15, 16, and 17; Object Code

The object of expenditure code positions will be used to classify and accumulate expenditure amounts within functions and projects according to whether expenditures are for personal services, state services, contractual services, or commodities, and will provide detailed classification within these categories as indicated by Exhibit II.A.3.-11.

The recommended 3 digit object code position would permit up to 999 object breakdowns, which is far too many for efficient and economical cost accounting. The particular breakdown recommended is somewhat arbitrary and empirical and should be modified periodically, perhaps prior to initial implementation, in order to accomodate other specific cost information needs.

The Department presently classifies purchases through three methods; (1) code chart 10-A, by which all purchases are recorded in terms of dollars and, for selected commodities, quantity, (2) materials are classified by the Equipment and Procurement Division for data on bid price, bid quantity, and delivery points, and (3) Board of Control class and item coding of purchasing.

These systems all focus upon gathering statistical data on purchases, as such, and are not designed to account for the uses or purposes for which commodities and services are consumed.

Object coding for cost accounting purposes as recommended here places primary emphasis on accounting for the consumption of commodities and services, with data accumulation for annual purchases analysis and reporting being incidental and secondary.

We recommend that only dollars and not physical quantities of commodities be handled within the cost accounting system, and that the extent of quantity accumulations be limited to the Board of Control and Equipment and Procurement Division systems.

GENERAL LEDGER ACCOUNTING CODES									COST ACCOUNTING CODES								
Account			Sub		Prefix	Detail											
					1	Auth-	EQUIPMENT NUMBER										
						orization Number			Manager		Function						
					2	Project Designator			PARCEL NUMBER								
									Residency Number		Engineering Function						
					3	I.P.E. Number											
					4	Road Sequence Number			Maintenance Section Number		Maintenance Function						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

Object of Expenditure

Participating (1) Yes (2) No

7) Position 18; Participating Code

The Participating coding position will indicate for each expenditure transaction whether the cost incurred is participating (code 1) or nonparticipating (code 2) for Federal reimbursement purposes under the Interstate Highway Act. This coding approach is based upon the assumption that personnel who fill in the transaction code blocks on source documents would be informed as to which costs are participating.

Coding as to P/NP will be required only for charges to those particular general ledger detail accounts which are qualified for Federal reimbursement. Data processing procedures can be designed to edit all charges to such projects and detect the absence of P/NP coding and to detect certain classes of errors in P/NP coding.

8) Alternate Uses of Positions

The coding layout block provides for several variations from the uses described. For Interstate right of way projects where it is necessary to accumulate land cost by parcel, both the function positions and manager positions would be used as a five digit parcel number. For equipment operating costs which are accumulated by unit of equipment, to be allocated to the equipment user accounts as rental, the function and manager code positions and two low order digits of the authorization code are reserved for a seven digit equipment number. Selected high order digits of authorization code would be reserved for equipment cost and rental controls. This will permit the use of a unique number for each unit of equipment consisting of three positions for specification number (Board of Control or Procurement Division) and four positions for a serially assigned unit number.

Organization

B. ORGANIZATION AND OPERATING POLICIES

1. ~~Existing~~ Organization and Policies

The Texas Highway Department functions as a separate unit of the State government under the administrative direction of the State Highway Commission. The Commission is comprised of three members who are appointed by the Governor with the consent and approval of the Senate. The Governor appoints one member to serve as Chairman. The terms of the members of the Commission are for six years and the term of one member expires every two years. The Commission is responsible for the formulation of over-all policies and plans for a comprehensive system of State and Federal highways. The Commission appoints the State Highway Engineer to serve for an indefinite period as chief operating executive of the Department. The direct supervision and control of the Department is his responsibility. The Commission holds regular monthly meetings and any special meetings which may be required. All requests for construction and maintenance funds are reviewed and approved by the Commission.

The State Highway Engineer is responsible for administration of over-all policies of the Commission and for supervision of the location, design, construction and maintenance of the highway system. He directs and controls all activities of the Department. Financial control is exercised through the State Highway Engineer who periodically presents budgets and programs for future operations and activities to the Commission for their approval. In the absence of the State Highway Engineer, his duties and responsibilities are executed by the Assistant State Highway Engineer who is in the direct line of authority between the State Highway Engineer and the organization. ~~(see Exhibit II.B.1.-1)~~

The highway system is divided into twenty-five districts with each district under the direction of a District Engineer. The District Engineer is responsible for planning, constructing, and maintaining the highways in his particular district. The employment and supervision of personnel required to perform these functions is the responsibility of the District Engineer. The District Engineers also are responsible for the maintenance and repair of the equipment, buildings and grounds assigned to them.

The internal organization of the districts follows a general pattern ~~as shown in Exhibit II.B.1.-2.~~ In general terms the districts are divided into maintenance, construction, and administrative activities. Executives under the District Engineer are typically:

a. District Maintenance Engineer
b. District Construction Engineer
c. District Design Engineer
d. District Administrative Engineer
e. Assistant District Engineer

Maintenance activities are generally divided into those duties performed by personnel at the district headquarters location and those duties performed in the maintenance sections. Activities of the district headquarters personnel are generally assigned according to functions, but assignments do not follow a uniform pattern.

For example, in San Antonio (see Exhibit II.B.1.-3) the headquarters maintenance staff is subdivided into:

a. Traffic, Signal and Radio Section
b. Special Jobs and Crews
c. Equipment, Signs and Properties
d. Shops and Buildings-Grounds

In Houston (see Exhibit II.B.1.-4) the headquarters maintenance group is subdivided into:

a. Accounting, Warehouse, Permits
b. Traffic Engineering and Sign Shop
c. Special Services-Building Design, Construction Maintenance, Special Assignments

In the field, highway maintenance of a regular or routine nature is usually the responsibility of the Maintenance Section Foremen working either directly for the District Maintenance Engineer as in San Antonio (see Exhibit II.B.1.-3) or through an assistant as in Houston. (see Exhibit II.B.1.-4). Special maintenance jobs are generally handled by a separate district organization reporting to the District Maintenance Engineer.

The District Design Engineer is typically in charge of the preparation and review of all plans. His district office staff is generally divided between highway and bridge design, and may include specialists in Interstate and non-Interstate roads in large districts. He may be in charge of district laboratories as in Houston (see Exhibit II.B.1.-4) or right of way activities as in San Antonio, (see Exhibit II.B.1.-3).

The District Construction Engineer is generally in charge of inspecting jobs and coordinating the construction activities of the entire district.

In most cases the coordination of the work of the separate residencies is performed jointly by the District Construction Engineer and the District Design Engineer, although the District Engineer himself retains the direct authority over the residencies. Within the residency organization the work is usually subdivided between plan work or design which is performed in the residency offices, and construction supervision which is performed by project engineers on project sites. Typically, a Supervising Resident Engineer is in charge of a residency, and assisting him will be two men; one in charge of plan work in the office, and the

other in charge of field projects under construction. Actual design work is done by a Senior Resident Engineer and his assistants who are assigned to specific design projects, and actual project supervision is provided by Project Engineers who also are assigned to specific projects (after award of the related construction contracts).

Although an individual engineer may exhibit a preference for either design or field work, an effort is made to expose him to both phases of the work in order to develop well rounded professional engineers. One or more projects may be assigned to one Senior Resident or Project Engineer, and he is expected to follow the project from design to completion of construction. ~~(See Exhibit II.B.1.-5).~~

Duties of the Assistant District Engineer and the District Administrative Engineer vary, but generally they handle the staff duties at the district level which may include the following:

a. Right of way negotiations and purchasing
b. Personnel administration and training
c. Accounting, laboratory, warehouse
d. Special assignments
e. Operations coordination

The existence of the positions mentioned will depend upon the overall size and relative workload of a particular district. In some cases positions are combined, as in smaller districts, so that not all of the staff positions immediately below the District Engineer are filled. In general, the district organizations follow a common pattern in regard to the field operations of design, construction, and maintenance, but staff duties and responsibilities are not divided on any uniform or consistent basis.

In addition to the twenty-five district organizations, there is an Urban Project Office located in Houston that is responsible for planning and constructing the highways in that urban area. The responsibility of the Urban Project Engineer-Manager is similar to that of the District Engineers with the exception that he is not responsible for maintenance of highways. The District Engineers and the Engineer-Manager report to the State Highway Engineer through the Assistant State Highway Engineer. ~~(See Exhibit II.B.1.-1).~~

The District organization is supported by headquarters functions which are located in Austin. The headquarters functions are divided into sixteen divisions who serve the districts in an advisory and consulting capacity. The divisions also serve to coordinate and maintain standards and specifications for design, construction, and maintenance of the highway system. Specialized technical skills and services are provided to the districts by the divisions. The Engineer or Director of each division reports to the State Highway Engineer through the Assistant State Highway

Engineer. (see Exhibit II.B.1.-1). The headquarters divisions and the executive in charge at September 1, 1965 are:

NUMBER	DIVISION	CHIEF EXECUTIVE
D-4	Equipment and Procurement	J. B. Nations
D-5	Bridge	C. F. Silvus
D-6	Construction	J. N. Robinson
D-7	Aid Projects	S. Huff
D-8	Highway Design	T. S. Huff
D-9	Materials and Tests	A. W. Eatman
D-10	Planning Survey	G. L. Carver
D-11	Accounting	G. Pendergrass
D-12	Motor Vehicle	R. W. Townsley
D-13	Personnel	F. T. Bennett
D-14	Secondary Roads	H. L. Arno
D-15	Right of Way	A. H. Christian
D-16	Travel and Information	T. H. Taylor
D-18	Maintenance Operations	J. A. Waller
D-20	Insurance	C. G. Curtis, Jr.
D-21	Operations	R. C. Faltinson

The Equipment and Procurement Division is the central procuring agency for the Department and it provides policy direction for equipment management. All requisitions for materials, supplies, and equipment to be used in the Department are reviewed and approved in this Division and are forwarded to the State Board of Control for actual purchasing. The Division prepares standard and special specifications. Central shops and general warehouses are operated by this Division. They supervise the operation of motor pools and dispose of surplus equipment, material, or supplies. Technical and specialized service is provided to the districts as needed. (see Exhibit II.B.1.-6).

The Bridge Division supervises the design of all bridges and drainage structures built by the Department. This Division provides standard and special designs and specifications for bridges to the districts and conducts regular inspections of all structures under construction. Negotiations with railroad companies for grade crossings and separations are conducted by this Division. (See Exhibit II.B.1.-7).

The Construction Division exercises general supervision over all construction operations on contract projects through prequalification of contractors, review and approval of plan changes, and periodic inspection of active construction projects. It supervises the opening of bids and makes recommendations regarding the award of contracts. It maintains records and prepares reports concerning construction and provides consultation to the districts when needed. (see Exhibit II.B.1.-8).

The Aid Division exercises financial supervision over construction operations by preparing and administering construction contracts and funds for construction. This Division prepares contracts and issues authority to begin construction. Right of Way acquisition funds are authorized and recorded and vouchers for payments to contractors are prepared. Agreements with the Bureau of Public Roads, cities, and counties for their participation in the cost of construction are administered by this Division. All charges to Federal aid allocations are accounted for daily by this Division. (see Exhibit II.B.1.-9).

The Highway Design Division reviews and assists in the design of all highways constructed by the Department. It consults with and advises the districts regarding the preliminary design and location of new highways and reviews the final plans, specifications, and estimates for compliance with State and Federal requirements. This Division assigns the control and section numbers to all highway construction projects and maintains records of preliminary engineering expenses. Urban transportation planning is supervised and coordinated and the necessary reports are published. This Division coordinates the research activities of the Department which lead to the development of new tests, specifications, designs, and standards. Photogrammetric service is provided to other divisions and districts. (see Exhibit II.B.1.-10).

The Materials and Test Division assists the districts by providing testing and inspection service for materials entering into construction and maintenance work. Reports of these tests are provided to the districts before the material is given final approval for use in construction or maintenance operations. Material specifications are maintained by this Division and are furnished to the districts. The Division also assists the districts in the solution of problems relating to construction materials. The Division coordinates materials research conducted by or for the Department. Training programs for specialized material testing are developed and conducted by the Division for district personnel. (see Exhibit II.B.1.-11).

The Planning Survey Division collects the necessary information for planning to meet the future needs of the highway system. The Division maintains the official records of the highway system with regard to mileage of highways and rural public roads. Road life and traffic density studies are conducted and future volumes are projected. Records of road life and the cost of construction are maintained. Statistics regarding county and city revenues and expenditures on roads and streets are obtained and maintained by this Division. Road and traffic volume maps are compiled and are sold to the public. (see Exhibit II.B.1.-12).

The Accounting Division is the central clearing house for all expenditures and income of the Department. Transactions involving expenditure of funds are checked for proper authority and procedural compliance before payment. Budgetary accounts are maintained to control expenditures. All payrolls are received by this Division and are transmitted to the State Comptroller for payment. Inventory records of the equipment, materials, and supplies of the Department are maintained and audited. The

Division maintains financial and statistical records and prepares the Biennial Report. Accounting Manuals of Instruction are prepared and maintained by this Division. Internal auditors from this Division work with district personnel to maintain a uniform accounting system. ~~(see Exhibit II.B.1.-13)~~.

The Motor Vehicle Division supervises the registration of all motor vehicles and the collection of the related fees. License plates are sold to the public through county Tax Assessor-Collectors and this Division audits and accounts for the money received from such sales. The Division issues and records Certificates of Title for motor vehicles and Certificates of Number for boats and provides information from these records to the public and various law enforcement agencies. The Division administers the Dealer License Plate Law, the Salvage Yard Law, and the Water Safety Act. Texas Motor Vehicle Laws are prepared in booklet form and distributed. The Division prepares proposed legislation affecting motor vehicle operations. ~~(see Exhibit II.B.1.-14)~~.

The Personnel Division is responsible for recommending, interpreting, and coordinating the personnel policies of the Department. All changes in the classification and compensation of salaried personnel are reviewed for approval and are recorded in this Division. The minimum wage rate to be paid on highway construction work is determined by this Division. It issues certificates of service and identification cards, maintains the Personnel Manual of Instruction, and acts as liaison agent between the Employees Retirement System and the Department. The Division assists in obtaining employees for the Department by interviewing applicants and providing information regarding their availability to other divisions and districts upon request. ~~(see Exhibit II.B.1.-15)~~.

The Secondary Roads Division reviews and assists in determining the route, location, and design of all secondary roads in the highway system. Secondary road construction and reconstruction plans, specifications, and estimates prepared in the districts are reviewed and approved by this Division. The adequacy of funds is determined. It supervises the preparation of the material necessary for receiving bids and analyzes the bids which are received for recommendation of acceptance or rejection. This Division coordinates with other divisions of the Department and the Bureau of Public Roads on matters pertaining to secondary roads. This Division also reviews agreements with outside agencies affected by construction or reconstruction of secondary roads. ~~(see Exhibit II.B.1.-16)~~.

The Right of Way Division is responsible for recommending policies and procedures regarding the procurement of highway rights of way. It assists the districts in procuring necessary land and provides legal counsel to the districts on matters pertaining to right of way. The Division procures rights of way for the Interstate Highway System and reviews right of way appraisals of cities and counties on non-Interstate highways. The activity of this Division has increased considerably since 1956. Records of right of way costs and all deed instruments for the highway system

are maintained by this Division. The Division negotiates with utility companies regarding the removal or adjustment of utility lines along or across the highway right of way. Real property no longer needed for use by the Department is disposed of by this Division. ~~(see Exhibit II.B.1.-17)~~.

The Travel and Information Division administers the public information program for the Department and travel promotion. Tourist bureaus on key highways are operated by this Division and promotional materials, films, and publications are developed and distributed. The official Highway Travel Map is compiled and published by this Division. ~~(see Exhibit II.B.1.-18)~~.

The Maintenance Operations Division establishes maintenance policies and coordinates the activities of the districts in maintenance, traffic, buildings, and landscape operations. Budgets and financing for maintenance of highways, traffic services, buildings and grounds maintenance, and boat ramp projects are administered by this Division. It administers all property of the Department except right of way real estate. It maintains logs of highways, bridge and railroad grade crossings, and boat ramps. Permits for oversize and overweight loads and vehicles are issued and traffic accident records are maintained and analyzed by this Division. ~~(see Exhibit II.B.1.-19)~~.

The Insurance Division administers the workmen's compensation program for the Department and processes all injury claims. This is a self-insurance program. Personal injury accidents are reported to the Industrial Accident Board which is an agency that has jurisdiction over all workmen's compensation claims throughout the State. The Division develops and directs safety and accident prevention programs and first-aid training programs. ~~(see Exhibit II.B.1.-20)~~.

The Operations Division provides reproduction, mail, telephone, and delivery service to the other divisions in Austin. It operates the Computer Center, which provides electronic data processing service to the divisions and districts. The reproduction section operates blueprinting, offset duplicating, photographic, and other reproduction process equipment and also provides bookbinding service. A typing pool is available for reproduction work. This Division maintains the central files and micro-films records for the other divisions. The buildings and grounds of the Austin headquarters facilities are maintained and serviced by this Division. This includes the renovation or reconstruction of office interiors. Materials, printed forms, and supplies for the headquarters divisions are requisitioned and stored. The visual-aid and tape recording equipment of the Department is operated by this Division. ~~(see Exhibit II.B.1.-21)~~.

The Administrative Division is made up of the State Highway Engineer, the Assistant State Highway Engineer, their secretaries, and a small staff who compile and maintain records pertaining to the various highway construction programs. In addition there are certain forms required by the Bureau of Public Roads which are prepared by the Programming Group. The Administrative Division also has an Engineer-Special Assignments who administers research projects not assigned to other divisions, and another staff member who handles various legal matters for the Department. (see Exhibit II.B.1.-22).

The major management philosophy underlying the organizational structure of the Department is that effective control of operations can be best achieved through a decentralized plan in which responsibility is delegated with sufficient authority. This principle of decentralization is very logical in a highway system that encompasses a geographic area as large as the State of Texas. The Department has been successful in recognizing and reacting to local needs through local management. Management personnel are provided with statements of the policies of the Department to guide and direct their operations and activities. Administrative Circulars and Bulletins are issued by the State Highway Engineer to define policies. Consistent with this approach, the Department has utilized an accounting system which emphasizes verification of expenditures by central review but with local administration.

A very significant principle of management applied by the Department stresses the importance of individual responsibility and integrity. The Department has directed its efforts to achieve an organization of loyal, honest, and dedicated people. The actions of management have been reviewed and studied to insure that they are consistent with the objective of good morale. Any program, plan, or policy that might be detrimental to the spirit and morale of the organization is modified or altered to preclude that undesired result.

Headquarters functions are organized to provide coordination of planning and design and to offer technical support service on an economical basis. The balance of authority between districts and divisions has been controlled to achieve the emphasis in the districts on results and the emphasis in the divisions on service. The authority of any division flows through the State Highway Engineer and the Assistant State Highway Engineer.

2. Critique of Existing Organization and Policies

The existing organization and policies of the Texas Highway Department have been based on a philosophy of decentralization. Many advantages have been realized from this approach. The Department has a history of successful and effective operations to support this method of management. The outstanding morale and pride in the organization is credited to a large extent to this philosophy, although the leadership that has been exercised must also be recognized as a major contributing factor.

Any comments on the present plan of organization and any recommended accounting system must be compatible with this principle of decentralization. Our observations suggest that improvements can be realized in the areas of cost accounting and financial management, utilization of data processing equipment, cash management, and manpower planning and control. These improvements are not only consistent with the principle of decentralization but should contribute to its more effective application and practice.

In our review of the operations and activities of the Department, we observed several areas of management in which the present plan of organization is weak. These weaknesses limit the effective control of a decentralized operation. They are:

a. Additional management information and cost data are required to achieve full management control of all operations and activities.

b. The present accounting system does not provide adequate data for financial management.

c. The inflexibility of district organizations and boundaries has resulted in unequal work loads and volumes.

d. Control of coding and classification of accounting data at the district level with reporting to the headquarters divisions only on a summarized basis weakens accounting control.

e. Decentralization of data processing has resulted in less efficient operations and has encouraged duplication of records and processes.

f. Duplication and similarity of those records which are maintained in various divisions tends to create confusion as to which are official.

g. Lack of coordination between the systems development activities of the various divisions has prevented the development of systems based on the needs and requirements of the overall Department.

h. Relations with outside agencies performed by various divisions on the basis of their own specific operations with little coordination hampers the effectiveness of planning.

i. Decentralization of employment and training functions has resulted in the lack of uniformity among districts and divisions.

j. Organization of the headquarters divisions on the basis of activities rather than functions results in responsibilities often being divided and overlapped.

k. Dissimilar assignments of like functions within the various district staffs detracts from effective liaison by the Austin divisions.

In the following paragraphs we will examine these points in greater detail.

a. In a decentralized operation, authority for decisions is delegated to the lowest level of the organization that is compatible with effective management control. Responsibility remains even when the authority is delegated. Consequently, top management requires information to assure itself that decisions have been made properly. In many cases, this information will be just as extensive as that which is required in a centralized operation. Cost data must be presented to top management to indicate areas in which their attention is needed. The large number of districts and divisions in the Texas Highway Department makes this most important.

b. Financial management of the Department is exercised primarily by the State Highway Engineer. The existing accounting system emphasizes the verification of the propriety of expenditures and the tabulation of remaining allocated funds. This information does not provide the State Highway Engineer with all of the data that is needed for financial management and consequently it is necessary that additional information be maintained in his office. The accounting system appears to more nearly satisfy some of the requirements of the district management personnel than those of the State Highway Engineer.

c. The changing population of the cities and counties of the State of Texas results in similar changes in the requirements for highways and roads in the districts. The Interstate Highway program also results in changes in the work volume between districts as phases of the program are started and completed. The dollars of construction incompleted and authorized per engineer varies greatly between districts.

d. In the present accounting system, coding and classification is controlled at the district level where reports are prepared. Reporting to the headquarters divisions is in summary form. The result is that the districts are evaluated on the basis of data that is prepared at the district level. The internal audit function strives to prevent serious or extensive miscoding or misclassification. The application of decentralization in the area of accounting appears to have been extended beyond the level for most effective management control.

e. In a decentralized operation, each organizational unit tends to be independent and self-reliant which tends to inhibit the efficient and economical combination or consolidation of activities and equipment. The development of the data processing operations within the Department has followed this decentralized approach with the result that there is a duplication of equipment and activities. There are data processing installations in five separate divisions. Four of these installations primarily serve only the needs of the particular division in which they are located. Data processing installations are located in the Computer Center of the Operations Division, the Accounting Division, the Motor Vehicle Division, the Planning and Survey Division, and the Right of Way Division.

f. Throughout the Department there are similar records, and in some cases duplicate records to those that are being maintained elsewhere. In addition to being inefficient, this creates confusion as to which records are official. Many accounting records which basically reflect the same data being maintained in various divisions in different forms. Some of the records are more complete or more detailed than others and are prepared at different times. Each division tends to rely only upon its own records.

g. The development of systems within the Department is decentralized. Each division develops the systems for its own operations. These efforts are not coordinated and as a result do not meet the overall needs and requirements of the Department. This encourages the development of specialization at the expense of the development of general management ability. Communication between divisions becomes more difficult as differences between divisions are stressed.

h. Each division contacts outside agencies independently concerning its own specific operations. There is little coordination of these relationships. Consequently several divisions may be negotiating with the same agency. An example of this is that both the Secondary Roads Division and the Bridge Division negotiate with railroad companies. Many divisions contact the Bureau of Public Roads. Aid, Accounting, Right of Way, Secondary Roads, Highway Design, Bridge, Planning Survey, Construction, and Administrative Divisions all deal with the Bureau on different, but related, matters. This has an adverse effect upon planning and increases the possibility that one division may contradict or act contrary to the best interests of another division.

i. Employment practices and training activities vary among districts and divisions. Recruiting of technical personnel at colleges is performed by the district in which the particular college or university is located. Training programs are developed and conducted by various divisions and districts without regard to the overall needs of the Department. Personnel are recruited and trained on the basis of the needs of the separate division or district. Planning of long range personnel requirements is not performed on a coordinated basis.

j. The headquarters divisions are organized on the basis of specific assigned activities rather than general functions. The organization tends to be people-oriented and short range. Responsibilities of the divisions are frequently divided or overlap those of other divisions. An example of the interaction which is required between divisions is the processing and administration of contracts. The Highway Design Division issues the authorization numbers for preliminary engineering. The Construction Division prequalifies contractors for bidding. The Highway Design, Bridge, and Secondary Roads Divisions assemble the necessary blueprints and proposals to be used for bidding purposes depending upon the nature of the construction. The Highway Design Division advertises for all bids and prepares the notices to contractors. The Construction Division mails the notices to contractors and issues proposal forms. The Construction Division supervises the opening and processing of bids. The Highway Design, Bridge, and Secondary Roads along with the Construction Division review the bids and make recommendation regarding the award of the contracts. The Aid Division prepares the construction contracts and administers the qualification of bonding companies. Plan changes, supplemental agreements, and extra work orders are reviewed and approved by the Construction Division and these changes may be reviewed by the Highway Design, Bridge, and Secondary Roads Divisions. The Construction Division coordinates these changes with the Bureau of Public Roads when there is Federal aid participation. The Aid Division executes Federal project agreements and prepares the vouchers for construction and right of way. Field inspection of construction is performed by the Construction Division and the Bridge Division inspects the construction of bridges. This describes only the participation of divisions and does not indicate the operations of the districts that are concerned.

k. The function assignments of the district staff organizations vary widely from district to district even when the workloads of the districts are roughly equivalent. For example, Houston's district laboratory is assigned to the District Design Engineer and San Antonio's district laboratory is assigned to the Assistant District Engineer who also supervises accounting and warehousing. In Houston, accounting and warehousing are functions assigned to the District Maintenance Engineer. (see Exhibit II.B.1.-3 and 4). These and other various organizational patterns within the districts tend to emphasize differences between otherwise similar districts, and detract from the effectiveness of Austin headquarters liaison.

The division of responsibility and the duplication of activities which we have observed appear to result from the effort to organize and manage the headquarters divisions in the same manner in which the districts are organized and managed. The divisions have been organized in terms of their assigned activities rather than basic function. The basic function of a division is different from that of a district. The objective of a division should be to aid in the management of the Department at the headquarters and district levels. The secondary function of a division should be to support the field organization by providing service and technical skills that are not feasible within each district. It appears that

too much emphasis has been placed on this secondary function. The uniqueness and differences of divisions has been emphasized rather than their similarity. This has hampered development of joint thought and effort, and has over emphasized the development of independence and self-sufficiency among the divisions.

One of the most important functions in any organization is that of financial management. It appears that this function has been neglected in the organizational planning of the Department. The accounting function in the present plan of organization has the character of being a monitor or auditor of the propriety of the use of the funds of the Department. Accounting personnel have not participated fully in financial management activities. The accounting system has effectively satisfied basic and statutory requirements but has failed to keep pace with the expanding scope of operations and the increasing financial management and cash flow problems of the Department. The need for analysis of information has been subordinated to the mechanics of processing. The breakdown or classification of data and the extent of detail has been determined largely by the economy of processing rather than by management requirements. Modern developments in management information science and data processing can contribute to the effective management of decentralized operations. The use of exception reporting techniques helps to increase the span of management control by directing attention to areas that are critical and by providing information in the most useful form to the field organization to aid them in making decisions and in initiating corrective actions.

3. Organizational Recommendations

a. Fiscal Management Division

A new division should be created by combining the functions of the existing Aid and Accounting Divisions and adding to this combination certain other accounting functions now performed in several other divisions. The name of this new division for purposes of this report will be The Fiscal Management Division, although it could be assigned any similar name which carried forward the connotation of consolidating the functions mentioned herein.

The Fiscal Management Division should coordinate all accounting and financial reporting activities of the Texas Highway Department. This will facilitate the development of a new system of accounting and centralized control of fiscal affairs that is based on the overall management needs of the organization. This new Division should serve to broaden the present concept of accounting and emphasize management control and planning information. The Fiscal Management Division should be directed by an executive who is experienced in financial management. The primary responsibility of the director will be to determine the financial management and control information requirements of the divisions and districts on a continuing basis in relation to the overall objectives of the Department, and to direct the Fiscal Management Division to satisfy these requirements. He should guide and direct the development of the financial

and accounting policies of the Department and insure that the Department complies with and meets regulations and requirements of the State. The Director of this Division should be management minded and must be familiar with highway construction and maintenance. He must not only be able to plan, but must also be able to assist other members of the management organization in their planning.

The basic function of the Fiscal Management Division will be to assist the State Highway Engineer in the financial planning and control of all operations of the Department. It should not only gather and process accounting data, but should also analyze and comment on the reports prepared. The value of any information can be appraised on the basis of the action to which it leads. Information that is not reviewed and interpreted can be of little value in terms of leading to corrective action. To maximize the usefulness of data, the principle of exception reporting should be used. Under this principle only major deviations from plans or standards are reported to highlight the need for management action in a particular area. The Fiscal Management Division must take the lead in this analysis and in encouraging corrective action.

Specifically, the intended functions and responsibilities of the Fiscal Management Division can be listed as follows:

1) To determine the financial requirements for meeting the future plans of the Department in all activities.

2) To forecast cash income and disbursements in order to determine the extent to which future plans can be implemented.

3) To consolidate and formulate budgets and report on deviations therefrom.

4) To control expenditures through the use of proper authorization procedures, budgets, and other appropriate methods.

5) To report and interpret the financial performance of the entire operations of the Department.

6) To maintain the necessary ledgers, records, files and support for all activities of the Department.

7) To furnish financial, accounting, and management control information to the districts to aid them in planning, directing, and controlling district operations, prepared from source data originated by the field organization.

The Fiscal Management Division should be organized in five functional sections. Each section will be responsible for one or more major functions of the Division. The suggested sections are as follows:

Fiscal Accounting Section
Cost Accounting and Aid Section
Budgetary Planning Section
Internal Audit Section
Business Data Processing Section

The sections will be divided into work units as shown in Exhibit II.B.3.-1. A Manager will be assigned to plan and supervise the activities of each section and to coordinate the activities of his section with the other sections. The Managers will report to the Director of the Fiscal Management Division. Their management ability will be of critical importance to the successful implementation and administration of the recommended system.

b. Fiscal Accounting Section

The Fiscal Accounting Section will perform those functions which are identified with the traditional concept of accounting as indicated in Exhibit II.B.3.-2. This will include the preparation of financial statements, the maintenance of accounting ledgers (or print outs), the preparation of vouchers for payment, and the accounting for the receipts of the Department. Any activity presently performed in the Department that is directly related to these functions should be transferred to this section, as is illustrated in Exhibit II.B.3.-3.

Some activities now performed in the Aid Division and in the Motor Vehicle Division will be consolidated in the operation of the Fiscal Accounting Section of the Fiscal Management Division. For example, the right of way accounting and processing of payments to contractors which is presently performed in the Aid Division should be assigned to this section. In addition, the accounting for cash collections into the State Highway Fund which is presently performed in the Motor Vehicle Division also should be assigned to this section.

The Fiscal Accounting Section should be divided into six units as shown in Exhibit II.B.3.-2, with general duties as shown on the chart. Some of these duties are presently being carried on, and Exhibit II.B.3.-3 shows the source of the proposed functions in terms of where they presently exist. Under the revised accounting system, many of the intended functions will not exactly resemble their present form. For example, the maintenance of almost all ledger records will be performed mechanically by the computer. This function will no longer involve operating a bookkeeping machine, or posting a manual ledger, but rather will be concerned with the filing and orderly maintenance of computer print outs of ledger records. As another example, payments to contractors will no longer

be subject to the present clerical procedures, but will be calculated by the central computer system. This function, therefore, will be changed from an essentially clerical job to one of editing and reviewing the validity of the input data (quantities) and similarly editing and reviewing the output reports for reasonableness and validity before approving payments to contractors.

Employee accounting should encompass the field of both payroll and personnel record keeping. Provision will be made on the master employee record maintained in the computer for recording personnel type data as well as accounting data. For this reason, the Employee Accounting Unit should alter its functions from the present functions to include the edit and review of input data forms on personnel status as well as on earnings.

Cash collections or cashiering should be handled by a single unit. It will combine the functions now performed in Maintenance Operations, Motor Vehicle and Accounting Divisions concerning cash. This does not, however, mean that the physical location of the entire unit must, or even should be, in one place. Direct responsibility for the function should be in the Fiscal Management Division.

c. Cost Accounting and Aid Section

The Cost Accounting and Aid Section will be responsible for the accumulation and reporting of the costs of all highway operations and for the billing and collection of Federal aid. The functions of the section are shown in Exhibit II.B.3.-4 with work units to handle Road and Asset Accounting, Construction Accounting, Maintenance Accounting, Billings to Outsiders, Project Cost Accounting, and Project Numbering and Control. Functions to be transferred to this section are shown in Exhibit II.B.3.-5.

Road and asset accounting is presently performed in several places within the Department. For example, inventories of all highways are kept in the Maintenance Operations Division, the Planning and Survey Division, and in punched card form in the Accounting Division. In addition, supplemental data is also kept in the Design Division. Under the system proposed, one master file of roads would be kept by the computer, and reference to print outs of this file would be made to answer many of the present questions about the status of the highway system, total mileage by type, etc. Cost information would be maintained by this unit for purposes of making road life studies.

Additionally, the unit would also maintain data concerning the status of other assets owned and operated by the Department. Depreciation records are currently kept in the Accounting Division for each unit of the Department's equipment, and the operating costs of equipment are also maintained in the Accounting Division. Some of these data are duplicated in the Equipment and Procurement Division. Under the proposed organizational plan, all of this common data would be kept by the Road and Asset Accounting Unit.

Maintenance accounting is presently performed in the Maintenance Operations Division. Records are kept concerning the status of district maintenance budgets, and monthly reports are prepared for management review. These functions should be transferred to the Maintenance Accounting Unit, and as most of the maintenance accounting records will be prepared by the computer, the duties should be changed to place more emphasis on analysis and comparison.

Although the proposed system contemplates eliminating much of the hand manipulation and posting of data, there still should be a unit set up with the function of reviewing and analyzing the cost accounting records which are printed out by the computer. A need will exist for preparing correcting journal entries, and for interpreting the results as shown by the cost accounting records. These functions should be performed by the Project Cost Accounting Unit.

Project numbering and control section numbering assignments are presently made in the Highway Design Division. This important control function should be assigned to the Cost Accounting and Aid Section of the Fiscal Management Division in order to facilitate the interpretation and analysis of computer output in relation to the project designators, or numbers, assigned to accounting units.

Billings to outsiders, including the Federal government, should be handled by a separate unit. This function is presently handled in the Aid Division. It would continue almost without change from the present, except that much of the record keeping would be computerized.

Billings to Outsiders, Project Cost Accounting, and Project Numbering and Control would all be under a unit called Construction Accounting. The general duties of this unit, besides the specific functions of the sub-units named, would be to gather and maintain Statewide and areawide cost averages and indexes for the purpose of comparing and analyzing cost data.

d. Budgetary Planning Section

The basic function of the Budgetary Planning Section will be to coordinate the planning of budgets and programs, and forecasting of cash requirements of the Highway Department. The functions of this section (presented in Exhibit II.B.3.-6), will include Program Compilation, Program Status Reporting, Budget Compilation, and Cash Forecasting. Functions to be transferred to this section are presented in Exhibit II.B.3.-7.

Construction programs are presently compiled by the Programming Section of the Administrative Division, and the status of programs and projects is reported through a computer program developed and administered by the Highway Design Division. The process of compiling and presenting the program submissions of the various districts and then coordinating the reviews which take place among the Austin division heads should be associated with the Fiscal Management Division so that various projections and forecasting techniques can be used with full knowledge.

The annual preparation of the budget is presently handled by the Director of the Accounting Division. The Maintenance Operations Division and Equipment and Procurement Divisions also compile parts of the overall budget. More effective coordination and control of the budgeting process can be achieved by having all budget functions assigned to one unit.

The Budgetary Planning Section should be concerned not only with planning on a financial basis, but should also be concerned with compiling statistics and data concerning the manpower requirements for performing the work in the districts and divisions. They should assist the districts in the development of manpower scheduling and control techniques and coordinate the reporting of progress in terms of man-hours as well as dollars.

Many of the functions of the Budgetary Planning Section are not now formalized or documented. For example, cash forecasting as practiced by the present Accounting Division is not now assigned to a functional organization unit because it is only performed once each year. However, a revised system of cash forecasting is recommended which will require a small group of personnel to administer.

Similarly, compilation of the budget is presently an annual task. Under the proposed procedures, considerably more attention is focused on budgeting, both in the compilation of the budget, and in the admistration and reporting of deviations from the budget. Accordingly, more personnel have been projected than are presently working in this function.

e. Internal Audit Section

The Internal Audit Section presently functions in two major capacities; one in conducting field investigations to determine that accounting procedures are being followed, and the other in the development and training of district accounting personnel in new or revised accounting procedures. That the present procedures function in accordance with their intended purposes as well as they do is in large measure due to the remarkable work of the present Internal Audit group. However, because of the large task of converting to a mechanical system, and because of the continuing need to monitor and update systems, it is recommended that the systems training function be transferred to the Systems Unit of the Business Data Processing Section.

The Internal Audit Section will continue to conduct the necessary field investigations to determine the compliance with approved accounting policies and procedures, and to insure that input data is properly originated and classified in the districts and divisions. It will perform the functions presently assigned to the Internal Audit group in the Accounting Division. It should also expand its operations to include routine investigations of the Austin divisions.

The functions of this section are presented in Exhibits II.B.3.-8 and 9. The consolidation of all accounting functions into the Fiscal Management Division should facilitate the work of the Internal Audit Section.

While the task of changing from manual to mechanical accounting procedures will be formidable for the operating personnel of the Accounting, Aid and other related divisions, the job of learning and applying new audit techniques will also be a large one. It will be the responsibility of the Manager of this unit to see that the necessary understanding and appreciation of modern data processing techniques is acquired so that auditing computerized procedures will be up-to-date and thorough.

In many commercial and industrial enterprises, the internal audit function is carefully separated from the accounting and financial function, on the theory that independence of the audit function is hampered when it is a part of the organization which it is auditing. However, this is not the case in the Texas Highway Department, where the purpose of internal audits is not to examine the records and accounts of the main accounting office, but rather to examine the records of physically separated divisions and districts. The main office records are audited satisfactorily by the State Auditor annually, and by the State Comptroller and State Board of Control on a daily basis. Nonroutine investigations (which are occasionally requested by the State Highway Engineer) are reported confidentially to higher authority, and it is expected that this practice can be continued under the proposed organizational plan without formally removing the Internal Audit Unit from the Fiscal Management Division.

f. Business Data Processing Section

To insure consistency of the accounting system throughout the Department, it is essential that the Fiscal Management Division be responsible for the development and installation of all accounting and management reporting systems and procedures. It is also important that the most suitable techniques of data gathering and control be used in the accounting system. These objectives can be realized most effectively by providing a Business Data Processing Section in the Fiscal Management Division. The functions of this proposed section are shown in Exhibit II.B.3.-10-11, and include units for Systems, Operations, and Programming.

The basic function of this section would be to design, develop, and process on a continuing basis all types of management control information, including accounting data such as payrolls and other payments, and also including budgets, cash forecasts, and man-hour estimates and comparisons. Engineering, design, traffic, and motor vehicle data processing applications would not be handled by this section, but would be the responsibility of other divisions. Computer applications of a nonaccounting and nonmanagement control nature would be developed and processed for the districts by personnel attached to the computer center at Camp Hubbard working in conjunction with division personnel on a specific project basis.

The Systems Unit of the Business Data Processing Section is a key unit in the section. Its function would be to design and develop refinements to procedures, and to design and develop completely new applications and methods for processing business data. This group should be given a broad scope and the freedom to cross division and district lines of authority in pursuit of the best overall systems development for the entire Highway Department. Much the same as the present consultants have been treated, this unit should be given all possible cooperation by all employees at all levels of the Department.

The Systems Unit should not have line authority, but should act in an advisory capacity. The decision as to whether or not to put into effect the recommendations of the systems analysts should rest with the administration of the Fiscal Management Division in counsel with other division heads. In this way, there should be little or no apprehension in dealing with the members of the Systems Unit.

The Systems Unit would not be concerned with computer applications alone. It also would be responsible for paperwork simplification and forms design throughout the Department, as it related to business or accounting type data. The Unit would be charged with preparing and keeping up-to-date all of the Highway Department accounting and paperwork manuals. These should include, not just manuals having to do with district office procedures, but also should include procedure manuals, not now written, covering the paperwork operations of the Austin divisions. However, some employees of the Systems Unit would be required to know a great deal about computer programming, although they normally would not be expected to write computer programs.

The Operations Unit of the Business Data Processing Section would be concerned with the actual processing of accounting and financial management data. To this unit would fall the responsibility of controlling and balancing input data and forms to prevent the accidental or intentional omission of data. This unit would also control and supervise the manual key punching of accounting type data from paper forms to punched cards or other machine processable media which may be later introduced into the system. The operation of the Fiscal Management Division computer and related processing machinery would be the responsibility of this Unit. In addition, any runs which are to be made on the large computer located at Camp Hubbard would be made by personnel attached to this Unit.

All computer programming for the Fiscal Management Division would be handled by its own Programming Unit which should be administered independent of the Systems Unit and the Machine Operations Unit. Personnel attached to the Programming Unit would be assigned to specific programming projects with the consultation of members of the Systems Unit. Programmers would be expected to conform to accepted standards of program documentation, and to make periodic progress reports on their achievements.

The art of programming or writing instructions for the operations of computers is relatively new. The activity was first started in about 1953 with the advent of internally stored programs rather than externally wired control panels for controlling the sequence of actions of the machine. As the jobs that computers were called upon to do became longer and more complex, the designers of computers handed over the programming or application of the machinery to another group, and they became known as programmers. Programming a computer can be compared to any other technical design process such as, for example, building a road. Just as there is a need for someone to make basic decisions about a roadway such as where to locate it (generally), what to use for materials, what the cross sectional patterns should be, etc.; so, too, there is a need for general design work in developing a computer program. This skill, as in roadway design, needs to be of the highest order. It calls for a technician who appreciates detail sufficiently well to make sound general decisions.

But once the broad concepts of a computer program are laid out and documented, a person with lesser skill and experience can take over. Just as the highway designer can rough out his basic concepts of design on some schematic drawings with notes and sections, so the skilled systems analyst or senior programmer can communicate his ideas on paper to a less experienced person to fill in the details. The notation of highway design is a series of plans, side sections, and cross sections, with appropriate structural drawings in three dimensions for structures. The notation of computer programming, although less highly developed (it is much newer), consists of a series of flow charts supported by logic block diagrams. As the most complex highway can be represented or simulated on paper by enough and proper documentation, so also can the most complex computer program be represented by drawings and diagrams.

The last process in developing a working program is to reduce the logic drawing to a series of coded statements or program steps which are understandable by the computer, and cause it to execute the desired actions. This program, usually in punched card form, is "read" into the internal memory of the computer, and there it stays, like a record being played over and over again, working on the data to be processed. The reduction of the logic diagram to machine language is called "coding", and may be compared to detailed drafting, which is the final step in preparing a set of highway plans. Coding can be performed by a fairly inexperienced person who has had fundamental training in the language of the particular computer, just as drafting can be performed by an inexperienced person with basic training.

g. Other Functions of the Present Aid Division

The Fiscal Management Division will consolidate the operations of the present Aid and Accounting Divisions. However, certain present functions of the Aid Division, notably the Contracts Section, should be assigned to the Construction Division. These functions include:

1) Preparation and administration of construction contracts.

2) Relations with the Bureau of Public Roads to obtain BPR concurrence on construction contracts.

3) Preparation of escrow agreements.

4) Maintenance of bonding and insurance requirements information.

h. Computer Center Operations

At the beginning of our study the computer center was a section of the Operations Division (see Exhibit II.B.1.-21). It was our recommendation that the computer center be made a part of a division specializing in technical services including reproduction and photogrammetry. This recommendation was put into effect in December 1965, by the creation of the Automation Division essentially organized as shown in Exhibit II.B.3.-12.

It is our recommendation that the programming services provided by the Automation Division be limited to engineering and technical programming assistance to the effected operating divisions. Computer applications having to do with bridge design should be the responsibility of the Bridge Design Division, and programs having to do with nonaccounting aspects of motor vehicle file operations should be the responsibility of the Motor Vehicle Division, etc. Personnel in the present computer center who are primarily programmers should be assigned to the operating division for which the major portion of their prior work has been performed.

In order that technical abilities be shared as needed, it is further recommended that a program project review committee be established among the division heads which primarily use the computer to determine the priority of program development projects. This committee would review proposals for computer programming projects submitted to it in a formalized fashion, and establish the priority and programming requirements of the projects it agreed were of prime importance. Specific individuals both from the computer center, and from within the affected divisions would be assigned to work jointly to place well documented operational programs in the hands of the computer center Operations Section. The committee should meet at least monthly, or if practical more often, to review progress reports and re-establish priorities. The programming projects would be under the direction of the particular division head affected, and all project personnel including systems men and programmers would be reporting to him.

As projects were completed and the need arose for an experienced programmer in another division, arrangements should be made to transfer programmers to the new division, still under the guidance and counsel of the program project review committee. The new project would be under the direction of the newly affected division head, and several division oriented personnel would normally be expected to be assigned full time to the project in order to make full use of the programmer. The goal of the systems-man/programmer teams would be to place fully documented programs on the computer for the use of interested districts and divisions.

In order to assure the best utilization of the computing equipment, it is suggested that a small pool of engineering and technical programmers be assigned full time to the computer center to act as trouble shooters, program test assistants, and consultants to the systems-man/programmer teams assigned to specific projects. This group would act strictly in an advisory capacity to the project teams, and would also serve as the communications link between the computer center and the districts and divisions with one or two men assigned the task of training the district personnel in the effective use of existing program packages. These men would also conduct formal programming classes both at the computer center and in the district and division offices in order to increase computer knowledge within the Department.

Actual operations of the computer center including the scheduling of time on the machine would be the responsibility of the Computer Operations Manager. It should be noted that with the configuration of computing equipment ultimately recommended, the problem of scheduling time on the computer main frame should be considerably less critical than with the present batch processor. Remote units in the major cities, the downtown design divisions, and in the computer center itself will allow single programs of a scientific or engineering nature to be run concurrent with other batch processing. This will, in effect, give each remote console holder a computer of his own with a full size memory and sufficient speed to solve problems immediately without the need for scheduling main frame time. The only critical schedules which may arise would be at month-end when business data processing requirements might conflict with traffic studies, or motor vehicle updating runs. The resolution of scheduling conflicts should be the responsibility of the Computer Operations Manager.

For those jobs which are suitable for batch processing on a routine daily basis, the Computer Operations Section of the Automation Division should provide the usual services of Key Punch, Data Control, and Machine Operations. (see Exhibit II.B.3.-12).

4. Other Organizational or Personnel Program Recommendations

a. District Territories

The district territorial assignments should be studied and where practicable changes should be made to equalize the workload. In the past two decades there has been a trend towards urbanization of the State's population. (see population change maps in the Introduction of this report). There has been no appreciable reaction on the part of the organization plan to this change except to add or transfer personnel. This has had an effect on our study and will have an effect on the implementation of our recommendations because it is extremely difficult for a district to make significant changes when it is understaffed or overstaffed. To reduce the physical size of the urban districts and enlarge the size of rural districts is one method of rebalancing the work loads and contributing to the already fast moving trend towards specialization in highway operations. The budgetary planning and manpower control methods mentioned elsewhere in this report will provide effective means for measuring and adjusting the extent to which a reassignment of territories should be made.

b. District Organizational Structures

Basically three organizational structures should be established for the districts; one for large urban districts, one for small rural districts, and one for medium sized districts associated customarily with Texas cities other than the four major ones. These structures would fit the district territorial pattern of today. If territories were reassigned, then only two patterns would be needed, rural and urban. Over a long period of time, a transition should be made towards appointing men to fill given positions rather than shifting functions to fit the ability of the incumbent. A long term goal should be to recognize unusual construction activity within a rural district (such as the Interstate program) and provide semi-temporary staffing over an appropriate period for meeting this semi-temporary need.

c. District Accounting Personnel

A statement of policy should be issued clarifying the authority to be given the chief accounting officer in the district offices, and the degree of functional responsibility which he has for following the procedures of the Fiscal Management Division. We recommend that the director of the Fiscal Management Division be given the functional and technical responsibility for the district accounting personnel, in the interest of the overall efficiency of the Department, and that the administrative responsibility for this group to be given to the District Engineer.

d. Houston Urban Office

At the best practical time, the Houston Urban Office should be merged into the operations of the Houston District Office and the combined forces should be reorganized to conform to the uniform plan for large urban districts.

e. Authority of Divisions

Steps should be taken to clarify the authority of the divisions. In cases of conflict with outside agencies specific policies should be written out to determine which division shall prevail. Over a long term, further study should be made of reorganizing the divisions according to their basic functions in order to strengthen the joint accomplishments of like tasks which are presently separated.

f. Employee Training

Training will be necessary for the effective implementation of the proposed new accounting and management reporting system. The management concepts which are included should be understood by as many people in the organization as possible. Technical training in specific subjects will be needed. Because of the pay differential between state personnel and nonstate personnel, the Department may have to rely heavily upon its own training programs to meet its needs for technical manpower. Coordinating this effort on a continuing basis would appear to be a proper function of the Personnel Division. There are many needs for employee education through a coordinated statewide program.

g. Skills Inventory

The Personnel Division should develop a skills inventory of all personnel employed by the Department. Often hidden skills are revealed which can be of great importance in developing new procedures or functions. This will be even more important in the future, and should be started at once. Provision can be made to carry certain basic skills data on the personnel portion of the employee master record for periodic processing, but the data must first be collected and classified.

h. Recruiting

Coordination of employment and placement of new personnel will be needed in conjunction with an aggressive recruiting policy to maintain the high level of engineering and technical personnel in the face of an increasingly intensive degree of competition from industry.

i. Compensation

The level of compensation in the Highway Department tends to be low in terms of the qualifications needed when related to industry. For example, the level of man that is required for the position of Director of the Fiscal Management Division would likely be reaching the upper limits of the present compensation grades. The compensation levels of the present administrative staff are low in comparison to positions of similar responsibility in industry. This, in turn, tends to keep relatively low, the entire compensation structure of the Department. Unless corrected, this inequity can result in either a lower quality of personnel, or the inability to hold qualified personnel or both.

5. Long Range Organizational Objectives

It has been necessary for us to evaluate and study these recommendations and the considered alternates in terms of the organizational requirements. We had to consider the structure objectively without regard to the qualifications of the people. Then it was necessary to determine whether our recommendations required abilities which were not presently existent in the organization. We also had to consider the changes which might logically be expected to take place in the organizational structure.

Basically the present structure of the Austin divisions is unsound. Too many people report to the top administrative management. It is based on activities rather than functions. But it has worked effectively for many years because working level employees have found ways to overcome the difficulties inherent in the organizational structure. Many of the division heads are approaching retirement age, as are second level supervisors. Without the qualifications and mutual experience of these people it is less likely that the present plan would function well. This becomes more critical as more and more top management personnel approach retirement age.

While the decentralized approach to management of the district operations is necessary, it should not be applied to the divisions. The headquarters organization should be based upon a functional alignment. While an immediate change may neither be feasible nor desirable, we suggest that a written long range goal be developed, and that personnel changes conform to this long range goal.

Data Processing Hardware

C. DATA PROCESSING HARDWARE

1. Description of the Present Situation

At the present time there are five major data processing machine installations in the Highway Department in Austin. There are no other data processing machines in use by the Texas Highway Department.

The five major installations and a short description of their functions are as follows:

a. D-21 Computer Center (Operations Division) located on the first floor of the Computer Building at Camp Hubbard. This is the largest single group of data processing machinery. As shown in Exhibit II.C.1.a.-1 there are 34 people, 22 machines, and monthly rental is about $32,500. This equipment is operated on a service center basis, and monthly billings are made to the districts and divisions for the amount of time actually used. Exhibit II.C.1.a.-2 shows the charges made in the past three years to the divisions and districts. Exhibit II.C.1.a.-3 shows that for all practical purposes the operation is sustained by the user billings.

A brief history of the Computer Center, as prepared by its personnel, is quoted for added background as follows:

> "In 1956, the Texas Highway Department conducted a study to determine the feasibility of using a computer to assist in the solution of Engineering problems. At that time an order was placed for an IBM 650 Computer. The equipment was delivered and installed in the latter part of the year and consisted of the basic IBM 650 Computer, and an IBM 402 (100 lines per minute) printer.
>
> During the first year of operation a letting and an earthwork program were written. A traverse program was obtained from the State of California and modified to meet the specifications of the Texas Highway Department. Utilization was low during this first year of operation due mostly to the fact that the field was not familiar with the computer. Extensive field trips were made to acquaint engineers in the field with the use of the computer and to determine other engineering applications suitable for computer solution.
>
> Over the next two years, geometric programs, bridge programs and new earthwork programs were written. The utilization of the equipment increased to such an extent that it was necessary to replace the IBM 402 printer with an off-line and an on-line IBM 407 (150 lines per minute) printer and to add magnetic tapes and core storage to the system.

Even with the additional equipment, it was quickly realized that a large computer was necessary to handle the work of the field, as well as processing and accounting problems that we were beginning to program. A study was conducted in 1959, and it was decided that a larger computer could not be justified but that an IBM 1401 should be obtained to assist in carrying the ever increasing load. In late 1961, when the 1401 was delivered, the computer section had more than 100 programs that were being processed on the IBM 650. These programs handled engineering problems, traffic analysis problems, accounting problems, warehouse inventory problems and one shot problems. The capacity of the IBM 1401 for handling input-output greatly increased the capacity of the IBM 650. Data processing problems, awkward on the IBM 650, were programmed for the IBM 1401.

Additional studies were conducted and it was determined that the computer section was doing only about 15% of the total engineering computations in the State, yet the IBM 650 was running over 90% utilization time and the IBM 1401 was running approximately 50% utilization time. In addition to this high workload, requests for programs were being received that could not be programmed economically due to the limited storage capacity of the IBM 650. This led to extensive restudy conducted by the computer section and a proposal was sent to the Administration to obtain a Control Data 1604-A computer to replace the IBM 650.

The CDC 1604-A was delivered and installed in February of 1964."

The work of the Center is concentrated in the engineering and scientific area with programs being run daily to serve the needs of the various field districts which use the computer services offered. Standardized programs are offered to the Engineers in the field to solve routine problems such as geometrics, traverses, earthwork calculations, and certain bridge design problems. In addition, the computer center processes bid letting programs and several other problems which are oriented towards operational functions of the department which are not strictly engineering in nature. The computer is also used to calculate matrix problems concerning traffic patterns in connection with research studies on traffic flow in urban areas.

b. D-11 Tab Shop (Accounting Division) located on the 4th floor of the State Highway Building. This is the largest of the tabulating machine shops. As shown in Schedule II.C.1.a.-1, there are 11 people and 15 machines located in this installation. The work consists mainly of punching tabulating cards from accounting vouchers and payrolls and using the equipment to summarize and list these cards for ledger postings. At the end of the year there is a considerable increase in the workload caused by various listings which are produced only once each year. The monthly workload is staggered so that an almost even amount of work is received in the shop each day.

c. D-10 Tab Shop (Planning Survey Division) located on the 4th floor of the Five Story Office Building at Camp Hubbard. This is a small tab shop which is used almost entirely for gathering and listing various punched cards concerning statistics of traffic usage. An inventory of official highway mileage is kept on punched cards for reporting to the BPR by classes of roads. Inventories of bridges are maintained on cards. The payroll of the division is prepared on this equipment.

d. D-15 Tab Shop (Right of Way Division) located on the 5th floor of the Five Story Office Building at Camp Hubbard. This is a small tab shop which was created after 1956 to assist in keeping the records of the Right of Way Division. The main functions are to punch cards from right of way documents and to maintain accounts for each parcel in each project to prevent duplicate payments and to know the status of right of way funds at all times. A transfer posting machine is used to print listings from the tabulator onto separate ledger cards which are set up for each parcel. Amounts are punched and posted at the time approved values are established so that the status of allocated funds can be carefully followed on each project.

e. D-12 Tab Shop (Motor Vehicle Division) located on the first floor of the Five Story Office Building at Camp Hubbard. This is a medium sized tab shop which uses 90 column "round hole" punched cards to serve the needs of the Motor Vehicle Division's Accounting Section. There are 10 employees. The main jobs are to punch and list daily cards from the cash collections made by the Accounting Section, and to maintain punched cards files on all boat and auto dealers in the State. These machines are not compatible with other machines used in the Department.

f. Other Equipment In addition to these five installations, there are several other machine accounting groups in the Highway Department. Specifically, thereare four bookkeeping machines used in D-11 (Accounting Division) for maintaining employee earnings records. There is a bookkeeping machine in D-7 (Aid Division) which has a key punch connected to it. This equipment is used to post project ledger cards with right-of-way payment information, and at the same time it produces punched cards which are run each month on the D-21 computer to prepare a Right-of-Way Certificate for use in billing the Bureau of Public Roads. Typewriter-Paper Tape Punch equipment is used by D-4 (Equipment and Procurement Division) for printing general warehouse shipping documents and preparing at the same time a punched paper tape containing certain data for further processing inventory and other applications monthly on D-21's computer.

2. Total Computer and Data Processing Potential Workload

For purposes of discussion and analysis, we have attempted to classify the total workload which can be performed on a central computer system into four major categories. These major classifications are described in terms relative to their handling on a computer system as follows:

a. Engineering and Scientific Work

In this category we include the routine daily problem solving runs which are presently being made in batches for the districts. Among the programs which are processed are standard packages for earthwork computations, traverses, bridge design, geometric point solutions, and others. Generalized solutions have been worked out and written down in manuals for use by the staff of the Department, who submit specific values for the standardized problems to the computer center for punching, running and printing.

Also included in this class is the development of new programs to solve specific problems of a general engineering nature. Each day a compilation is made of FORTRAN programs submitted from various programmers who are seeking unique solutions to problems. This includes programs of a scientific nature written for research purposes. Such programs are usually the forerunner of some generalized solution to a problem which will need solving repeatedly.

There exists a need for an effective means of processing engineering problems which are not repetitive but are sufficiently complex to justify use of the computer. The most satisfactory means of solution to these problems is to provide direct access to the computer by the designer. Problems should be formulated, tested, processed and solved quickly with the designer participating in all phases of the solution.

b. Traffic Problems

These problems require a large amount of computer memory, and usually involve the technique known as matrix inversion. Traffic studies are being made of the traffic patterns in urban areas, and in the testing of trial designs of highways to meet the demand shown by the studies. These requirements are fluctuating in time depending upon the activity of traffic research.

The amount of memory required for matrix inversion problems varies with the size of matrix being inverted. Computer capacity can be justified to solve many of the problems, especially if they are scheduled to be run during low demand periods. Extremely large matrices can be solved by renting computer time on outside equipment.

c. Business Data Processing

This category of work can be broken down into several main subdivisions as follows:

1) Accounting Work - This includes the processing of payrolls, ledgers, account status reports, cash receipts, etc. paying of warrants and preparation of financial reports.

2) Clerical Work - This includes the taking over of routine clerical jobs such as the compilation of haul tickets and calculating contractor's estimates.

3) Log Maintenance Work - This is the keeping of master records current and preparing routine and special reports from master records of personnel, equipment, roads, inventories of materials, and projects in process.

4) Cash Forecasting Work - This includes preparing estimates and cash flow forecasts for projects started or comtemplated in order to determine the rate of contract lettings and to plan the work schedules of the Department.

d. Motor Vehicle Division System

This workload of this Division centers around registration and title files which are maintained to provide current registration, current ownership, lien status and other pertinent information on all Texas motor vehicles. The system involves maintaining current information in automated form for approximately 6,000,000 motor vehicles and updating these records daily, as changes occur.

To provide for rapid, accurate updating of title and registration information these processes should be automated to the greatest extent possible. The impact of changes in registration and title procedures is felt by the public and all of the county tax collectors. Therefore, it is essential that the simplest and most foolproof system that is economically feasible be devised.

One important use of the registration and title files is to supply information to law enforcement agencies, government agencies, business and the public. This information must be available 24 hours a day, 7 days a week, and be quickly accessible.

Several other operations also are performed in the Motor Vehicle Division System and must be considered, these are:

1) Inventory of county license plates.
2) Forecasting future license plate requirements.
3) Scheduling and recording inspection of vehicle dealers and salvage yard.
4) Development of registration and title statistics in summarized form for management or commercial purposes.

Thus, the design of data processing systems for the Texas Highway Department should include consideration of these four major categories of work; Engineering and Scientific Work, Traffic Problems, Business Data Processing, and the Motor Vehicle Division System.

3. Recommendations

We have reviewed the proposals made by the personnel of the Computer Center to the State Highway Engineer concerning future computer hardware. In our opinion, these proposals are based upon the premise that the Motor Vehicle Division workload would not become an integral part of the Highway Department's overall workload, and the Motor Vehicle Division has not been considered in their recommendations. On this premise, these recommendations are valid as they provide a solution for an immediate and pressing need in the present configuration of machinery.

Our study of Motor Vehicle Division electronic data processing requirements indicates, however, that a joint solution to engineering and motor vehicle needs can be achieved by changing the size and type of the proposed computer to conform to that shown in Exhibit II.C.3.-1. This computer would have the capability to satisfy engineering requirements, solve many of the traffic problems, operate the Motor Vehicle System, and process the periodic data of the Fiscal Management Division. Large traffic problems involving large matrix inversions could not be handled by this computer and arrangements should be made to rent computer time on a large outside computer as needed.

The recommended computer main processor would be located at Camp Hubbard and would be supported by a separate key punch section to handle much of the input data. Full scale operation of the computer should be based on the number of shifts required to satisfy engineering, traffic and fiscal management needs. The Motor Vehicle System includes a requirement for 24 hour access, therefore the computer must also have the capability to meet this need on a limited use basis. Operation of the computer processor and control of the data would be the responsibility of the personnel of the Computer Center. Direct access would be provided for selected engineering groups and the Motor Vehicle Division. The recommended computer system is the latest type equipment, known as "third generation" computers. The monthly rental for a system of this scale would be between $40,000 and $50,000. It is likely that delivery of the equipment will be from 1 to 2 years after it is ordered. The lead time will permit training, development of systems, and conversion of data.

The technique for providing simultaneous access to many different users is known as time sharing. Although this concept is new it is presently being used successfully by many different organizations. Time sharing describes the capability of a computer to be shared by several "on line" facilities of its complex, even though each facility requires the operation of its own program and is concerned with responses unique to itself. The computer will process on a seemingly simultaneous basis, engineering problems, motor vehicle data updating, file inquiries, fiscal management batch processing, and other unrelated tasks.

The four most common features of time sharing systems are:

a. Simultaneous to the degree that a number of people are using the computer at the same time.

b. Instantaneous to the degree that all users receive responses to their interrogations within seconds - in some cases, almost immediately.

c. Independent to the degree that different services, programs or devices can be in use separately or in combination during any given period of time.

d. General purpose to the degree that no restriction is placed on the kind of program or application involved.

The computer complex shown in Exhibit II.C.3.-1 involves equipment located in several different organizations and cities. The largest amount of equipment will be located at the Camp Hubbard computer center but stations for direct access to the computer will be located in the Motor Vehicle Division, the State Highway Building, the Department of Public Safety and selected District Engineering Offices. The quantity of direct access stations shown is recommended as an initial system. However, the growth potential of the system is almost limitless. For example, a computer at the Massachusetts Institute of Technology, Project MAC, (Multiple Access Computer) has 500 remote, time shared, stations directly connected to it.

The Computer Center at Camp Hubbard will be the physical location of the computer and its principle related equipment. This equipment and its uses are as follows:

a. Central Processing Unit

This is the heart of the computer and contains the control circuitry, logic, arithmetic circuitry, and quick access memory. To handle the engineering problems and simultaneously provide inquiry to motor vehicle data we estimate that between 450,000 and 500,000 positions of memory will be required.

b. Magnetic Tape Units and Tape Control

Magnetic tape should be used to handle the processing of engineering, traffic, and fiscal management data and to process motor vehicle data which does not involve random inquiry. Magnetic tape is the most effective means of handling data which is not kept permanently in the memory of the central processing unit. Two channels are provided so that simultaneous processing of data and programs on tape will be facilitated. Eight magnetic tape units are recommended to provide for effective processing.

c. Random Access Units and Random Access Control

Random Access is the capability to obtain information from any part of a file without having to read the file sequentially until the data is found. The random access units will contain three types of files, Motor Vehicle Records, Indexes to the Motor Vehicle Records and the programs which are used for processing data. The Motor Vehicle Records include a master record for each vehicle. The records would contain title and registration data. The indexes provide for access to motor vehicle records by license number or vehicle indentification number. Program files provide a means of temporarily storing programs for quick access when they are called for. If a matrix inversion problem were put into the computer in the executive program the central processing unit would recognize it and obtain from program storage the necessary programs to complete the problem.

d. Input Output Units

At the Computer Center various methods of putting data into and getting data from the computer are provided. These units are normally used for "batch" processing. Batch processing involves accumulating input data for a period of time and processing it in a "batch", usually in a particular sequence, to provide for effective utilization of the equipment.

The optical scanner is an input device which can read symbols from a card or piece of paper and convert to the necessary computer language. Registration data will be the primary information read by the scanner.

The card Read-Punch is a combination input-output unit and is used to read punched cards and used to provide an output of punched cards for processing at another computer or at a later time.

The high speed printers are used as output for "batch" processing of data.

The plotter is a unique output device and converts computer language to graphic representation. The plotter would be used primarily to plot contour maps. Use of plotters has not been completely proven as a method of efficient output. Therefore, we recommend that the plotter be obtained on an experimental basis to determine if it can provide the required output economically.

e. Communications Control

The remote stations are connected to the communications control device for access to the computer. The communication control unit is a multiplexer which polls the remote stations to determine if a message is available for input to the computer and directs messages from the computer to the correct remote station. Additional remote stations can be connected to the first communications control unit. Also additional communications control units can be added to the central processing unit to provide for growth.

Eight remote stations are to be provided for use by the Motor Vehicle Division; six to be located in the Records Section, one in the Title Examining Section and one in the Communications Section. The Records Section units are of two types; one which provides a visual display of information on a cathode ray (television) tube and one which provides a typewritten output. The primary workload of the Records Section stations will be to answer inquiries for information from the Motor Vehicle Random Access File. The visual display devices will be used when a copy of the data is not required, for example, in answer to telephone requests. Registration and title data routinely required by the Correspondence and Title Examining Section will be obtained by Batch Processing. Each day the applications for titles, requests for certified copies of originals and other similar requests will be input to the computer and the required data will be provided by high speed printer in a batch. In addition, each section of the Motor Vehicle Division is provided a station for emergency use and for inquiry concerning exceptions. When the batch processed data does not seem adequate or accurate to the person handling the request, he may use the remote station. Although only eight stations are shown, as the workload increases additional units may be added as they are relatively inexpensive. Another area of potential growth could come through offering the county tax collectors an opportunity to obtain a remote access device to connect them directly to the Motor Vehicle Files. It is recommended that the operating costs of any such remote stations in the counties be assumed by the counties.

One remote station is planned to be provided in the Department of Public Safety. This station would be located in the DPS Austin Headquarters and service both the north and south loop law enforcement inquiry workloads. The Department of Public Safety would not be permitted to update data in the file but would have the capability to add suspension and stolen vehicle stop codes to the motor vehicle records. Locating a station in this Department provides the advantage of direct access and will significantly reduce the routine inquiry workload in the Motor Vehicle Division.

Remote stations for input, testing, and solution of engineering problems should be located in The State Highway Building and selected District Offices. We recommend that Houston, San Antonio, Dallas and Fort Worth be provided stations initially and that more stations be added as other districts provide justification based on volume and complexity of workload. The concept behind the use of these remote stations is to provide individual designers access to the computer on an "open shop" basis. By "open shop" we mean that a designer can, at any time, put his problem on the computer through his remote station and receive the solution on the same remote station as quickly as the computer can solve it. This concept provides for direct participation of the designer in the solution of his problem without having long periods of waiting between the time the problem is formulated and the solution is obtained. This concept is particularly useful when the problem's method of solution is not clearly defined. The designer can test each aspect of his program and modify it while the situation is still fresh in his mind. This concept has proven to be a highly effective method of solving design problems by many firms engaged in research and development and product design.

The remote station located in the State Highway Building would be shared by the Highway Design Division and the Bridge Division. As more designers begin to use this remote station additional stations can be provided. The remote stations would provide for the direct solution of problems requiring quick answers or for problems not suitable for batch processing. Those routine problems for which a general program has been developed should continue to be mailed to the Computer Center for batch processing.

Three tasks must be accomplished for successful implementation of the computer hardware as recommended. These three tasks are obtaining the equipment, converting the motor vehicle files to automated form, and the selection and training of personnel. In addition, arrangements should be made for rental of computer time on a large outside computer to solve the large traffic matrix problems.

Ordering the equipment is the determining factor in the sequence of actions to be taken as the delivery time is from one to two years after an order is placed. To accomplish this task promptly several steps must be taken as follows:

a. Develop a set of specifications for the equipment which is sufficiently detailed to enable vendors to prepare a proposal and bid.

b. Select several qualified vendors and submit the specifications to them.

c. Evaluate the bids received from vendors and select the vendor or vendors and the equipment to be installed.

d. Develop a plan for physical facility modifications based on the requirements of the selected equipment.

The equipment should be installed just prior to a registration renewal period so that conversion of motor vehicle files may be limited to the title files. Registration data can be directly converted during the renewal period. The activities necessary to accomplish this task are:

a. Define the exact method of conversion and write specifications for a contract to be submitted to selected contractors.

b. Write a program to maintain the records as they are converted.

c. Select a contractor, begin conversion and updating title files. This should be scheduled for completion just prior to installation of the equipment to minimize unnecessary file updating.

Important in any system are the people who design, program, and operate it. Care should be taken in their selection and thorough training should be provided. In addition, retraining should be provided for persons holding jobs which will be assumed by the computer system. It is important

that the personnel be selected as early as possible. They will be needed for conversion programming and for detailed systems design of the programs which are to be implemented. A slightly different situation exists in the district engineering offices which are to have remote stations, because every designer must receive training in the computerized solution of design problems.

The conversion section of this report contains a thorough treatment of the tasks which must be accomplished and their relationship to one another.

To provide for current data processing requirements and to enable conversion of engineering, traffic, certain fiscal management, and motor vehicle data to the large computer, certain immediate modifications should be made to the existing computer equipment at Camp Hubbard, as follows:

a. Strengthen the present computer equipment by trading the present small peripheral computer for a later model which will be more compatible with the present large computer. The exchange computer should have four magnetic tapes that are interchangeable with the present large computer.

b. Retain the four magentic tape units on the present large computer but expand the overall large system to an eight tape system, through tape switching with the new peripheral computer.

c. Utilize the complete eight tape system for testing motor vehicle and fiscal management programs which will ultimately be installed on the large third generation computer.

d. Use this interim system for conversion of the motor vehicle files. Tapes received from the contractor performing the conversion can be tested, and updating of the motor vehicle records can be processed periodically as a sufficient quantity of changes are accumulated.

Modifications of the present computers should be initiated as quickly as possible. Current needs exist and these modifications will be required soon after the Motor Vehicle file conversion is undertaken.

To provide for repetitive daily data processing requirements of the Fiscal Management Division, a small computer system is recommended for downtown use by the Fiscal Management Division. The recommended configuration is shown in Exhibit II.C.3.-2 and includes the following equipment:

a. Central Processing Unit

b. Card Read Punch and High Speed Printer for input and output

c. Two Magnetic Tape Units for Processing Data

To support this system several pieces of auxiliary equipment should be obtained. The auxiliary equipment includes two card sorters and an optical scanning punch. In addition, a separate key punch section will be required to handle exceptions and various input documents. The capacity of the central processing unit should be approximately 8,000 positions of memory. Large processing jobs, such as month-end or year-end processing, should be processed on the computer system at Camp Hubbard.

The workload of this computer would include the work of the existing tabulating card shops as well as the processing of accounting data from the districts. Imprinters will be utilized in the districts to encode on cards the accounting data required. These cards will be input to the optical scanner-punch, which will read the symbols and punch the data into the same card. These cards can then be put into the small computer system through its card read-punch, and be written onto magnetic tape for further processing.

4. Benefits of the Recommended Plan

a. It avoids the immediate merger of new business data processing applications into the main computer center, and provides limited computing machinery to the Fiscal Management Division for processing much of its workload.

b. It keeps separate the distinct tasks of controlling accounting data and engineering and scientific data. Under this plan the Fiscal Management Division would receive and convert all input data to machine media under its own control. It would also be allowed the use of the larger computer on a second shift with its own operators as required at month-end and year-end.

c. It overcomes some of the immediate problems of distance between the State Highway Building and the Camp Hubbard computer center.

d. It provides a means for accomplishing the conversion of motor vehicle files prior to installation of the large scale computer.

e. It provides for the Motor Vehicle Division needs without requiring a second large scale computer center.

f. It provides for remote stations for the solution of engineering and scientific problems on an immediate basis in the larger urban offices and at the State Highway Building.

g. It allows for the continued economical batch processing of routine problem solutions.

h. It provides for almost limitless expansion, for inclusion of a data plotter and a second output printer, all on the type of computer main frame which will be most economical.

i. It provides for processing traffic analysis problems on an off site commercial computer without requiring excess capacity on a full time basis at the Highway Department.

j. By keeping business data processing applications partially separated from the engineering and scientific work, this plan provides compatibility with any future plans for combining some business data processing applications with other State agencies.

k. In terms of economics, it provides for the immediate merger of the four major tabulating shops into the Fiscal Management Division Computer. These shops have an aggregate monthly cost of almost $15,300 which, if converted to a single small computer, would substantially pay for it and the necessary operating personnel.

l. The rental of the computer configuration shown in Exhibit II.C.3.a.-1 will be $40,000 to $50,000 per month, which, considering the Motor Vehicle Division workload, will be substantially less than the comparable rental of dual computers for engineering and motor vehicle work. By comparison, another major state has 100 full time people in the computer function and pays a monthly rental at present of over $36,000 for three medium sized computers. This state is presently converting to a third generation type computer.

Motor Vehicle System

D. MOTOR VEHICLE DIVISION SYSTEM

1. General Concepts

The Motor Vehicle Division of the Texas Highway Department exists to administer the Texas Motor Vehicle laws which pertain to the registration of vehicles, the recording and processing of Certificates of Title, and to a lesser degree the actual operation of motor vehicles. The Division processes all revenues from the annual registration of vehicles. These revenues are collected, by law, by county tax assessor-collectors who sell license plates to the motoring public. Duplicate copies of license receipts are presently sent to Austin together with a weekly cash report prepared by the county, and a check in payment for the registration fees collected, less an amount retained as the county's commission. Thus, the 254 Texas counties are, by law and practice, directly concerned with the procedures used by the Motor Vehicle Division for issuing new plates, and for collecting for them.

Additionally, the Motor Vehicle Division maintains, in Austin, an immense file containing copies of all the Certificates of Tile issued for every motor vehicle in the State. This file and the file of duplicate license plate receipts are used on a 24-hour-a-day basis to answer questions concerning the ownership of vehicles which are directed to Austin by law enforcement agencies and others. The present manual filing system and corresponding inquiry service are usually very efficient; requiring as little time as 40 seconds to retrieve one record from among 6-7 million.

In order to change the ownership of a motor vehicle, it is necessary to withdraw the present Certificate of Title from the file, and compare data on it to data which is submitted on the application for change. At present, there are approximately 8,000 such applications per day in Texas. During and for several weeks after the annual registration season, which lasts from February 1 to March 31, it is very difficult to secure current year license data from the Motor Vehicle Division, because many duplicate license plate receipts are in the process of being sorted and filed.

To provide better services at reduced costs, we recommend that a substantial portion of present procedures in the Motor Vehicle Division be converted to computer processing.

The system which is recommended is designed to achieve the following specific improvements in operation of the Division:

a. An even further increase in responsiveness. This will be accomplished by reducing inquiry response time, eliminating out-of-file delays, and by maintaining the file in a more current condition at all times.

b. An increase in public convenience and decrease in county workload by simplifying county procedures.

c. An increase in overall control by more positive document editing, and more accurate collection of data.

d. Availability of new methods of data analysis and exception reporting which highlight abnormal or illegal situations.

e. A reduction in operating costs by fewer manual data handling steps and improved physical facilities necessary to maintain the system.

f. An increase in overall system capability by the expansion of the number of different services which can be provided.

2. Registration System

a. The Registration System proposed for the Motor Vehicle Division includes consideration of the following functions:

1) A means for automatically processing high volume registration renewals with manual handling of exceptions only.

2) A means for handling new inputs and changes to the file such as new vehicles, out-of-state registrations, and vehicle transfers of ownership.

3) A means for handling special registrations such as:

a) Boats

b) Personalized license plates

c) Dealers

d) Amateur radio operators

e) Antique autos

f) State officials

b. The proposed system for registration renewal would require two renewal periods for full implementation. The first year would provide for input to the computer system to add registration data to the vehicle master record which had been already partly established by an earlier conversion of the title files. The first year would also serve to provide a document which could be read automatically during the second annual registration and would enable direct input to the computer. The concept of the new registration renewal system is based on the premise that usually only the license number changes when registration is renewed. In some cases, however, other data, such as address changes, will occur. These must be handled on an exception basis.

The first year registration should utilize a registration receipt form as shown in Exhibit II.D.2.b.-1. The data on the form is identical to the present form, except that certain heading data is printed in a type font that can be optically read. This includes a form number and the vehicle license number. They are both printed in special type which can be easily read by man and machine. The license number on the present receipt is preprinted only in standard arabic characters. The form number, which is new, will enable the computer to recognize the classification of the vehicle and establish the correct type of master record and corresponding record format. This aspect of the system is discussed under Records, Section II.D.5. Also on the form is a designated position for a sticker to be placed during the second annual registration.

The flow chart for county registration procedures for the first year is shown in Exhibit II.D.2.b.-2. The registration receipt for use in this first year renewal period is a five part document with the last part on card stock. In the case of commercial vehicles a six part form is required. The reason for the card stock is not to improve the mechanical readability of the form but simply to minimize mutilation of the form during the year.

Assume that the first registration renewal period under this system will be in 1968:

The procedure begins by the owner arriving at the county tax collector or deputy to purchase his license plates. He has with him his title, to prove ownership, and his 1967 registration receipt. The deputy examines these documents, determines the correct fee by referring to precalculated tables, and then prepares the owner's 1968 registration receipt. This involves collecting money for the amount of the fee from the owner, delivering the proper set of license plates and typing a 1968 registration receipt, just as is presently done. However, when the deputy is preparing the 1968 registration receipt it will not be necessary for him to completely fill out the form. Only those elements of data are required which are new and not part of the already existing title master record, or which are apt to be more current or reliable than the title data (such as address). The deputy will also need to accurately enter the vehicle identification number so that the new receipt form can be later input and matched to the master computer record according to this number. During the first year the following elements of data will be required for passenger cars:

1) Owner name

2) Owner address (include zip code)

3) Diesel fee

4) Penalty fee

5) Number of months

6) Total fee

7) Vehicle identification number

Other vehicle data will already be on the master record, having been obtained from the more reliable title document. For commercial vehicles the entire receipt form must be filled in by the deputy since the owner is required to carry one copy of the receipt in his vehicle, separate from the title document.

After the deputy completes the registration transaction the card stock copy, (copy 5) is given to the owner with his plates and title. Two of the tissue copies may be kept for filing in the county office. The other two copies are sent to the Motor Vehicle Division in Austin for further processing. For commercial vehicles one extra tissue is given to the owner to carry in his vehicle.

Under the proposed system it will no longer be necessary for the county tax collectors to make the present weekly registration report, compute the state's portion of the fees collected or forward the cash payments to Austin with the license receipts. It is recommended, however, that registration receipts be sent daily to the Motor Vehicle Division instead of weekly. The tax collector may wish to prepare a tape of the total license fees collected for his own auditing purposes, but no report will be required by the Motor Vehicle Division. Billings to the counties will be prepared by the Highway Department's Fiscal Management Division.

The receipt processing activities of the Motor Vehicle Division during the first year are shown in Exhibit II.D.2.b.-3. The Motor Vehicle Division, upon receipt of the registration receipt documents from the county, will file one copy by license number. This copy will provide for backup in case the other is lost or destroyed. The other copy will be keystroked for input to the computer system. It is recommended that this keystroking be typing on a continuous form which contains the format of the registration receipt and is optically legible type. Verification can be made by proofreading rather than by a second keystroking process. The registration receipts next are input into the computer system and are matched with the applicable master vehicle record. The receipts are edited for completeness and if acceptable are recorded in the county ledger account. Those registration receipts which do not match a master vehicle record or are rejected by the edit procedures are printed out by the computer for subsequent correction by registration examination personnel. A summary of the day's transactions is printed out together with separate fee computations for each county. One copy of this computation is sent to the county for validation and one copy is sent to the Fiscal Management Division for input to the county control ledger. Weekly billings will be prepared and sent to the counties by the Fiscal Management Division.

During the second registration renewal year, (1969 in our example) some significant changes in procedures will occur. The recommended county procedures for the second registration renewal period are shown in Exhibit II.D.2.b.-4. This procedure will be followed in all subsequent years, and represents the permanent operating system. In this procedure the registration receipt is changed to a four part document using a format similar to the 1968 receipt. In the case of commercial vehicles a five part form is required. A layout of the proposed receipt is shown in Exhibit II.D.2.b.-5.

The procedure starts with the owner arriving at the tax collector or deputy with his title and 1968 license receipt (copy 5, the card stock form with optical type font license number and form number). After these documents are reviewed, the deputy prepares the 1969 registration.

In addition to the 1969 license receipts and license plates a roll of stickers will be provided to the deputy. These stickers will be packaged with the 1969 license receipts and plates. They will be printed with 1969 license numbers which correspond to the license numbers printed on the 1969 registration receipts and the 1969 plates. The printing on the sticker is in the same special type font as the receipt and can be read by optical scanning equipment. The sticker printed with the 1969 license number is placed on the 1968 registration receipt which the owner has presented. The new 1969 registration receipt is then prepared just as in 1968 except that only the vehicle identification number need be entered. The owner will be asked to sign the 1969 card stock copy which he will retain. The county tax collector may elect to have his deputy also enter the total fee so that fee receipts may be audited at a later time. In the case of commercial vehicles the entire 1969 receipt form must be filled out because a copy of the new receipt must be carried in the vehicle. In the case of a change in address or other similar changed data, these should be made directly on the new registration receipt in all cases. Many types of data changes, however, must be made through title file change procedures and will not be routinely accepted on registration documents.

Once the 1969 registration receipt form is complete the card stock copy is given to the owner with his 1969 license plates and title. Commercial vehicle owners are also given an extra tissue copy of the receipt so that it can be carried in the vehicle. The card stock copy of the 1968 receipt which was received from the owner and which now has the 1969 license number sticker on it, is forwarded to the Motor Vehicle Division in Austin. In case of an address change one tissue copy of the 1969 receipt is also sent to the Motor Vehicle Division. If no changes are made, then this tissue copy can be destroyed by the county. In case the owner has lost the 1968 card stock receipt, but can otherwise prove registration in 1968, a general purpose card can be substituted on which the 1969 license number sticker is placed. The correct form number according to vehicle type and the old (1968) license number is then hand written on the general purpose card. The last three digits of the permanent vehicle identification number should also be written on this form so that errors can be detected by computer matching license number and vehicle identification number of the

receipt to the vehicle master record. This card will be routinely rejected by the optical reader on the computer since the reader will not be able to recognize hand written characters. The general purpose card will then be sent to be keystroked and then re-routed for subsequent input.

In the case of a license number sticker which is missing, torn or destroyed, the county deputy should be instructed to write the correct license number in the sticker space. The optical reader will similarly reject this document and it will be routed for manual keystroking. As in the 1968 renewal period no county reports or fees will be required to be sent with the receipts to the Motor Vehicle Division. Registration receipts should continue to be sent to Austin on a daily basis.

The procedures within the Motor Vehicle Division during this second registration renewal period are shown in Exhibit II.D.2.b.-6. These procedures will be repeated in all subsequent years. The registration receipt cards that are received from the county are immediately read by the optical scanner for direct imput to the computer system. Those items which cannot be read by the optical scanner are rejected. Together with the tissue copies of all data changes the rejects are keystroked prior to re-entry into the computer system. The computer first compares the data from the receipts to data contained on the vehicle master file and prepares an edit-error report so registration examiners can investigate and correct all unacceptable transactions.

For all registration transactions which do match the vehicle number and license number contained on the master vehicle file, the computer, through its programs, substitutes the 1969 license number for the previous license number on the master vehicle file and otherwise updates the master vehicle file with any changed data. In addition the computer is programmed to update the county ledger record for the appropriate county, and write out an old number-new number record for subsequent printing of index listings. The method for billing the counties remains the same as in 1968. County billings are produced weekly from a ledger summary of county registrations. An additional product in 1969 and thereafter will be an index of license numbers arranged by county which refers the new 1969 license number to the old 1968 license number (or to the most recent year's license number which was used the last time a completely filled out registration was submitted). By using this index listing in the counties it should not be necessary for county personnel to continue to file the registration receipts year after year. The index can be referenced by county personnel to find any receipt already on file and also to provide current license number information.

Inputs such as new car registrations, out of state registrations, and transfers of ownership are input continuously during the year. Each of these transactions are considered title transactions and are treated in further detail in Section II.D.3., Title System. The registration receipts corresponding to each of these title transactions, however, are processed using the registration system. They are held in suspense by the computer system until the subsequent title transfer is processed.

In the case of new car registrations or out of state transfers, the procedure is very similar to the annual renewal procedure except that a sticker is not used for recording the old license number. Also no card will be available to place the sticker on because the card stock copy of the prior receipt has been given to the new owner so that he may properly renew his registration during the next registration renewal period. Because the receipt copy sent to the Motor Vehicle Division is a tissue copy, it will be processed just like a change during registration renewal, that is by keystroking. It will be necessary, however, to keystroke only the following data as all other necessary file data will be input from the title application documents:

1) Vehicle identification number

2) Total fee amount

3) Number of months registration

4) Diesel fee amount

5) License number

Vehicle identification number and license number are used to establish a suspense file for the record pending subsequent acceptance and processing of the new title documents.

For transfers of ownership the county procedure is slightly different because no license plates are issued. A special registration transfer form is necessary. The transfer receipts are only needed to update the county ledger account, as all file data changes are made by title procedures. Transfer receipts should be counted by county and one summary input document should be keystroked containing the total count. The actual transfer receipt does not need to be processed at all. At the county level when transfers are being prepared the new owner should be given the card stock copy of the old registration receipt which was in the name of the original owner. When registration is renewed during the next regular period this card will be accepted for input as if it belonged to the new owner. The copy of the transfer receipt which the new owner presents will provide proof to the county personnel that registration laws were followed properly and that license renewal is authorized to the new owner.

Special registrations that provide for perpetual use of the same license number or same license plates from year to year should be handled in almost the same manner as at present. Presently "turn around" documents are prepared and mailed in advance of renewal dates to the vehicle (or boat) owner. These documents are checked by the owner for any changes and are returned to the Motor Vehicle Division accompanied by the proper fee remittance. One improvement in these present procedures would be to use second or third class mail and to mail renewal notices from the local counties. Those notices which could not be directly delivered, due to

address changes, would be returned by the post office to the county tax offices, and the boat or vehicle owner would be required to present himself at his county tax office for this special registration renewal. This procedure should be carefully explained on the owner's copy of the original registration to encourage submission of address changes during the year as they occur. "Turn around" documents should be designed to make address changing convenient to the vehicle owner.

3. Title System

a. The title system proposed for the Motor Vehicle Division includes consideration of the following:

1) Title transactions concerning new vehicle sales and out of state vehicles in Texas.

2) Title transactions concerning transfer of ownership on vehicles titled in Texas.

3) Applications for certified copies of original titles.

4) Applications for changes to data already existing in the master vehicle record.

Recommended improvements in the title system are designed to provide for examining and preparing documents as thoroughly and as far in advance as possible. Although the most important part of the title process, that of title examination, cannot be changed significantly at the present time, certain improvements can be made. For example, by limiting the editing of documents for accuracy relative to the vehicle master record to nonroutine matters, the title examiner can direct his attention to examinations in greater depth. Also by prepreparing the necessary title documents by computer prior to the title examination, the title transaction process can be significantly shortened.

The procedures for processing title transactions involving new vehicles, out of state vehicles and ownership transfers are essentially the same. These procedures are shown in Exhibit II.D.3.b.-1. All title transactions will be processed through the county tax collector using the same forms that are presently used except that the title receipt (Form 31) that is presently used will no longer be required. Because it has been established that the registration receipt can be used for temporary proof of ownership and the computer system has the ability to maintain a record of title transactions accepted by county, there will no longer be a need for the documentation provided by the Form 31, title receipt. In addition there will no longer be a need for the county to prepare and submit the daily title collection reports and title fee remittances. The counties should be billed by the Fiscal Management Division for title fees in the same manner that registration fees will be handled.

The proposed title procedures at the Motor Vehicle Division begin by assigning a title number to every title application that is submitted. This number is critical to all title suspense records on the computer and to the county title billing system. After assigning the number, the application for title is keystroked and input to the computer. The computer matches the title application with the vehicle master record and prints out the actual title, on safety paper, in triplicate. The computer also prepares an examination group list, which is a list of 50 new title numbers, the corresponding old title numbers, and a corresponding group number. All of the title applications, with supporting evidence, and newly printed out titles are sent to the examiner in batches according to the examination group number as shown on the group list. The examiner reviews the documents and if acceptable distributes them as shown in Exhibit II.D.3.b.-1, page 2. To indicate his acceptance the original Certificate of Title is impressed with a seal. If a title transaction is rejected, the reason for rejection is recorded in code on the examination group list beside the corresponding title number. This list is then sent back to the computer and directly input through the optical scanner to release the accepted transactions and establish a suspense file for the rejected title transactions.

For all rejected title transactions the examiner checks off a preprinted rejection notice according to type and encloses a certified title application for resubmission by the tax collector. This certified title application is a blank application for title but it has a control number assigned to it. Using this form the tax collector can resubmit the title transaction after correction without further need to pay additional fees. The original fees are retained pending clearance of the transaction. A blank certified title application is not returned to the tax collector for those rejections which should not be resubmitted, such as, titles which have been suspended by the Department of Public Safety. The rejection documents are distributed as shown in Exhibit II.D.3.b.-1, page 2.

An application for a certified copy of original title (commonly called CCO) is processed in a manner similar to the other title transactions. There are some significant differences, however. The CCO application procedures are shown in Exhibit II.D.3.c.-1. Applications for CCO's come directly to the Motor Vehicle Division by mail from the general public and contain cash (usually 25¢ in coin) attached to the application. The recommended procedure will begin by removing the quarters and sending them daily to the Fiscal Management Division for deposit. The CCO application is then keystroked and input to the computer. It is not necessary to keystroke the whole record, only a code indicating the type of transaction together with a vehicle identification number or a license number. The computer prepares a Certified Copy of the Original Title, and other reports and these are examined in the same manner as other title transactions. If the application is accepted, then the forms are distributed as shown in Exhibit II.D.3.c.-1, page 2. A rejected application for CCO is handled in the same manner as a rejected title transaction. The controlled certified application blank, which is returned to the sender, eliminates the requirement to also return the 25¢ with the rejected application. Since the general public is involved the returned certified application should be accompanied with a simple message describing its purpose and use.

Applications for changes to data already existing on the file are processed similarly to normal title transactions, as shown in Exhibit II.D.3.b.-1. The primary difference is in the input procedures. Only the change, and a code to indicate the type of transaction is necessary to be input to the computer. The computer can then print out a new title based on the change combined with data contained on the master record. The most frequent case of data change involves release of lien, or in the case of older model vehicles, changes in motor number.

4. Inquiry System

a. One of the most important functions of the Motor Vehicle Division records is to provide quick information to a number of commercial, governmental and law enforcement agencies. A listing of the sources of inquiry and the type of information requested is presented in Exhibit II.D.4.a.-1. In addition to procedural questions, such as where and how to register or apply for title, many requests for data are made. A summary of the nature of these requests is as follows:

1) Vehicle ownership

2) Vehicle identification numbers

3) General vehicle identification

4) Lien information

5) Stolen reports

6) Suspensions of registration changes

7) Replacement license plates

8) Skips and missing persons

b. The recommended Motor Vehicle Division system extends the means of inquiry by enabling the county tax collectors to install remote input stations for direct access to the data. In addition, the number of inquiries handled by Motor Vehicle personnel will be reduced by providing a remote station located in the Department of Public Safety, one of the most frequent users of the records.

Some inquiries are made for reasons which might not be considered essential. For example, a real estate agent observes the vehicles which drive through his subdivision and then obtains their name and address from the motor vehicle records. A method should be developed to give authorized personnel or companies a code or password to use when requesting information. Other requestors should be required to ask for information by mail, stating the intended use which is to be made of the information. These procedures will also provide a means for recording the number of requests processed by each requestor. A method for billing for the service can then be developed.

5. Records

a. The Motor Vehicle System includes records which will be maintained on electronic data processing equipment, microfilm and manually. A listing of these records is shown in Exhibit II.D.5.a.-1. The electronic data processing records necessary to operate the title and registration procedures include the master records, indexes, various tables, and accounts. In Exhibit II.D.5.a.-1, these records are extended to show their size, volume and the estimated number of positions of computer storage that will be required. Over 2 billion positions of random access memory will be required to store 23 million records. To provide for growth and expansion of the system, and to include additional indexes for special inquiries from law enforcement agencies, at least 2.5 billion total positions should be provided.

The proposed microfilm records are basically the same as those kept today except for some additional requirements. Microfilm images will have to be made of master records which have little or no activity so that the whole record will not be required in the computer data storage files. The presently existing microfilm records of the registrations will not be required because adequate indexing and purging of inactive records within the computer will provide essentially the same results. Although it is not known precisely how many unregistered titles are presently in the files, we estimate that there are about one million such records.

Manual records will continue to be maintained for registration files of certain infrequently referenced and temporary classes of registration. Approximately 90,000 registration records are included in this group.

b. Electronic data processing records which are maintained in the random access files and shown in Exhibit II.D.5.a.-1 are discussed in detail, as follows:

1) Master Record - The master record includes all title and registration data that is presently maintained, including the supplementary data such as additional fee receipts which are filed behind the present registration receipts. The master records, their volume and type of record are shown in Exhibit II.D.5.b.-1. Those records which are not to be filed or are to be filed manually are also included in this exhibit to give a complete picture of all records that presently exist. Those records which are to be filed in electronic data processing equipment are divided into three classes, long records (300 positions), short records (200 positions) and supplementary records (100 positions). The only exception to this classification is the transfer receipt (Form 17) which is used to update master files and does not actually use any space.

Long records are those which generally require both registration and title data to establish a complete record. The length of this record (300 positions) is based on the elements of data required in the longest record.

Short records are those which do not require title data to establish a complete record. The short record length of 200 characters is adequate for all short records.

Supplementary records are a very special record since they refer to master records which are elsewhere in the file. To eliminate an exceedingly long master record a means is available to file such data on a supplementary record. This would occur when a vehicle is registered for additional fee or when a title transaction has a second lien. The supplementary record could also be used to indicate leased vehicle owners. Instead of providing space in every record for second lien information a supplementary record is suggested for those infrequent records on which there is a second lien. The number of supplementary records which can refer to any master is not limited. Each master record has an element of data called "supplementary record number" which refers to the supplementary record. In addition each supplementary record also has this same element of data so that it can refer to another supplemental record. In this manner a chain of records each referring to a single master can be established.

Two special cases of the supplementary record exists in dealer and replacement registration. Dealer supplementary plate and replacement registration records use their "supplemental records" element of data to refer directly back to the dealer master record and original license number. This allows these records to be cross referenced and the master record can be found when given the license number, the dealer supplement number or the replacement license number. Replacement and dealer supplement license numbers will be in the license number index and therefore directly accessible.

The elements of data which make up the master records are shown in Exhibit II.D.5.b.-2. This exhibit provides the following information on each element of data:

a) Element description - the name of the element of data.

b) Type of data - whether it is numeric (N), alphabetic (A), or alphanumeric (AN).

c) Applicability - whether it is used on boat records, title records, passenger cars or other vehicle records.

d) Frequency - the number of different types of master records which require the data.

Although the total number of positions required to represent all elements of data greatly exceeds 300, some records are only required on some forms. Some elements of data, such as owner name, appear on all records and others, such as amount of refund only appears on one record. The form number which is given in Exhibit II.D.5.b.-1 is the code key to decipher which elements of data belong to which master record. To keep from an excessively long master record the system should be programmed to recognize the correct record format from the form number which is used to identify the vehicle classification.

2) Vehicle Number Index - This index is in sequence by vehicle number and contains the record number or computer address of the master record for each vehicle number. The vehicle identification number is frequently used for inquiry and justifies an index for quick access.

3) License Number Index - This index is a dual purpose index. It serves to locate master records when the license number is given and also provides a means for updating county inventory. To avoid maintaining a separate inventory of license numbers, county codes, and sales status of the license plate, the license number data of this index is combined to fulfill this purpose.

4) Rejection Suspense Index - This index refers to master records which were developed by the input of an application for title, but have been rejected, and are currently pending correction. This provides for direct input of corrected applications when they are returned. This file is purged periodically to prevent an accumulation of records due to unreturned applications.

5) Title Examining Index - This is a record of all in-process title applications arranged by title number and temporary record number. Although the application develops a master record, it does not update the previous master record until it is accepted by the title examiner. This index provides for the exception reporting of examined titles by the title examiner. It is only necessary to indicate rejected titles on a group list. The other titles in the group are then considered accepted. Less than 4% of examined titles are rejected.

6) Microfilm Index - An index of film and image number is kept of all title data which is unregistered or inactive. This allows for quick access to those records in case activity should occur. These indexes should be purged by date from random access storage periodically, printed and microfilmed.

7) Old-New License Index - This is a temporary index that is maintained only during the annual registration renewal period. Because during this period a person who registers may not immediately install his license plates, a means for accessing his master record must be provided by both old and new license number. The new license number will be in a license number index as soon as the registration renewal is processed. At this time the old license number and new license number are stored in old license number sequence.

8) Code Tables - Tables should be kept which contain certain cross referenced information. These tables should include such items as county name to code, vehicle classification to form number, and resident state name to state code. An attempt to simplify the element of data structure may reveal others that are necessary. These tables will be used for batch input and output. When a county name is input, the code will be referenced and stored in the correct record location. Conversely, when the county name is desired as output, the code will be read from the file, referenced, and printed as output.

9) County Accounts - The recommended Motor Vehicle System provides for billing of counties for registration, Certificate of Title and other fees which are to be sent to the Texas Highway Department. This is a ledger account in which the county transactions are summarized and weekly a statement is prepared. This statement is sent to the Fiscal Management Division for the actual billing process. Likewise, when the money is received by the Fiscal Management Division notification is sent to the computer to update the county ledger account.

10) Production Accounts - These accounts are used to prepare an analysis of Motor Vehicle Division production. Quantities of title applications processed, registrations by classification and other essential management data are kept in these accounts.

c. Microfilm records which are maintained by the Motor Vehicle Division include a continuation of the presently existing transaction recording procedures and additional recording of records which are purged from the electronic data processing files. As unregistered titles are purged they are placed on microfilm, and as files are updated (transfers) the old record is output to be included in the transaction recording. In addition, as vehicles are declared junk or are moved to another state, a microfilm record of these transactions is provided. An index to these records is kept in random access storage of the computer for a short period of time for quick access. Periodically the indexes are printed, microfilmed and stored for a longer period of time.

d. Manual Records - These records include present manual records which are not considered in this study and some registration records which should not be maintained on electronic data processing equipment. The registration records which should be maintained manually are shown in Exhibit II.D.5.b.-1. These records are either temporary, such as one trip receipts, or are not important to the master record, such as delinquent penalty receipts.

6. Other Applications

Although the most significant workload of the Motor Vehicle Division System is concerned with registration processing, title processing and random inquiry, several other applications are equally important. These other applications are generally processed less frequently than the title and registration systems and frequently are processed on an "as required" basis.

a. County Inventory

County inventory is actually an integral part of the registration system. As a part of the license number index a code for county and license plate status is provided. This provides a means for indicating which license plates are sold or are unsold. Periodically a list of active license plates can be prepared for each county. These lists can be prepared at the request of the county, the investigation section or for use by other sections of the Motor Vehicle Division. Some uses of such a listing could be:

1) To provide a means for counties to audit their sales and to count their unsold license plates.

2) To provide a basis for the investigation section's field men to inventory counties.

3) To provide a basis for decisions regarding the redistribution of license plates when shortages exist in some counties and excesses exist in others.

b. Rejection Analysis

As title or registration transactions are rejected by the computer or title examiner, a record should be made, by county, of such rejections showing the reason for rejection. The computer could periodically prepare an analysis of these rejections by county and by type of rejection. Rejection rates could be computed and county comparisons made. This comparison would provide an additional incentive for more accurate data input from the county. In addition, a statistical analysis could be made to determine if any "reasons for rejection" are occurring too frequently. This could be used to indicate which counties need additional training, and in what procedures.

c. File Purging

In order to keep Motor Vehicle Division System records from becoming excessively voluminous, filled with unused or outdated records, a means for purging the file should be provided. Files should be purged of the following items:

1) Titles with no registration.

2) Rejections which have been in suspense longer than 60 days.

3) Title transactions for junked vehicles or vehicles moving out of state.

4) Title transactions involving transfers or data changes that produce inactive records.

All of these purge type transactions are recorded on microfilm as they are made and an index to these microfilm records is kept in the active file index. Periodically the index to these inactive records is also purged and put on microfilm.

d. Financial Procedures

The Motor Vehicle Division System is designed for all financial transactions with agents of the Texas Highway Department, such as county tax collectors, to be handled by the Fiscal Management Division. All other "money mail" is received at the Motor Vehicle Division, accounted for, and sent to the Fiscal Management Division. Cash should not be kept unnecessarily overnight at the Motor Vehicle Division.

To process the registration and title transactions from the county tax collectors, a ledger account is kept in the Motor Vehicle Division computer records. Each day these records are summarized by county and punched cards are prepared for input to the Fiscal Management Division computer. Statements for each county are prepared weekly by the Fiscal Management Division. As payment is received at the Fiscal Management Division, cards are prepared to update the ledger account on the Motor Vehicle Division computer records.

For other "money mail" for which the transaction is rejected a rejection notice is sent to the Fiscal Management Division for preparation of the refund. No refunds should be made for less than one dollar. Rejections for which a correction and resubmission is required, the requestor is sent a certified application on which to resubmit his request. The certified application is numbered and the computer records contain this number and the name of the person to whom issued, so that adequate control of the document is assured. The certified application enables the requestor to resubmit his request with no cash, thereby eliminating the need for handling small refunds. The index of certified applications should be purged every 60 days and documents received after that time considered invalid.

e. County Remote Stations

The number of remote stations that can be directly connected to the computer and therefore the motor vehicle records is almost without limit. Each county should be offered the opportunity to obtain a remote station for direct access to the records. Although the counties should only be able to make inquiry at the present time, ultimately they could process their registration inputs through the station. Remote stations are relatively inexpensive, and arrangements can be made for usage rates.

f. Production Analysis

As title, registration and inquiry workload is handled by the computer production records of the various sections of the Motor Vehicle Division should be accumulated. These production records could be analyzed to provide essential management data. Some aspects of the production data could be:

1) Changes in rates of title or registration input

2) Changes in flow time for processing documents by section

3) Forecasts of workload for planning purposes

g. Report Generator

Special reports which are needed periodically should be individually programmed and processed when they are required. Other reports are required on a "one time" basis. To provide for quick production of the necessary information a report generator is recommended. A report generator is a special compiler which accepts a description of a required report, such as special summaries or sorts, and automatically prepares a program which generates the report. The report generator could be used to:

1) Prepare special lists of data for sale to authorized users of the data.

2) Prepare special lists for Coast Guard use in analysis of marine activities.

3) Provide special searches for data as required by the Department of Public Safety.

4) Provide a magnetic tape or other similar output of motor vehicle transactions for commercial use such as for the R. L. Polk Co.

5) Provide special listings and analysis of data for other internal management purposes.

Regarding the sale of motor vehicle data, authorized or approved buyers could purchase summarized data for commercial uses.

h. Investigation

The master record contains information regarding vehicle dealers and can assist the investigation section's field men. The system could provide an output document which schedules the dealer inspection and provides for reporting inspections and violations. This method would provide for equitable investigation of dealers to assure that some dealers are not overinspected while others are underinspected. The system should also provide a means for reporting inspection of salvage yards to provide for purging the master files of inactive records.

i. Department of Public Safety Support

For the present inquiry requirements of the Department of Public Safety one remote station having direct access to the computer will be located in their headquarters in Austin. Additional support which can be provided by the computerized system involves additional elements of data and special access to individual and special searches of records. Some of the additional features which could be provided are as follows:

1) Identification of vehicles by color.

2) Access to vehicle data by owner name.

3) Listing of vehicle when only partial license number data is available.

4) Listing of vehicles given color, make, model and county.

5) Listings of stolen, suspended and other vehicles flagged by the Department of Public Safety.

Some of the requests for these data could be provided immediately through the remote station. Other information would require extensive processing and could be provided overnight. Ultimately the Motor Vehicle files and the Department of Public Safety files could be integrated to provide several additional types of information which will not be otherwise available.

Manpower Controls

E. MANPOWER CONTROLS

1. General Concepts

Management of human resources in an organization with the responsibilities of the Texas Highway Department is essential and vital since public monies are involved. Management of manpower has implications which are more demanding than management of other resources such as materials and equipment. The availability of a man to do work costs money and if his time is not used the value which could be returned for the cost is lost. This is not necessarily so with other assets, such as materials. Material which is not utilized can still be used at another time. In addition, the manpower resources which are expended in an organization are key resources to which management effort can be applied and result in increased productivity. Material requirements can be changed, equipment can be made available, improved tools can be obtained but to maximize the efficiency of an organization manpower must be well managed within the restrictions of these other assets.

Effective manpower management starts with the capability of measuring performance in terms of defined management objectives. Measurement of performance leads to an improved allocation of manpower to changing workload requirements. Most employees want to work under circumstances where their accomplishment and productivity are measured objectively, acknowledged, and rewarded.

Within the Department total manpower resources presently cost over $80 million per year, of which over $70 million is spent in the decentralized district organizations. (see Exhibit II.E.1.-1). The workload in the district organizations can vary a great deal from time to time particularly in engineering and right of way activities. The workload frequently does not match the assignment of staff within a district organization.

An effective manpower control program should be directed towards controlling those groups of workers where the largest potential benefits exist. The essence of such a program concerns three simple principles as follows:

a. Preparation of estimates (or standards) to determine how much manpower is needed to perform identifiable work segments.

b. Using these estimates to forecast the amount of manpower needed to perform long and short range programs which are multiples of the work segments.

c. Using these estimates to monitor and measure actual performance as a basis for evaluating the need to reduce or add personnel.

This concept of manpower control means "plan your work, and work your plan" with a goal of having and using the optimum amount of manpower.

2. Design and Construction Engineering Staff

Field construction salaries presently cost an estimated $30 million per year of the total $80 million spent on salaries (see Exhibit II.E.1.-1). The field construction group, which includes almost 6,000 persons, represents one of the largest segments of manpower in the Texas Highway Department. The characteristic variability of the construction activity, which is inherent to the economics, finance, and engineering of highways, creates a sizeable problem in scheduling the manpower of this group.

The general pattern of organization within the districts consists of resident engineers who are responsible for both design and contract construction for one or more whole counties in the rural areas of the State. There are approximately 194 such residency organizations of which 150 have thirty or fewer employees. Nineteen have ten or fewer employees. In the large urban areas the pattern is for design to be centralized under a single residency organization and for construction to be supervised by one or more construction engineering residencies. The district engineers from time to time change their residency arrangements to meet new conditions, for example by closing the residency in a county where little additional construction is anticipated and assigning responsibility for that county to the resident engineer organization in an adjacent county. The most significant new condition in many instances has been the start or completion of construction of the Interstate routes through the districts. This program has presented a very unusual and nonrecurring workload for many of the districts, especially those in rural parts of the State.

Estimated funds available for construction are first allocated to the districts according tc a formula which gives one-third weight to relative area, one-third weight to relative population, and one-third weight to relative vehicle-miles of travel. The resulting formula allocations are adjusted according to the Department's experience and judgment concerning the relative costs of local materials, and other factors such as soil conditions, etc. Then each district prepares a program which is its recommendation to the State Highway Engineer for the priority allotment of its share of construction funds among specific proposed projects in the district, based on general need and the necessity for the proposed improvement. The actual volume of construction funds that is spent in specific counties (which coincide with the residency organizational units for construction manpower in many cases) can be quite variable from one year to the next. (see Exhibit II.E.1.-2). In half of the first ten counties selected for study, construction spendings in the highest of the six past years were from 17 to 62 times greater than spendings in lowest of the same six years. In only two counties was the difference in spending less than double. However, the variation may not be as pronounced when the counties of a particular district are grouped, and district totals compared, as funds allocated by district are considerably less variable. Among other factors contributing to this variability of spending, the Department does not have control of construction start dates for those projects where the counties purchase right of way and pay either all or half of right of way costs.

The difficulty in solving the workload problem can be further illustrated by Exhibit II.E.1.-3. Columns 3 and 4 indicate that the forecast or anticipated workload, when measured in terms of dollars per available man, can be much higher in some districts than in others. By contrast, the historical amount spent per man, as shown in column 5, is much less variable, falling close to $300,000 per man, with one exception. This seems to indicate that the manpower is made available by the time anticipated projects are contracted, or that contracting is spread out in time to fit the capability of the existing work force. Actually, construction spending per engineer varies considerably between years in each district, and between districts as is shown in Exhibit II.E.1.-4. One would expect to find similar or even greater variations in construction spending per engineer and in forecast workload per engineer at the county or residency level, especially in the 150 small residencies.

As in several other management areas, we have noted a lack of any specific, formal, or regular method for coordinating engineering manpower resources on a Statewide basis. The State Highway Engineer attempts to schedule contract lettings so as to minimize the up and down swings in work. However, many other factors enter into the scheduling of projects for letting, such as cash management and the timing controls imposed by the Bureau of Public Roads on the large Interstate program.

3. Maintenance Forces

As shown in Exhibit II.E.1-1 there are over 7,000 employees concerned with highway maintenance, and their salaries represent over $32 million of the total $82 million presently spent per year in salaries. These forces are generally assigned to Maintenance Section Headquarters located in strategic areas throughout the State. Funds are allocated to districts and then to Maintenance Section Foremen based on highway mileage multiplied by various per mile factors developed over the years. These factors are not connected to actual maintenance costs as developed by the cost accounting system, but are rather established as being equitable for the distribution of funds. The practice has tended to perpetuate any imbalance which may exist between the size of a given maintenance work force, and the amount of work it must accomplish in a given year. The overall result is that the amount of work done in the way of regular or routine maintenance expands or contracts to fit the amount of funds allocated. Extra work is covered by district contingent funds or by special project programming through the Austin Maintenance Operations Division.

In our field studies, we observed that regular maintenance crew sizes and work methods were not uniform or standard between districts or often between Maintenance Section Headquarters. No established criteria seems to exist for determining whether the size of a crew sent out on the road to do a particular job is too large or too small. Most crew scheduling is done from day to day, with manpower needs seldom being anticipated more than a week in advance.

4. Administrative and Clerical Workers

This third major group of employees represents almost $12 million per year in salaries according to Exhibit II.E.1.-1. It includes about 2,400 district and divisional office workers of almost every category. Although difficult to measure in terms of manpower requirements, this group does have an advantage in terms of potential gain through better control. Generally, these workers remain in one location and are under fixed supervision. A control procedure applied to this group would be easier to administer, and results could be more dramatic than procedures attempted for engineering or maintenance manpower.

5. Recommendations

For engineering forces we recommend that the following procedures be developed and installed by the Systems Unit of the Fiscal Management Division:

a. Prior to the authorization of any design, IPE or construction project, the Supervising Engineer would be required to prepare in writing, on standard forms and format, an estimate of the Highway Department manpower required in man-hours or man-months by category or skill, spread by month.

b. Each month, the Supervising Engineer would be required to prepare in writing, on standard forms and format, an estimate of the future work assignments of each employee or crew under his supervision for each of the next twelve months.

Such projections are presently being made in varying degrees by many supervising engineers. There is a need for a uniform method Statewide, rather than the informal approach which is constantly being affected by the resignation, retirement, or transfer of supervising engineers. These projections would be useful to the engineers who prepared them, and to District Engineers and other higher officials in making decisions effecting the overall balancing of workloads.

Making the explicit estimates and schedules will be useful only if they are revised monthly to reflect changed conditions, and if something can be and will be done toward achieving balance between work and workers when these standard practices point up imbalances.

The recommended estimating and scheduling practices would serve a primary purpose at the local level where the work is planned and supervised. They would also be available to higher levels of management. Having access to detailed plans laid out by subordinates should make it easier to analyze the quality of thinking and planning.

The workload forecast prepared by each supervising engineer for his organization would be summarized at each district to yield a manpower forecast for the entire district. This would be used by the District Engineer in connection with personnel assignments, programming, and other decisions which bear upon keeping workloads and personnel in balance.

Each district's summary manpower schedule would be sent to Austin where the data would be taken into account as one of the many factors involved in determining letting schedules, recruiting and salary policies, program review, and other administrative actions related to the districts.

The manpower estimates prepared for each construction contract and IPE, and updated as conditions change, should be used to report on progress of the work which is underway. Thus, the "status" books prepared monthly to show the percentage completion of advance planning projects could show instead the original and revised estimates of manpower requirements and the remaining work to be done expressed in terms of man-hours or man-months.

After sufficient documented experience is gained from estimating manpower requirements for typical kinds of work, standards can be derived and used instead of re-estimating manpower required for each project. The recommended project cost ledgers and reports are designed to accumulate not only cost information, but also manpower data such as estimated man-hours, revisions of estimate, and actual man-hours used for each work function of the project.

For maintenance forces we recommend that industrial engineering studies be made by the Systems Section of the Fiscal Management Division to determine the basic complements of personnel necessary to perform regular or routine highway maintenance. Our preliminary surveys indicated that considerable savings can be made by making several simplifications in work methods, then determining the proper crew sizes to perform the standardized tasks, and finally using these normal crew complements for planning and scheduling the actual work.

This technique should also provide the data for the accurate budgeting of normal and routine maintenance operations. Provision has been made in the recommended budgeting procedures for establishing engineered standards as the basis for budget amounts, and to accumulate actual costs by corresponding categories in order to adjust the unit factors used in preparing subsequent budgets.

Several detailed observations and suggestions are submitted to illustrate the application of industrial engineering techniques to highway maintenance operations:

a. It was observed in one district that sign truck crews generally consisted of three men. Posts and signs were carried unassembled on the truck. Wooden posts were carried unpainted as raw lumber. Inasmuch as working conditions for field assembly of signs are comparatively difficult, and further, the specific signs to be erected by a crew during any one day are pre-scheduled, it would seem logical to pre-drill holes in the posts necessary for sign attachment in the shop using power equipment. A further possibility would be to equip sign trucks with power post-hole drills and with racks which would allow signs to be carried fully assembled. With these modifications a two man crew could handle routine sign erection jobs and increase the output of erected signs per crew per day. If studies were conducted to determine the normal number of signs per crew per day, then this index or standard could be used for advanced planning. If the methods and

equipment were relatively uniform throughout the state, then the same standards could probably be applied, with minor modifications, in all districts.

b. Similarly, sign tree erection (i.e. multiple sign posts) on Interstate highways could be greatly accelerated by pre-placement of the commonly used clamps in the shop rather than under the less favorable working conditions in the field.

c. Routine sign maintenance that includes the normal replacement of signs and painting of posts could be accomplished at less expense by using one of several probabilistic replacement methods. The savings would be caused by a reduction in travel time as replacements could be planned and routed in advance of field work.

d. Consideration should be given to expanding the use of hired mowing crews, and reducing or eliminating entirely the use of the Department's own mowing equipment. Because outside mowing crews are paid for only as needed, and the mowing season is about seven months of the year, idle mowing equipment and mowing equipment maintenance costs could be substantially reduced. In addition, travel time by Highway Department employees in rural and semi-rural areas would be eliminated. Travel to the mowing site apparently consumes a large portion of time when mowing is done in rural areas. This subject should be studied further by developing accurate cost data which includes idle equipment time, operator travel time, original equipment cost, equipment operating and maintenance costs, as well as the fully loaded cost of operator labor, and balances these costs against the competitive market in each area.

e. Some maintenance section crews use spreader-boxes of their own design to spread road material mix when performing shoulder repair. This is definitely an improvement over spreading mix by hand, but it still requires two or three men to rake and sweep the mix off the road-bed edge before the rolling operation. Further design refinements, including a blade attachment behind the box and a rotary type sweeper should be considered as a means for reducing the number of men now performing these manual operations. A similar type of spreader and blade arrangement might also be used for patching road beds.

We suggest that further study be made to determine the feasibility of maintenance manpower scheduling from one to three months in advance. These schedules could be operated similar to a production shop schedule in each Maintenance Section Headquarters. As a starting point, they could be based on the past maintenance history for any one maintenance section according to the maintenance operations performed. Past hisotry of a number of years should be evaluated in order to make allowance for climatic variations which can influence the amount of maintenance work necessary. The per man output of maintenance personnel can be substantially increased by a more effective scheduling system which would also reduce crew travel time to and from job sites.

For clerical and administrative employees, we recommend a simple system of self-reporting productive and stand by time by organizational sections and units within divisions and districts. On future revised payroll reporting forms, each employee would report daily the amount of productive or stand by time which he worked. This data would be collected and accumulated through the regular attendance payroll system. Each pay period a productive labor report would be prepared listing each employee within his organizational unit, and showing the percentage of productive to total available time for each employee and for the organizational units. This system would merely serve to notify supervisors and Division Heads or District Engineers that surplus or deficient capacity existed within their clerical organization for the period just past. No action would normally result unless the same results were reported over an extended number of periods. Employees would need to be thoroughly familiarized with the purpose of the self-reporting system, and considerable training would be necessary.

We do not recommend this system for immediate implementation, but as an additional refinement to the automated payroll system at a later time. We also feel that eventually the recommended plan should give way to a general installation of clerical work measurement techniques. Once office procedures have been redefined and stabilized, clerical manuals have been written and installed, it will then be appropriate to study and install office work standards in the division and district offices.

Plan for Conversion

F. PLAN FOR CONVERSION

1. Accounting and Financial Management Conversion

It is important that considerable attention be devoted to developing a plan for implementing the recommendations contained in this report. The sequence in which actions are taken as well as proper amounts of men and materials are as important in building a paperwork system as in building a highway or bridge. It is also necessary to handle the existing traffic of paperwork while changes are being made just as it is necessary to make provision for vehicular traffic during highway construction.

The large number of people, activities, problems, and decisions involved in the proposed conversion make this a major undertaking. The organization of the financial management function, the methods of processing financial data, and the accounting system itself must all be changed concurrently. Yet, during the conversion period all normal functions and services necessary to the efficient operation of the Department must still be provided.

It is therefore imperative that positive administrative control be built into the conversion plan from the beginning. We feel that the degree of central control and coordination which will be needed can be best attained by making one Highway Department employee responsible for the job. This person should be provided the services of an advisory or steering committee composed of selected Division Heads and District Engineers, and the full-time services of a number of Department employees who would become the conversion task force. Consultants should be used strictly in an advisory capacity. Administrative action and coordination can be effected only by Department authority. The actual work of conversion should be performed by Department employees to reduce the conversion cost and provide for experienced operating personnel at the end of the conversion period.

The high morale and loyalty which is typical of Department employees should be carefully protected. It is almost inevitable that some employees will feel much concern about how the changes will affect their jobs, their duties, and their associations. The prospect of change may alarm some employees who are strongly devoted to doing whatever is best for the Department. The most important step which can be taken to minimize these reactions is to inform all employees as early as practical of the general plan for conversion and how it will, or will not, affect them. This should allow management and supervisory employees to deal more with problems based upon realities and should dispel most of those concerns which are without basis.

The Department should immediately organize and start planning for a rapid implementation of the primary recommendations of this study in the areas of cost accounting and current billing. The following items should have a completion target date of September 1, 1967, the beginning of the State's fiscal year:

a. Convert to revised chart of accounts.

b. Computer processing of all accounting ledgers, including recommended cost accounting.

c. Substantial completion of recommended reorganization of the fiscal management function.

d. Current billing for Federal aid reimbursement.

e. Changes in computer capability.

The following secondary items should be developed concurrently, but would not be completed until after September 1, 1967. These items should be considered at all times so that their subsequent implementation will be facilitated by work earlier completed.

f. Installation of system for forecasting cash payouts each month for each of the next 12 to 24 months for each contract and for other expenditures.

g. Budget preparation system based upon work planning.

h. A manpower control system based upon work measurement and productivity standards.

September 1, 1967, is the earliest practical target date for the completion of implementation of the first five items. Exhibit II.F.1.-4 graphically depicts the suggested overall conversion schedule. The following points justify an immediate beginning of the conversion process:

a. The overall cost of conversion will be reduced by cutting down the time period of the conversion program. Employee interest and motivation can be mobilized and sustained at a higher level by a relatively short and aggressively prosecuted conversion effort.

b. Although the State is now collecting all Federal aid apportioned by the Bureau of Public Roads, some aid ultimately may be lost because the present cost accounting system does not necessarily include all participating cost in the Federal aid billings for Interstate projects.

c. Present methods, particularly the billing of Federal aid on the Interstate Program, are expensive in terms of personnel time consumed.

d. The greatest effort required in the conversion program will be employee training in computer systems programming and in new methods of data recording and control. Such training should start early and be accelerated by a variety of methods.

e. Although the estimated delivery dates for the recommended additional computer capability probably can be met, there is little slack in the schedule.

Because the proper recording and classification of all transactions must continue to be performed efficiently throughout the conversion period, fiscal year-end dates are important. Certain accounting systems changes would need to be installed as of September 1, 1966, and subsequent changes would be put into effect as of September 1, 1967.

The changes scheduled for completion by September 1, 1966, will essentially computerize what is being done now, but also put into effect the changed account coding systems which are designed for computer processing. Detailed cost accounting by object and function classifications will be scheduled to start on September 1, 1967. This means that the proposed general ledger chart of accounts, budget numbering system, project designators, road sequence numbers, and authorizations number systems will need to be refined, tested, taught, and put into effect by September 1, 1966.

The summary distribution vouchers now prepared by the districts would continue to be prepared there and would be key punched for computer processing during the fiscal year 66-67 essentially in the same manner as they are now key punched by the Accounting Division. The volume of such key punching during this year would be reduced however. The project designator would be used instead of the State project number and the computer master files would carry certain fixed data such as in which county any project or control-section is located, and which Federal numbers are associated with each project.

A substantial amount of computer programming will need to be completed before September 1, 1966. This will be programming to handle essentially what is being performed now, using the new account coding systems. However, these programs should also be designed to accomodate the detailed cost accounting at object and function levels which are to be placed into operation on September 1, 1967. This programming and the related systems development will for the most part involve only the Austin staff, the conversion task force, and the Fiscal Management Division. However, the large number of personnel in the Department who are concerned with the initial recording of transactions, will be affected by the September 1, 1966 conversion to new budget and project numbers. Code numbers will change at that time but the method of recording and the basic forms used will not change. Old number-new number cross reference lists should be published prior to September 1, 1966. Considerable field training should be scheduled. Review and editing of all account coding should be

strengthened during the early months of the 66-67 fiscal year to detect coding errors and prevent a breakdown in the processing procedures. Account balances of all project and balance sheet accounts as of August 31, 1966, should be established under the new code numbers in order to commence processing transactions during the new year.

Starting in September, 1966, computer print-outs of project ledgers and budget accounts would be sent to the districts. These would be compared to the manual district ledgers and any differences investigated. Manual preparation of district ledgers would be discontinued in the fall of 1966, as soon as it was established that the computer prepared ledgers were accurate substitutes.

Testing of new input forms, plastic plate encoding, and the use of object and function coding would be commenced on volume data by December, 1966. Testing on volume would involve four districts, each one testing a different transaction type. These tests would be pilot installations to develop experience, employee training, and methods refinements. During the pilot operation the pilot districts would not manually prepare the traditional distribution vouchers which summarize source documents, but would prepare and control the new source documents from which distribution cards would be prepared for computer processing.

The degree of success which is experienced during the pilot tests on volume data will determine whether or not the Department wide conversion scheduled for September 1, 1967, can be realized. If the systems and equipment then tested prove adequate and, if the training materials and education methods are effective... then a similar conversion of all districts can be started in the Spring of 1967. However, if major modifications are found to be necessary and these should require several months of elapsed time, then statewide conversion should be postponed until September, 1968.

The conversion of all districts would require a sizable training program. The amount of new knowledge to be absorbed by each employee would be minor, but the number of different employees involved and the diverse subject matters would call for many instructors, some of whom would become qualified to instruct as a result of working with the pilot installations.

Exhibits II.F.1.-1, 2 and 3 show the elapsed time and planned beginning and ending points for the more important events of the conversion. These exhibits consider the major functions of Organization, Personnel and Training (Exhibit II.F.1.-1), Systems Development and Programming (Exhibit II.F.1.-2) and Hardware (Exhibit II.F.1.-3). Each event on these schedules is referenced in column 1 to the corresponding node number of the Activity Network shown in Exhibit II.F.1.-5. The Activity Network shows the dependency and interrelationship between all of the events. It shows that although some activities can be performed concurrently with others, much of

the work is serially ordered and depends upon the prior completion of preceding events. For example, the activity of "input systems design" between circles number six and seven must be completed before the start of any of the activities after circle seven. The activities shown in the Activity Network can each be expanded into separate activity networks, and this would need to be done prior to the start of each major activity.

To meet the schedule dates it will be necessary to determine the latest and earliest dates for starting and completing all the activities which have high potential for delay of the conversion. Control of the conversion schedule will involve watching these key activities and expediting those which fall behind.

The activity which may assume the greatest delay role can be decision-making. This is an important reason why one person should be responsible for the conversion.

2. Motor Vehicle System Conversion

a. Conversion of the present Motor Vehicle Division procedures and records to utilize electronic data processing equipment involves six areas of effort.

1) Installation of the large scale computer system with random access data storage.

2) Design and programming of registration and title systems.

3) Conversion of motor vehicle data to automated form.

4) Modification of present computer center equipment for program testing.

5) Education of county personnel and the public.

6) Redesign and preparation of the new registration receipts.

Each of these tasks are related to each other and to provide for successful implementation each must be completed in proper relation to the other. For example, by installing the computer later than completing the file conversion would result in unnecessary file updating; conversely, installing the computer too early would result in low utilization of the equipment while the files were being converted.

The time at which these tasks are completed is a key to effective implementation. The most opportune time to install the operating system is just prior to the February-March registration renewal period. Installation at this time would eliminate the requirement to convert the registration files and provide for a minimum of updating after the title file conversion is complete.

b. The six tasks which must be accomplished involve 50 different activities which must be completed in the proper sequence. These 50 activities are related to one another in a complex manner. Exhibit II.F.2.-1 is an Activity Network for Motor Vehicle System Implementation. Each solid arrow in the network represents one activity which must be completed. The manner in which the arrows are drawn together show the sequence in which the activities must be accomplished. The circles represent events, the ending or beginning of activities. Those events which critically affect the total amount of time the implementation will take are partially colored. Of the 50 activities, 21 of them directly affect the overall timing of the implementation. These critical activities are the controlling factors in scheduling implementation.

c. The earliest practical time for implementation of the Motor Vehicle System is January, 1968. It is important to note that if implementation date is later than March, 1968 it should be delayed until January, 1969 to coincide with the next registration renewal period. Based on a planned implementation of January, 1968, a schedule for the activities of each task has been developed.

1) Installation of the recommended large scale computer system is shown in Exhibit II.F.2.-2. The key activity is the vendors delivery time. It is expected that delivery time of the equipment will be between one and two years. If it is greater than 20 months then the 1968 implementation schedule cannot be achieved. All of the activities are critical in this task and affect the timing of implementation except the events labelled evaluate proposal in detail, plan facility and prepare facility. The writing of systems specifications is separated from writing hardware specifications due to the requirement to redesign forms based on systems specifications and to write hardware specifications based on specifications for modification of the present computer. No schedule for evaluating this report is shown as it should be complete prior to January 1, 1966. This evaluation prior to January 1, 1966 need only be to the extent necessary to justify beginning of the tasks which are critical. If, during the detailed evaluation, a decision is made not to proceed then very little effort will have been invested. If the decision is made to proceed then implementation by 1968 can be achieved.

2) Design and programming of the registration and title systems involves selection and training of personnel as well as programming and is shown in Exhibit II.F.2.-3. Within this task training on vendor equipment, detailed systems design, programming, title system operation, registration renewal and registration conversion is critical. Although

evaluation and selection of personnel, training, and writing of conversion programs is not critical, only one week of slippage can be allowed before they become critical. It is very important that these activities be started as quickly as possible. It is planned that writing of programs for conversion be a part of the training so that experience can be gained in programming on the actual computers presently in the Texas Highway Department. Inasmuch as the actual conversion of data is recommended to be handled on present equipment this type of programming will be excellent experience. Conversion of the registration data will consist of only that data which is not on the title record (such as fee amount and number of months) or is more reliable on the registration file (such as address). The conversion of registration data is planned to coincide with the registration renewal period to avoid the need of converting present files.

3) Conversion of Motor Vehicle Data to a machine processable media is shown in Exhibit II.F.2.-4. The actual conversion is recommended to be performed by outsiders on a contract basis. Only the title file need be converted because registration data will be input during registration renewal. It is estimated that 18 months will be required for the conversion with a contractor staff of approximately 20-25 personnel. It is recommended that the conversion be accomplished by keystroking, in a legible optically readable type, the data in the title record on a continuous roll of paper. The paper should have a motor card format for ease of editing. By using optically readable type the data can be directly input into a computer. Verification can be made by proofreading rather than by duplicate keystroking. The contractor should be required to furnish converted data on magnetic tape which can be tested and updated on the present large computer. Another significant function that must be accomplished during the conversion is file updating. As the file conversion proceeds, title transactions will be processed which affect the records already on the magnetic tape. These files must be updated with changes or they will be useless by the time all records have been converted. The updating with changes will not be difficult in the beginning since few records will have been converted, but when as many as 90% of the records have been converted then up to 90% of the title transactions must also be processed for file updating. It is not necessary that this updating be handled immediately as transaction records can be accumulated for a period of time and processed in a batch, provided they are processed in the same chronological sequence in which they arrived. There should be some errors detected by the computer edits in the conversion program such as title transactions which do not match records on file. The greatest source of error detection should be when the first registration data is input in machine language. Both unregistered titles and untitled registration can be expected, although the latter is likely to be infrequent. Unregistered titles should be purged and put on microfilm with an index to them maintained by the computer system in case of future activity on the record.

4) Modifications of the existing computer located in the computer center at Camp Hubbard is also shown in Exhibit II.F.2.-4. These modifications are to make the present computer compatible with the large scale computer to be installed in January, 1968. The important contribution which this computer will make to the motor vehicle system implementation is to provide a means of testing programs as they are written. The computer will be used to simulate the large scale computer and will provide a means for operational programs wher the large computer is installed. For this reason the recommended hardware modifications must be complete when the programming of the title system is begun. The present computer will also be used to process the title files after they are converted to automatic form. As the contractor completes file conversion his magnetic tapes will be tested on the present computer. In addition, changes which are input to update the converted files will be processed. It is not necessary that the hardware modifications be complete prior to beginning conversion.

5) Education of county personnel and the general public is shown in Exhibit II.F.2.-5. One of the most significant factors in a successful implementation is good training, education and motivation of the personnel who are affected by the system and who must operate it. A two phased training program is planned for the county personnel. The first phase would be pretraining and would be for obtaining constructive ideas prior to detailed systems design. In addition, the pretraining would serve to insure good county cooperation by allowing the counties to contribute to the detailed design. The system, at least partially, belongs to the counties. The second phase would be more detailed and would be aimed at training the operating personnel in system procedures. Two techniques are recommended for this training; use of programmed instruction for procedural training, and use of a special film to explain objectives of the system. Programmed instruction is a rather new educational technique which has proven highly successful in other training situations of this nature. The film would be general in nature so that it could be used in county training to make a uniform presentation to everyone. In addition, it could be used in the following public education program. The timing of the second phase of training and education should be such that it corresponds to the registration renewal period. It should be begun early so that some educational saturation can be achieved prior to February 1, 1968.

6) Preparation of the 1968 license plates and receipts is shown in Exhibit II.F.2.-6. Forecasting license plate distribution and manufacturing scheduling will be generally unchanged. Printing of the license receipt will be changed considerably as the form will be modified to use a type font which can be read by an optical scanner. Redesign of the form must be begun as soon as the system specifications are complete. This is important because the printer will probably require some new equipment such as special numbering wheels for printing the forms.

d. Scheduling of the activities to accomplish the six tasks is very important if a smooth implementation is to be achieved. If it is later decided that only a test county should be implemented in 1968 then the same implementation schedule would apply. Perhaps some of the activities, for example file conversion, would not take as long as a full conversion but the total elapsed time to implement would still be two years. Because test implementing only one county in 1968 would essentially delay full implementation to 1969, it is not recommended. The same capital investment would be required to operate one county as it would to operate the whole state. To provide the advantages of a test period without delaying implementation for a year we recommend that a simulation be run after the detailed systems design is complete. Although all the aspects of an actual test would not be realized in a simulation, it would provide valuable insight into the major problems which could be expected in a full scale implementation.

3. Estimated Conversion Costs

A major consideration of a plan such as the one proposed is its cost. This must constantly be weighed against the expected benefits both in terms of dollar savings and in terms of intangible advantages not realizable from the present system. We have attempted to estimate the costs of conversion in Exhibit II.F.3.-1, realizing the danger in placing absolute values on activities and events which cannot be precisely forecast. Many of the values in this schedule are pure estimates, and should not be segregated too closely for scrutiny and detailed examination. For example, the requirements in terms of full time personnel are based on an educated guess at the amount of systems and programming work which can be achieved in the allotted conversion period by reasonably diligent and well trained personnel. It must be agreed and understood that actual and estimated performance in this particular area is subject to a considerable margin of error. We feel, however, that in the aggregate, the conversion costs presented are a fair estimate of the total costs which can be expected.

There are some costs which might better be classified as start-up costs rather than conversion costs. For example, the cost of the initial supply of plastic plates for imprinting accounting codes will not be a recurring cost. But some plastic plates will necessarily have to be purchased regularly under an operating system. Whether or not to include the initial supply of plastic plates as a conversion cost, or to consider this an allocated portion of recurring operating costs is a decision of cost allocation. In general, we have chosen to include such start-up costs in the exhibit in order to arrive at a total out-of-pocket expense estimate for making the recommended changes. It should also be pointed out that not all of the conversion costs shown will be additional costs, as many present employees can be assigned to the task force without necessarily being replaced in their old jobs.

Although the total cost of conversion appears to be staggering in magnitude, and may suggest postponement of action because it is so large, we would encourage another point of view; that of considering the higher cost of doing nothing. With salary rates constantly on the rise, file sizes growing, and paperwork volumes increasing, the present system can produce less and less at more and more cost. Conversion costs may never be lower than they are now. If a change is to be made, it should be made now.

Legislative Considerations

G. LEGISLATIVE CONSIDERATIONS

1. Accounting Matters

In the course of our study it became apparent in some areas that substantial systems improvements could be made were it not for provisions of law which specifically provided for certain practices and procedures. In other instances, long standing customs or practices, particularly with respect to functions performed by the Texas Highway Department for other State agencies, have been followed which may require legislative action prior to making procedural improvements. In the following paragraphs we are submitting recommendations for systems improvements which in our opinion are worthy of legislative action to the extent required for their implementation:

a. Pre-Audit on Site of Voucher Support

A great deal of benefit could be realized by performing certain audit and review functions of the State Comptroller's Office in the Highway Department's Accounting Office. For example, much time and effort is now spent in preparing proper documentation of vendor invoices for payment by the State Comptroller. When rejected by the State Comptroller's Office for various reasons, much confusion exists in determining the cause for rejection and in remedying the defect. This could be avoided by having a full time auditor (or more as required) as a resident in the Highway Department, for performing the State Comptroller's check while the documents are being processed. The audit personnel from the State Comptroller's Office who performed this work should be rotated frequently to avoid an over familiarity between the employees which might defeat the purpose of independent examination. Examination of voucher support, on site, would provide the following advantages:

1) Errors or flaws in documentation could be cleared much faster, providing faster payment service to payees.

2) Fewer copies of documents would be sufficient if provision were made for the State Comptroller's representative to stamp or otherwise validate the papers examined. This would eliminate permanent duplicate files in the State Comptroller's Office.

Similarly, considerable efficiency could be gained by performing some or all of the State Board of Control audit procedures with on site representatives in the Highway Department accounting offices.

b. Payment Warrants

Present procedures call for all State payments to be made by warrants issued from the State Comptroller's Office. If on-site audit were performed, then it should also be possible for the Highway Department to prepare, on its own computer, the payment warrants to its own employees and suppliers. The Highway Department is one of the largest State departments, and Highway Department business consumes considerable time on the computer of the State Comptroller. If a representative of the State Comptroller were on hand to physically control all blank warrants during their printing, it seems immaterial whether they are printed on one computer or another. The strongest argument for doing this operation completely within the Highway Department is to facilitate doing much more of the data processing work to completion in high volume computer runs without, for example, writing out warrant printing media as we have recommended elsewhere as a concession to the present legal requirements.

2. Motor Vehicle Matters

A review of the Texas Motor Vehicle laws pertaining to Registration and Certificate of Title reveals some inconsistencies with the recommended Motor Vehicle system. These conflicts pertain to the amount of data necessary on registration receipts, frequency and method of county reporting and payment, and county procedures for issuing receipts for title applications as follows:

a. Revised Civil Statutes 6675a-3, paragraph (a) and (b) and 6675a-12 are concerned with the amount of data required on registration applications and receipts. The recommended system attempts to eliminate repetition of data which is not necessary to identify the registered vehicle or to update the master record. As a result, some clarification as to intent of data on registration records is desirable.

b. Revised Civil Statute 6675a-10 and Penal Codes 1435 and 1436-1, Section 57, pertain to reporting of county registration and title transfers. They also are concerned with the method of remitting State funds. The recommended system attempts to simplify reporting so that daily updating of registration and title files can be achieved. To simplify the reporting system, one recommendation is to bill the counties weekly for State funds rather than having counties submit funds with the receipts. The present legislation clearly defines the present procedure and should be either changed to the proposed procedure or rewritten in a general manner to allow flexibility in Motor Vehicle systems of cash collection.

c. Penal Code 1436-1, Section 13 and Section 31, present the requirement to provide a temporary Certificate of Title by preparing a receipt for title applications. The recommended system attempts to simplify title application procedures by eliminating the requirement for this document. The system provides for the intent of the legislation by allowing the registration or transfer receipt to serve as temporary Certificate of Title. The registration forms and the title application receipt contain essentially the same data.

d. In addition to the legislation that directly pertains to Motor Vehicle system recommendations some areas were noticed that should be clarified. One instance is the definition of"owner" in Revised Civil Statute 6675a-1 and Penal Code 1436-1, Section 4. The present definitions do not provide for adequate control of leased automobiles. The recommended system can recognize leased vehicles and their peculiar ownership requirements. Another instance is concerned with the procedures for issuing certified copies of original title, covered in Penal Code 1436-1, Section 36. Certified copies of originals can be used as a means of providing collateral for borrowing money. There is no present method of controlling the issue of these copies and it is possible for several certified copies to be obtained by an individual allowing the vehicle to be represented as lien free collateral several times. The recommended Motor Vehicle system can provide greater control of this situation.

e. In a few instances legislation cannot presently be complied with due to limitations of the present system. In particular the specifications on Penal Code 1436-1, Section 24, paragraph f and paragraph i are that the current license number is required on the title record and that the title must be signed by the owner after receipt. The recommended system will provide for updating the license number of each registration renewal. It will also require a validating signature by the owner after the title is received.

On a longer term basis, some other major changes in motor vehicle procedures need to be considered. For example, one of the most costly procedures now in existence in the Highway Department is the annual re-registration of all vehicles in the State. This causes a tremendous volume of work in the Motor Vehicle Division each spring during and immediately after the three month registration period. Regardless of the computers used, this annual work load will continue unless other provisions are made to relieve it.

One alternate used in some states is to stagger the registration season over the entire year, and to re-register 1/12th of the vehicles each month. All citizens are assigned a particular month, and they register their auto in that same month every year. A serious disadvantage to this solution is that the color of the license plates does not uniformly change on one date each year, and the enforcement of prompt and complete re-registration becomes more difficult. In Texas now the unregistered auto is very apparent the day after the deadline passes for purchasing new license plates.

A simpler and more direct approach is to simply stretch the registration period from one year to several years, perhaps even five or six. One set of license plates would then suffice for the entire life of the average auto. Registration fee collection could still be handled on an annual basis, if desirable, but if a discount arrangement were offered to the motorist whereby he would pay less per year by paying for several years at one time, a longer payment period could be stimulated which would increase cash flow into the highway fund, and reduce the number of transactions substantially.

If a license number became a relatively permanent identification of an auto, the enforcement of collections by periodically publishing a list of delinquent car owners would become a feasible way to collect registration fees in arrears. This could be done especially well through the use of computer prepared lists by county, city and plate number showing registrant's name and address as well as make and model of the auto. The computer could also be used to send out delinquent notices, reminders and other contacts with auto owners.

Without further study of the possible effects of these steps, it is difficult to define the best ultimate system. Some segments of the following plan could be legislated and tried without necessarily adopting an entire package at once. We recommend the following tentative steps in this area:

a. Provide for a six year licensing term with payment periods of 1, 2, 3 or 6 years. Corresponding discounts on the per year cost might be considered as follows:

EXAMPLE	PAYMENT AMOUNT	INCOME IN 6 YEARS	DOLLAR DISCOUNT
1 year	$ 20.00	$120.00	$ -o-
2 years	36.66	110.00	10.00
3 years	52.50	105.00	15.00
6 years	100.00	100.00	20.00

b. Provide for a permanent six year plate to be issued at the time the vehicle's title changes. This would automatically place registration on a staggered basis throughout the year, because the volume of purchases and sales of vehicles is relatively level throughout the year.

3. Other Matters

a. Administrative Salaries

We have noted the salaries paid to the top management team of State Highway Engineer, Assistant State Highway Engineer, the District Engineers and Division Heads in the Texas Highway Department. In order to attract and hold top quality personnel, we believe the legislature should consider raising the salaries of these positions to levels consistent with those of similar positions in industry.

b. Salary Differentials

We also feel that higher salaries should be paid to those District Engineers and their staffs which call for more administrative responsibilities and skills, such as exist in the large metropolitan areas. These higher salaries for urban area districts should also extend to the rank and file personnel on the grounds that living costs are proportionately higher in urban areas. Such a system is in partial operation at the present time, but its use should be extended considerably, so that proportionately larger differentials are paid to city employees.

Research

III. RESEARCH

A. ALTERNATES CONSIDERED

1. Accounting Systems

There are several modifications which could have been recommended for the accounting system which were considered as follows:

a. Financial Statements - The possibility existed of making major changes in the data and format of the present Balance Sheets and Statement of Revenues and Disbursements. In one case, we considered the inclusion of accounts which incorporated programs and plans extending farther into the future than one year, and we studied one state's statements which set up a five year plan in the accounts. However, in our opinion, this technique would not find general acceptance among the administrative officials because the amounts shown would be difficult to comprehend in terms of past amounts shown. In addition, there is little wide spread study of the monthly financial statements presently prepared, and such a procedure would tend to be overlooked or ignored by many who are not financial statement oriented, but who have need for the communication of the proposed data. Therefore, we chose to make few changes in the statements, but to provide, through the account structure, for long-term plans to be recognized by such subsidiary reports as cash forecasts and program status reports.

b. Budgeting - Several alternates to the recommended modifications to the budgeting procedures were considered. One plan would call for establishing the annual budget in terms of twelve monthly budgets instead of a single full year amount. This would call for considerably more detail, but would allow for seasonal or other nonregular fluctuations to be recognized in the forecasting stages of budget development. Less detailed classifications would be budgeted to partially compensate for the increase in processing volume occasioned by using twelve amounts for each budget item instead of the customary one. The plan would have an advantage of providing a much more accurate budget, and consequently allow closer budget variance reporting. We found this practice already established in memo form in several Maintenance Section Headquarters where the annual amounts were divided by twelve to establish a monthly norm to which expenditures were compared. The apparent need existed for a method to raise or lower the norm for seasonal or political variations which could be fairly accurately predicted.

This scheme was not adopted, however, because it would not find universal application. In many cases a total balance to spend is an adequate accounting tool, and the additional effort to provide the fluctuating monthly budgets would not justify the effort. Because there was a necessity to use a uniform procedure throughout the Department, particularly during a critical period of conversion, the twelve monthly budget plan was not developed further.

Another budgeting device, borrowed from industry, was considered. This scheme, similar to the twelve monthly budgets, calls for the use of flexible monthly budgets instead of a rigid amount for each category. Such flexible budgets are commonly found in manufacturing enterprises where variable production rates produce a variable budget fund to which actual expenditures are compared. Thus in a period of low activity, the budget amount is automatically reduced, and in periods of high activity it is increased. This idea, however, has all of the disadvantages of the previously discussed alternate, and in addition calls for the need to develop standard indexes which can be tied to production. This development would be tedious and expensive at the present time. The idea will have more and more merit for the Texas Highway Department as the other matters recommended in this report are accomplished, but we considered it premature to install such a sophisticated budget system when other matters were more pressing. To a degree, our recommendations concerning manpower controls, particularly in regard to the development of highway maintenance standards, would fit into this plan. In developing such standards, it would be necessary to identify the common units of work, and these units could then be considered production units suitable for calculating flexible budget amounts. Similar standards could also be developed to cover many of the service center activities which closely resemble manufacturing operations, as the products are uniform and repetitively produced.

c. Cash Forecasting - An interesting modification to the cash forecasting method recommended, would be to obtain from the highway contractors detailed monthly estimates of their future expected cash collections on the contracts in process. This procedure would replace the use of standardized earning curve data to predict the payout pattern of known contracts already let, and would increase the accuracy of the near range forecast. On the other hand, the procedure would also create numerous problems of liaison with contractors, many of whom would either not know or not be willing to cooperate in providing the data. Without a high percentage of cooperation the plan would certainly be without merit. We did not pursue this alternate, but rather elected to reason that it could be considered further after the more apparent advantages of the recommended cash forecasting plan were realized. We believe that major progress would be achieved in using the historical earnings curve system to predict payouts without disturbing contractor relationships in the beginning, but recognized the obvious advantage of eventually using data which could be considered more realistic. An additional reason for not pursuing this idea was that the hypothecated contracts would still require the use of earnings curve data, and a "double-method" system would be difficult to administer.

d. Accounting Codes and Coding Structure - We considered several different charts of accounts and coding structures including the official accounting manual prepared for the American Association of State Highway Officials (AASHO), and the charts of accounts of several other states. After considerable study and deliberation, it was our conclusion that none of these exactly met the requirements of the Texas Highway Department, although parts of them were useful in creating the chart of accounts which

we have recommended. One disadvantage and danger in using uniform classifications from other states is that the finer points of operations are often not similar, and erroneous conclusions can be drawn by comparing data summarized according to these classifications. We have attempted therefore to design a coding pattern including object and function codes which in broad terms fits the operations of any highway system, but specifically suits Texas. In this manner, some comparative results can be obtained, and yet data concerning unique operations will not be sacrificed.

We did not choose to provide for a Highway Investment and Fixed Assets Fund, because the present Texas procedures regarding the monitoring of road life and the need for reconstruction projects were well established, workable, and not likely to be materially influenced by such provisions.

e. PERT and CPM Planning Methods - Although many states have found this technique useful in the overall administration of a highway management program, and we concur that it would be beneficial, we did not pursue this approach to a fiscal management control system. After an investigation in depth of the accounting needs of the Texas Highway Department, it was our early recommendation to the Steering Committee that these needs be emphasized in the remainder of our study, to the exclusion of immediate automated techniques for allocating and monitoring the construction activities of the Department. We feel that the use of network techniques will ultimately find acceptance in the Department, and have emphasized this technique in our proposed plan for conversion. We feel that considerable knowledge and confidence in it can be gained through exposure during the conversion period.

2. Organization and Operating Policies

There are several alternate organizational actions which could serve to overcome the weaknesses pointed out in the critique of the present plan of organization and which would help meet the current billing and concurrent audit requirements of the Bureau of Public Roads. Although each of these alternate plans of organization has certain desired qualities or advantages, they were rejected after thorough study. This section will attempt to present these alternates in an objective manner pointing out both their advantages and disadvantages.

Five alternate plans of organization were studied in reference to the needs of the Texas Highway Department. These plans were:

a. Consolidation of all systems development, programming, and data processing into one division. This plan of organization would involve the creation of a centralized systems group, a centralized programming group, and a centralized data processing group. The data processing installation that would be appropriate for this plan would be a large, multipurpose computer with the necessary peripheral equipment. These groups could either be assigned to one or more existing divisions, or a new division

could be created with these groups as a basis. Our initial study indicated that assignment to one existing division which had a service relationship with other divisions and districts would be more desirable than creation of a new division or separation of the functions and assignment of them to two or more existing divisions. The latter two alternatives would tend to complicate existing organizational relationships and would not have the advantage of existing service channels.

This plan has the obvious advantage of concerning the management and administration with only one computer installation and it would tend to eliminate the possibility of duplication of computing activities. Separation of the systems development and programming functions from the operation of the data processing equipment would facilitate the control and scheduling of equipment operations on a production basis. A slightly larger and more powerful computer might be justified. Many organizations which have both engineering and business applications have demonstrated that this approach can be effectively implemented. Both the systems group and the programming group would have to be divided according to specialization. It is anticipated that the systems group would require specialists in engineering systems, business systems, motor vehicle registrations systems, and traffic studies. Some interchange between these specialists should be possible however. This extensive division of duties would not be necessary in the programming group where the distinction between engineering and mathematical programmers and business programmers would be sufficient. It would be advisable to train engineers to do their own programming and have a small group of general engineering and mathmetics programmers. The activities of both the systems and programming groups could be coordinated and supervised by one manager while the data processing machine operations would be under the supervision of another manager. These groups could be assigned to the Automation Division, where the Computer Center is presently assigned, and the managers would report to the Director of that division.

The disadvantages of this plan lie in implementation. The present plan of organization of the Department emphasizes decentralized management. Because there is no effective alternate for centralization of the fiscal management function, this must take priority. Centralization of the systems development, programming, and data processing operations would appear to complicate the transition. This alternate consequently would be more ideal as a a long range goal which could be considered after successful implementation of the recommended plan.

b. Creation of a separate Systems Division which would report to the State Highway Engineer. This plan emphasizes the overall needs of the Department for a comprehensive or total system and the necessity for full support from top management. The question of where the data is processed within the Department is subordinated to the importance of the development of total systems for the Department in this alternate. The Director of the Systems Division would report to the State Highway Engineer and the Division would be organized along the same lines as the systems group

in plan a. By having divisional status, the Director would have the advantage of being able to approach other divisions and districts on equal terms. The Division would be a service type organization. A disadvantage of this plan is that a system can not be imposed or forced upon others. It must be accepted and desired by them. The status of the Director is actually secondary to his ability and personal characteristics. This alternate has the added disadvantage of increasing the span of management required of the State Highway Engineer.

c. Creation of a new Management Control Information Division which would coordinate the development of control techniques for financial and budgetary planning, cost accounting, and manpower scheduling and control. This organizational plan appears to broaden the concept of plan b. Developments in the science of management control have caused many organizations to give recognition to this science as a separate management function. This approach also presents an alternate to the establishment of the Fiscal Management Division in that it would perform many of the functions assigned to that Division in the recommended plan. The Management Control Information Division would not be responsible for the accounting function but would coordinate the development and use of control and planning systems. The Division would consist of a Systems Section, a Budget Section, a Cost Accounting Section and a Manpower Control Section. Data Processing would be centralized into one Computer Center under an Operations type division. Study of this approach indicates that it fails to present advantages over the Fiscal Management Division concept and in addition would tend to duplicate or compete with the accounting function. It also has the added disadvantage of centralizing systems and data processing operations at the present time.

d. Creation of regional data processing centers to prepare certain reports for assigned Districts and act as an input source into a central data processing system. This organizational plan proposes the separation of the Department into five geographic regions which would each have its own data processing center. An additional central data processing center in Austin would consolidate the work sent from the five centers and would provide the data processing and computer service needed by the Headquarters Divisions. The five regional data processing centers would act as an input channel to the central data processing system and would also perform independent auxiliary data processing functions. They would receive systems, programming, and operating supervision from a division in Austin. These five centers would have an advantage in being able to provide rapid processing service for the districts and would also tend to avoid the concept of centralization. This approach, however, could lead to many unnecessary duplications, and would be more difficult to manage and staff than computer installations which were centrally located.

e. Creation of an Interstate Highway Division to have responsibility and control over construction of only the Interstate highway system. This plan is an approach to meet both the requirements of the Bureau of Public Roads for current billing and concurrent audit, and also to

partially solve the problem of the large shifts in work volumes between districts that result from the Interstate highway program. This approach would consolidate all work related to Interstate highway construction into one separate division. This division would be responsible for all functions from financial planning and preliminary engineering through the construction and inspection of the finished highway system. A primary advantage of this approach would be that the Interstate work force would not be organized by districts. Employees could be more easily shifted from one location to another as the work load changed. Personnel planning in the districts could be more easily controlled because the regular district work volume would be more stable. A savings in the total number of construction personnel could be anticipated by this approach. This alternate, however, does not appear to answer the problems related to the financial management of regular noninterstate highway construction which also qualifies for Federal aid participation. Following such a plan would result in a certain duplication of effort because provision would still need to be made for financing and constructing noninterstate highways.

3. Data Processing Hardware

a. One Central Computer

When considering the possible methods of combining the computer hardware known today for the best and most economical solution of the Highway Department's requirements, the first and most natural thought is to put all of the work on one central computer. Such a machine would have enough capacity and available time to process in an economical manner both business and scientific work. It would also be able to handle the large memory requirements of the traffic work, and would have a random access file attached which was large enough to store all of the data of the Motor Vehicle Division. However, the realities of the situation present the following disadvantages of this first alternate solution:

1) The mixture of applications is too diverse for the computer hardware which can be economically rented today. For example, to acquire and rent on a full time basis enough internal memory to fulfill the requirements of the traffic work, would cause a great deal of memory capacity to remain idle when traffic work was not being processed. In as much as the traffic work load can be expected to fluctuate, it seems unwise to rent this added capacity. A better way to meet the demand for such a large memory on an intermittent basis would be to rent time on a large computer at a commercial service center as necessary.

2) The physical distances between the computer center and the State Highway Building could cause a great deal of travel time between offices if all work is processed, even on a daily basis, at one location. This travel time would be accentuated in the period when business applications are added to the computer.

3) Data control problems would be increased by virtue of introducing accounting data into an organization which is trained to handle essentially engineering and scientific data.

4) Regardless of the overlapping processing ability of a large computer, scheduling of business, engineering, traffic and Motor Vehicle applications would be more difficult on a single machine than it would be if more than one machine were used.

b. Separate Computer for Motor Vehicle Division

This plan would provide a separate computer for the work of the Motor Vehicle Division, and place all other work within the present computer center. This would allow part of any scheduling problem to be solved, by eliminating Motor Vehicle Division work from consideration. In addition, the motor vehicle work could be programmed for a limited capacity, special purpose computer with very little internal memory at what would probably be a considerable savings in rental. The traffic work could be taken outside. This solution, however, also has several disadvantages as follows:

1) Although the mixture of applications for the main computer would be less diverse than the first solution above, there would still be the need for very close scheduling between engineering and scientific work and business data processing. It is doubtful that both types of work could be successfully scheduled to the complete satisfaction of all users, especially during the two or three year period when new business data processing applications were being programmed and tested.

2) Physical location problems between the users of one computer would still exist.

3) Data control problems would also continue to exist.

c. Combining Motor Vehicle and Business Data Processing

This plan would merge the business data processing work load into the Motor Vehicle Division work load on a single computer, and place the engineering and scientific work on a separate computer. This would, in effect, continue the present computer center as an engineering and scientific center, and place the new work (business data processing and motor vehicle) on a new computer. The main problem with this plan is that the hardware requirements for the business data processing work load, and the hardware requirements for the Motor Vehicle Division work load are radically different. A computer to handle the business data processing work should have moderately small internal memory, and relatively high speed input-output devices, such as card reader, card punch, and magnetic tapes. On the other hand the requirements for the Motor Vehicle Division work load are for a very large random access memory, a small internal memory, and relatively slow input-output devices.

d. Regional Data Processing Centers

This plan, which was at first considered in some detail, would establish five regional data processing centers in the State to collect and process accounting data on a partially decentralized basis. Some routine engineering and scientific work could also be processed at these centers, although the computers would not be large enough to handle more than simple problems. A large central computer center would also be used to consolidate data which was partially processed in the regional centers, and to handle Motor Vehicle Division work.

This plan has the following advantages:

1) Communications to and from the district work centers would be shorter and more direct. In many cases daily delivery of data to be processed could be made via Highway Department messenger to the regional centers.

2) Short "flash" reports could be prepared and returned immediately to the supervisors and managers in the filed.

3) Errors in coding or classification would be located and corrected nearer to their source.

4) Employee training and systems development would be on a more continuous basis if operated through the regional centers.

5) Partial summarization of data could be made in the regional centers so that central processing workloads would be lighter and more evenly distributed. Overloads in one regional center could be dispatched to another regional center.

6) Data transmission linkage from five centers to Austin would be more practical than linkage from twenty-five districts to Austin, and this modern communications tool could be employed with far more ease at an earlier date.

The plan, however, has the following disadvantages, which in our opinion, were sufficient to reject it from further serious consideration:

1) Duplication of computing equipment and auxiliary devices such as key punches, scan punches, sorters, etc., would create an excessively high equipment cost in relation to the overall data processing power achieved. In short, duplicate small computers are not as economical as fewer large machines.

2) The Motor Vehicle Division workload would still require a fairly large computer installation in Austin, and when coupled with the central business data processing workload, almost as much central computer would be required as is being recommended. Under these circumstances the regional center computers would be almost entirely superfluous.

3) The regional plan would impose a new level of management and administration which would be foreign to all organizational concepts in the Department.

4) Supervision and uniformity of procedures among the five regional data processing centers would require a strong central systems coordination effort, which if expended in direct attention to field systems problems, would result in considerable economy of management manpower.

e. Data Transmission

This plan would involve setting up data origination stations in each district office, and making provision for keystroking all accounting transactions before sending them by leased wire to Austin. Some accounting reports would be transmitted back from Austin, and others would be mailed.

We feel that the recommended data origination system (using pre-embossed plastic plates) has several immediate advantages over a plan whereby data must be serially keystroked in the districts. These advantages are as follows:

1) Serial keystroking data and then positively verifying the accuracy of the keystrokes in some manner generally requires a fairly tight control procedure, and considerable employee re-education and training. Less resistance should be encountered by introducing a familiar imprinter than would be found in attempting to "automate" the district accounting offices by introducing more complex machines.

2) Data transmission from twenty-five districts to Austin on a beginning basis would present many scheduling and editing problems for a central computer center. These would not be as critical under a mail-in plan such as is recommended.

3) Fundamental coding accuracy at the original recording level is almost assured using the plastic plate concept. Under a data transmission scheme, the entire burden of coding accuracy would fall upon the district accounting office which would be forced to take responsibility for editing and correcting erroneous codes as well as for accurately translating them into machine media.

4) The original cost of data origination devices is considerably smaller when purchasing plastic plate imprinters as opposed to add-punch machines in sufficient quantity to record and verify the input data.

We believe that data transmission may be an ultimate solution to communication with the districts and with the field. In our opinion, this is a technique which should not be permanently scrapped, but merely shelved pending the acceptance and functioning of the recommended steps towards central processing. In time, this alternate plan should be re-examined for application, especially as district engineering forces utilize the remote stations which are provided for under the recommended plan.

4. Motor Vehicle Division Systems

The alternates considered during the design of the proposed Motor Vehicle Division System were concerned with methods of processing registration data, methods of inquiry, and methods of data conversion.

a. Use of a "turn around", or mail out, document was considered as a means of providing automatic input of registration renewal data. This method is presently being used in the form of a tab card system for special registrations, such as boats, dealers and personalized license plates.

1) The advantages of such a "turn around" document are:

   a) Centralized preparation and control of documents.

   b) Preprepared documents for direct input into the system on return at great savings.

   c) Complete display of all pertinent data on the format of the document.

2) The disadvantages of such a "turn around" document are:

   a) All necessary data cannot always be prepunched or preprinted, therefore in some cases the returned document must be handled manually prior to input.

   b) High costs of mailing the document.

   c) Low percentage of returned documents due to changes of address and persons who cannot or will not follow the instructions properly.

   d) The general public is directly involved in the system rather than selected county personnel who can be trained.

3) Selection of the proposed system rather than use of a "turn around" document is based on a lower operating cost and increased control of the system by State and county officials. The "turn around" document was recommended for continued use, with modified mailing procedures, on special registrations. If license plate renewal periods should be lengthened to be greater than one year, as we have recommended for long term consideration, then this alternative should be reevaluated.

b. Use of plastic cards was considered for use in the title procedures as well as to aid in the collection of registration data during renewal periods.

1) The advantages of a plastic card for data collection are:

a) The plastic card can be mailed to the owner, once, with his new title thereby eliminating recurring mail out costs.

b) The plastic card provides for optical scanable type font and other general data to be economically imprinted on a receipt document quickly and accurately with no manual entry.

2) The disadvantages of a plastic card for data collection are:

a) The plastic card serves no real purpose in title transactions. Applications for title changes must still be keystroked.

b) The plastic cards must be individually prepared and mailed with each title transaction.

c) An additional computer index is required to reference the title number on the plastic card to the vehicle record number.

d) Individual plastic card imprinters are required by all tax collectors and their deputies to imprint the plastic cards onto receipt documents. These imprinters and plastic cards would be used to make only one impression per card per year.

e) The general public is directly involved in the procedural operation of the system by having to retain the plastic card during the year and then present it in usable form during the renewal period.

f) Address changes will require continuous updating of plastic cards, or repeated keystroking of new addresses each year at substantial cost.

g) An increase in the term of license renewals to more than one year would further decrease the benefits of the plastic cards because they would be used less frequently, and would be subjected to even more changes between uses.

3) The recommended system did not include use of a plastic card because of the magnitude of public involvement and the ultimate requirement for a large number of imprinters in the county offices and at deputized license sales stations.

c. Use of microfilm records for data storage and inquiry purposes was considered in lieu of large random access computer files.

1) The advantages of microfilm records for information storage and retrieval are:

a) The data is stored as an image of the actual document rather than in digital form. Signatures and other general information can be retained in the system.

b) Microfilm procedures are generally more economical than computer processing.

c) Reasonably good access time could continue to be realized using microfilmed files.

2) The disadvantages of microfilm records for information storage and retrieval are:

a) It is relatively difficult and expensive to provide an updated and current index to the microfilmed records for quick access. Computer processing is still necessary to provide such an index.

b) A microfilm filing system is unable to provide special analysis or reports directly from the records for law enforcement or other purposes.

c) A microfilm filing and retrieval system is still a semi-manual system subject to many human errors which cause out-of-file conditions.

3) The microfilm records which are recommended are restricted to records of transactions and inactive files rather than active files. It is expected that significant developments in data storage and retrieval will be made in the future, particularly concerning a combination of digital and image storage techniques. These developments should be carefully followed and consideration should be given to them as they are announced and proven operative.

d. Conversion of the present title file data to electronic data processing records was considered for implementation by both State employees and by outside contractor. Use of an outside contractor was recommended due to the high investment in employee training and the extensive but temporary need for personnel and equipment during the conversion period. Use of State personnel for periodic computer updating of the converted records with title transactions was recommended, however, because this updating task would begin on a limited basis and would grow to include a staffing requirement that will be necessary during operation of the system.

e. A general review of the present Motor Vehicle Division procedures reveals that there are too many different types of registration documents. Standardization of these documents by related groups to reduce the number was considered. However, the idea was not developed in detail, nor included in these recommendations because of the need to limit the amount of changes to be made at one time. To change the forms significantly at this time would have imposed additional training requirements as well as creating additional sources for errors. By designing new forms to closely resemble the present forms, the overall system is only slightly disturbed. Less change is noticed by the public and county personnel. After the recommended system is implemented and operating, further study should be made regarding the combination and elimination of forms.

f. Centralized registration by direct mail at the State level instead of through the county tax collectors was not included as a recommendation due to the high cost of mailing documents and license plates. It was also believed that county personnel can provide better direct service to the public within their respective counties. Such a scheme of centralized registration would still require either continued county participation or greatly increased field activities by State employees.

g. Use of a fixed license number or semi-permanent plate was studied but was not recommended for immediate consideration. The impact of this recommendation on the Texas Penal System, the relatively low present cost of Texas plates, and the increased difficulties of law enforcement tend to discourage an immediate move toward permanent license numbers. However, there would be many gains and savings from such a plan, and we have included a recommendation for future legislative action concerning this subject in Section II.G.

h. Staggered registration dates are often utilized in other states to evenly distribute the registration workload during the year. Staggered registrations cause difficulties in law enforcement and require several complicated administrative controls. The recommended computer system is designed to handle the peak workload without additional staffing due to direct input of data from the counties.

5. Manpower Controls

The principal alternate manpower control system considered is known as the personnel complement plan. This plan, as implemented in one state, calls for a general top management oriented review of all operations of the Highway Department, and then the development of ideal "cells" of workers for performing all main activities. The Department is reconstructed around these cells or personnel complements, and managers are requested to supply reasons for deviations from these standards. This plan, in effect, closely parallels the recommendations which are made herein, only it is developed in an atmosphere independent and separate from the accounting system. We have preferred to include the manpower control system as a part of the regular accounting system, and the development of ideal personnel complements would follow rather than precede the presentation of manpower usage reports. In essence, the procedures which we have recommended for making manpower estimates prior to beginning projects, is a decentralized approach to setting personnel complements. Similarly, the work simplification recommendations concerning maintenance methods and crew sizes are detailed steps to establishing ideal "cells" for performing routine maintenance jobs. The personnel complement system has an advantage in regard to manpower controls, because it places definite overall emphasis on this problem. On the other hand, it may tend to perpetuate the concept of static manpower forces within fairly limited geographic areas, which could serve to limit the flexibility of centralized pre-scheduling on a long-term basis.

B. INDEX TO CONSULTANTS WORK PAPERS

1. General Remarks

In the course of our study which lasted from April through December 1965, numerous work papers were created, accumulated, studied, and filed in two filing cabinets in our office space located on the first floor of the State Highway Building. Many items, such as reports and manuals, were loaned to us for the duration of our study with the understanding that they would be returned when no longer needed. This index is a listing of everything in these two file cabinets before anything is returned. Many of the work papers, such as correspondence, flow charts and notes, created by our staff will be permanently stored in our offices in San Antonio, Texas. These items will be marked "X" in the KEPT column. The other items will be returned to the persons noted in the RETURNED TO column after January 1, 1966. No attempt has been made to list all of the data about each item in a formal bibliographical style, but simply to note a descriptive title for purposes of general identification.

2. Index Listing

DRAWER AND ITEM/FOLDER NO.	DESCRIPTION	KEPT	RETURNED TO
Drawer 1			
1.	Correspondence, Part A, contains pre-engagement data, specifications, contract, and general correspondence	X	
2.	Correspondence, Part B, continuation of correspondence from Part A	X	
3.	General Project Management Notes	X	
4.	Highway Department Billings, one folder for each month, labelled A, B, C, etc. starting with April 1965 through December 1965 (at report publication date). Files contain monthly invoice copy from E & E to THD with all supporting papers	X	
5.	Flow Charts of Present Procedures		
	A. Federal Aid Billing, Construction Cost Accounting, Right of Way Cost Accounting	X	
	B. Financial Reports, General Ledger Accounting, Project Ledger Accounting, Budget Ledger and IPE Accounting, Equipment Asset and Depreciation Accounting	X	
	C. Service Center Accounting	X	
	D. Budgeting, Maintenance Programming, Construction Programming	X	
	E. Warehouse Payroll	X	
	F. Equipment Rental	X	
	G. Material and Supplies - Purchasing	X	
	H. Salary and Labor	X	

DRAWER AND ITEM/FOLDER NO.	DESCRIPTION	KEPT	RETURNED TO
	I. D-4 Budget Bookkeeping, Inventory Processing, Commodity Purchase Data, D-8 Interview Notes, D-14 Interview Notes, D-5 Interview Notes, D-18 Interview Notes	X	
	J. 1. Motor Vehicle Division Master Record, Notes, Examples, and General Documents	X	
	2. Motor Vehicle Flow Charts, Forms and Workload	X	
	3. Motor Vehicle Present System, Notes and General Information	X	
6.	Field Visit Notes		
	A. Industrial Engineer's Visits to Dist. 12	X	
	B. Visits to Childress, District 25;	X	
	Paris, District 1; and Ft. Worth, District 2	X	
	C. Visit to San Antonio, District 15	X	
	D. Visit to Abilene, District 8	X	
	E. Visit to Houston, District 12	X	
	F. Visit to Dallas, District 18	X	
	G. Visit to Houston Urban Office	X	
7.	Progress Data Given to Steering Committee	X	
8.	Report Draft Notes		
	A. Forward Section	X	
	B. Manpower Controls	X	
	C. Network Schedule for Conversion	X	
	D. Data Processing	X	
	E. EDP Output, Cost Accounting, General Ledger, Input Forms	X	

DRAWER AND ITEM/FOLDER NO.	DESCRIPTION	KEPT	RETURNED TO
	F. 1. Organization Notes, Part 1	X	
	2. Organization Notes, Part 2	X	
	3. Organization Notes, Part 3	X	
	G. Miscellaneous Report Draft Notes	X	
Drawer 2			
9.	Data From Foreign States		
	A. Arkansas; Sample Cards, Budget Status Reports, Accounting Manual, Data Processing Center Costs, Current Bill and Support, Interview Notes	X	
	Accounting Manuals		Courter
	B. California; Organization Charts		Brooks
	Sample Forms and Salary Rate Bases		Brooks
	Accounting Manual		Kirkley
	Rules Covering Equipment Rental		Kirkley
	Sample Statements and Status of Funds		Kirkley
	Cash Position Forecasting and Control of the State Highway Fund		Courter
	Monthly Time Sheet Preparation		Courter
	C. Colorado; Colorado Current Bill		Brooks
	Employee Time Distribution Sheet	X	
	Sample Computer Output	X	
	Cost Accounting Manual		Brooks
	Payroll Register		Brooks
	Budget Summary		Brooks
	D. Florida; An Approach to Financial Forecasting in State Highway Departments		Courter
	E. Illinois; Operating Procedures Manual		Courter
	Mechanized Construction Accounting and Related Financial Reporting in Illinois		Courter

DRAWER AND ITEM/FOLDER NO.		DESCRIPTION	KEPT	RETURNED TO
	F.	Iowa; Final Report, Cooperative Financial Management Review, BPR and Iowa State Highway Commission	X	
		Payroll, Time, Expense and Equipment Sheet	X	
		Financial Statements	X	
		Weekly and Monthly Federal Aid Status Reports	X	
	G.	Kentucky; Concurrent Audit and Billing Manual	X	
		Concurrent Audit	X	
		Operations Manual, Division of Accounts, Federal Aid Billing and Audit Section		Courter
		Preliminary Study of Data Transmission Feasibility	X	
	H.	Louisiana; Fiscal Codes		Courter
		Accounts and System for Charging Service Centers and Payroll Additive Costs, Interview Notes	X	
		Fiscal Manual		Courter
	I.	Missouri; Chart and Code of Accounts		Courter
	J.	Nebraska; Current Billing		Courter
		Current Audit Listing		Courter
		Project Finance and Cost Control Listing		Courter
	K.	New Mexico; Expenditures Ledger of Budget Accounts		Brooks
	L.	New York; Specifications for A New Electronic Data Processing System		Nations
	M.	Oklahoma; Accounting Manual		Brooks
	N.	Oregon; Cost Coding Manual, Current Billing-Concurrent Audit		Courter

DRAWER AND ITEM/FOLDER NO.		DESCRIPTION	KEPT	RETURNED TO
	O.	Pennsylvania; Highway Management Systems,		
		Pennsylvania's Program	X	
		Flow Charts	X	
		Budgetary and Accounting Presentation	X	
		Field Office Manual of Accounting Procedures	X	
		Project Analysis Report and Data Sheets	X	
		District Project Log Draft	X	
	P.	Virginia; Virginia Maintenance Study		Courter
		Research Study of Administrative Practices and Control Procedures		Courter
		Flow Charts		Courter
	Q.	Washington; Accounting Systems Development Leading to BPR Concurrent Audit		Courter
	R.	West Virginia; Highway Management System- 2 volumes		Courter
	S.	Wisconsin; Allocation of Eligible Indirect Charges		Courter
		Schedule of Accounts and Codes		Courter
Drawer 3				
10.		Texas Forms and Manuals		
	A.	Program Status Books		
		Noninterstate Advance Planning Program		Destroy
		Interstate Programs		Destroy
		Noninterstate Programs		Destroy
	B.	Construction Report - Status Book		Destroy
	C.	Status of Maintenance Operations Projects		Destroy
	D.	Monthly Report of IPE Work		D-8
	E.	Equipment and Procurement Division;		
		Supplies, Printing Section		Destroy
		Supplies, Merchandise Awards		Destroy
		Materials Handling Procedures Manual		D-4
		Manual of Procedures		D-4

DRAWER AND ITEM/FOLDER NO.	DESCRIPTION	KEPT	RETURNED TO
	F. Policies of the Texas Highway Department with Commission Minute Orders, Administrative Orders and Circulars		Sanders and Waller
	G. Design Standards		D-8
	H. Introductory Highway Engineering		
	Part I Basic		District 12
	Part II Intermediate		District 12
	I. Engineering Computer Manuals		
	Earthwork Programs		Ball
	Interdependent Traverse Computations		Ball
	Geometry Programs		Ball
	Three Point Problem Program		Ball
	Skewed Bridge Computations		Ball
	J. Accounting Manuals		
	1. Forms Manual		Sanders
	2. District Warehouse Clerical Operations		Brooks
	3. Warehouse Stock Payroll		Brooks
	4. Salary and Labor Payroll		Brooks
	K. Code Charts		
	1. Chart of Accounts Print	X	
	2. Accounting Manual	X	
	3. Code Charts 12A and 13	X	
	4. Code Chart Manual	X	
	L. Financial Reports		
	1. Annual Report 9/1/64 to 8/31/65	X	
	2. Biennial Report 9/1/62 to 8/31/64	X	
	3. Biennial Report 9/1/60 to 8/31/62		Brooks
	4. Biennial Report 9/1/58 to 8/31/60		Brooks

DRAWER AND ITEM/FOLDER NO.		DESCRIPTION	KEPT	RETURNED TO
	M.	Budget Request 8/31/66 and '67	X	
	N.	Construction Records and Data to Support Final Estimate Pay Quantities		Brooks
	O.	IBM Run of Maintenance Costs		Brooks
	P.	Item Classification and Maintenance Expense		Brooks
	Q.	Forms 527 for April 1965		Brooks
	R.	Aid Division		
		1. Tabulation of Appraisals		Kirkley
		2. ROW Certificates		Kirkley
		3. ROW Disbursement and Utility Audit Data	X	
Drawer 4	S.	Right of Way Division		
		1. Manual for Negotiators		Kirkley
		2. Utility Manual		Kirkley
		3. Right of Way Manual - Book 1		Kirkley
		4. Right of Way Manual - Book 2		Kirkley
	T.	Motor Vehicle Division		
		1. Motor Vehicle Division Tour	X	
		2. Functions and Operations of THD's Motor Vehicle Division	X	
		3. General Information Covering Commercial Vehicle Operation in Texas	X	
		4. Helpful Hints on Titles and Tags	X	

DRAWER AND ITEM/FOLDER NO.	DESCRIPTION	KEPT	RETURNED TO
	5. Harris County Tax Collector's Tab Procedures and Card Layouts	X	
	6. Motor Vehicle Division'sBudget Recommendations	X	
	7. Motor Vehicle Facts, 1964	X	
	U. Planning and Survey Division		
	1. Texas Road, Street and Highway Finance Facts	X	
	2. District Control - Section Maps	X	
	3. Texas Local Road Finance Report	X	
	V. Construction Division		
	1. Contractor's Financial Resources	X	
	2. Confidential Questionnaire Forms	X	
	W. Texas Motor Vehicle Laws 1963-64	X	
	X. Texas Highway Laws 1963	X	
	Y. Special Labor Provisions for State Projects	X	
	Z. Personnel Data		
	1. Functions and Operations of THD	X	
	2. Resident Engineers by Districts	X	
	3. Engineers Paid vs. Paid Estimates and Programmed Work		Ging
	4. Austin Office and District Office Personnel		Ging
	5. Duties and Responsibilities of the Main Office Divisions		Ging
	6. District 14 Personnel		Ging

DRAWER AND ITEM/FOLDER NO.	DESCRIPTION	KEPT	RETURNED TO
	7. General District Organization Chart		Ging
	8. Personnel Record		Ging
	9. Classification Analysis		Ging
11.	Other Data and Reports of Others		
	A. Kirkley's and Brook's Reports on Visits to Colorado and California	X	
	B. Position Classification Data from State Auditor's Office 9/1/65	X	
	C. Criffenhagen Report - 1/10/33	X	
	D. Texas Research League Reports		
	1. Motor Vehicle Registration		Pendergrass
	2. Highway Needs 1956-1975		Pendergrass
	3. Highway - User Tax Structure		Pendergrass
	4. A Program for Texas Highways		Pendergrass
	5. Resources for Texas Highway 1956-75		Pendergrass
	E. George Amistead Report 1930		
	1. Instructions Book		Pendergrass
	2. Book of Code Charts		Pendergrass
	3. Forms of Reports to be Made		Pendergrass
	4. Changes to be Made in Forms		Pendergrass
	5. Card Forms		Pendergrass
	6. Changes to be Made Cards are Reprinted		Pendergrass
12.	Data From Other Sources		
	A. IBM State Federal Newsletter #38	X	
	B. HEEP Newsletters	X	

DRAWER AND ITEM/FOLDER NO.	DESCRIPTION	KEPT	RETURNED TO
	C. Manual of Uniform Highway Accounting Procedures - AASHO	X	
	D. AASHO Sub-committee on Uniform Accounting - Task Force Report on "Reporting to Management"		Priest
	E. Automatic Data Processing in State Government of Texas - Report of Governor's Committee	X	
	F. State Auditor's Reports	X	
	G. Federal Laws, Regulations, and Other Materials Relating to Highways		Priest
	H. BPR Administrative Manual Sections		
	1. Transmittal 428 12/29/64	X	
	2. Transmittal 291 7/16/63		Priest
	I. Concurrent Audit Considerations (6/29/62)		Courter
	J. Highway Financial Management Bulletins	X	
	K. State Bureau Financial Management Conference - Nashville, Tenn. 5/18/62	X	
	L. BPR Letters - file folder		Kirkley
	M. Survey of the State Highway Department Procedures Relating to Highway Construction		Priest
Drawer 5			
13.	Raw Data Forms Collected		
	A. Machine Usage Reports	X	
	B. Motor Vehicle Division Data		
	1. Workload Measurements	X	

DRAWER AND ITEM/FOLDER NO.	DESCRIPTION	KEPT	RETURNED TO
	2. Inquiry Counts	X	
	3. Registration Sample Counts	X	
Drawer 6 (Cabinet 2)			
14.	Physical Layouts		
	A. State Highway Building Plans	X	
	B. Camp Hubbard Site Drawing	X	
	C. Motor Vehicle Office Plans	X	
15.	Personnel Listing at April 1965 of Austin Divisions	X	