(6) Account Sub-System

When goods are received, a transfer-transaction occurs between governmental accounts, inventory is taken, and stock delivered, and information concerning the transfer transaction is transferred to the account file from all sub-systems.

4-3-3 Hardware and Software

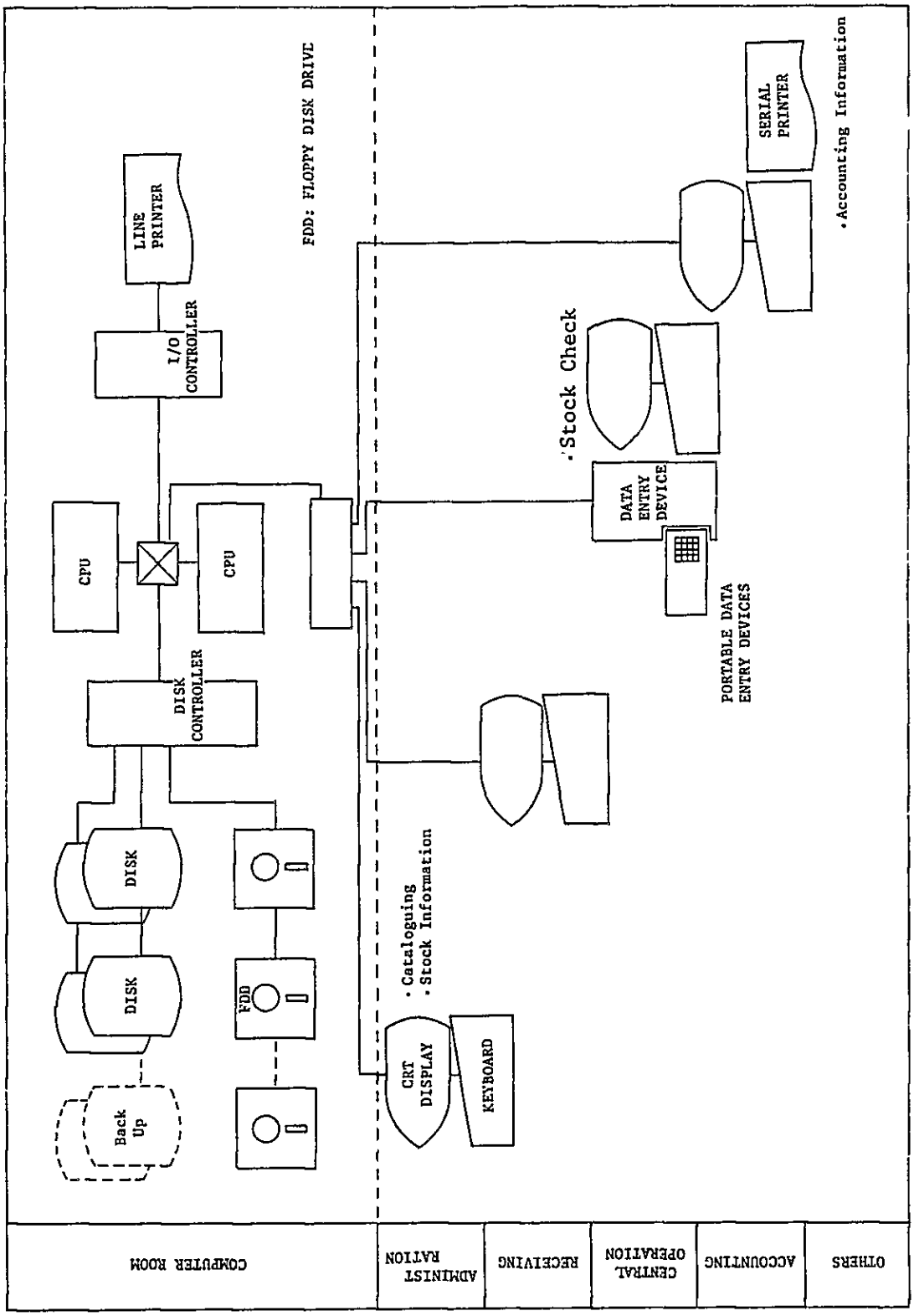
The following describes the required functions of all hardware and software in the model plan Fig. III-4-5 shows the model plan of hardware configuration in the Government Store. This is for the purpose of showing how a CPU, peripheral equipment, and terminals are to be posted. Equipment required in the model plan consists of a central processing unit, hard disk, floppy disk drivers, a line printer, and terminal devices such as keyboards, CRT displays, and other support equipments.

The Central Processing Unit (CPU) will be required to have a sixteen bit architecture, for which both the INTEL 8086 and the MOTOROLA MC 68000 are popular. Since the Treasury Department is using an AEDS-100 with INTEL8086, it is advisable, inview of compatibility, to use the same microprocessor.

Moreover, small business computers provided with stock control software package are also suitable for the system in the department. They can be implemented with multistation OS without compatibilities.

Among peripheral equipment, the hard disk unit (Winchester Disk) is indispensable in the plan. Capacity is required to be 10MB for the stock master (the catalog file), 1MB for the supplier file, 2MB x 2 = 4MB for the order file, 4MB x 2 = 8MB for the stock file, and 1MB x 2 = 2MB for the account file 24MB are necessary in all. If room for extra capacity is kept, some 40MB will be necessary. As for the hard disk drives to be used in the CPU, 5-¼ inch and 8 inch types are available. The former has a capacity of several MB to dozens of MB, and the latter has a capacity of dozens of MB to hundreds of MB. Considering that a capacity of 40MB is required in the plan, the 5-¼ inch type with a capacity composition of 10MB x 4 or 20MB x 2 is suitable. If system security is to be taken into account, all files should be dual. For this purpose, a capacity of 20MB x 4 and total operating capacities for the disks of 80MB with on-line connection are necessary.

Fig. III-4-5 Hardware Configuration Planned for the Computerization of the Government Store



The floppy disk drive (FDD) is necessary for the audit trail and is recommended to have as large a capacity as possible in order to deal with large-capacity files It is, therefore, recommended to use a double-sided 8 inch-type disk in the FDD. Each floppy disk should have a capacity of 1 to 2MB. Two units are sufficient but it is advisable to have an additional back-up unit.

The line-printer is used for printing management materials such as various monthly records. From estimates based on "Store Inventory Management System – Information & Reports Required" given by the Government Store, the printing volume of monthly management materials has reached approximately 200,000 lines per month. If the materials are printed during the first five days of the month, printing volume amounts to 40,000 lines per day and it is necessary to print out 5,000 to 6,000 lines per hour with seven hours of operation a day. To accomplish this work, a serial-printer is inadequate and a line-printer which has the above-mentioned capacity is required to be added. From the viewpoint of management materials output, a line-printer of dot-type, which is needed for special high-quality and print-type printing, is adequate.

One terminal unit is necessary each for stock control and accounting, and one unit is adequate, in some cases, for management. Terminals basically consist of a keyboard and a CRT display unit, and in addition are required to have a type-system serial-printer for document issuing work.

For inventory, storage, and delivery, portable input devices are convenient. These are pocket calculator type off-line input devices with ten-keys, which can store thousands of items of data at one time, and can input data while warehouse inventory is being made. The data are stored in the entry device temporarily before being input into the computer through a special coupler

The first requirement for additional software is that it should be compatible with the basic software. As OSs for the sixteen-bit unit, MS-DOS and PC-DOS lines, CPM-86, and also UNIX are popular.

4-3-4 Organization for Implementation of the Plan

Since the Government Supply Officer is the only person in the Government Store having experience in system design, it is difficult for the Store to conduct system development. Accordingly, it is recommended to use the existing stock control and accounting software package as much as possible. Organization, therefore, will be centered on operations, such as data input and print-out. In computer systems on a scale of this size, the CPU, disk units, and a line printer should be installed in a special room. Since tasks required for computer operations, such as changing and supplementing of printing paper are estimated to be of considerable volume, it is necessary to have a full-time operator. It is also desired that all related staff be able to operate the terminals, but it will do for the time being to have two operators for each terminal (a shift system). The operations

volume is not yet known because the transaction volume has not yet been determined At inventory time, it would be ideal if all of the staff could use the portable entry devices, but, at the beginning, it depends on the number of devices installed in the store. Periodic operation training for the terminal unit is required to be made.

So that the introduction of computers will be positively accepted by the internal staff, a simple system of operation should be implemented.

Because interface with external systems will increase in volume, obtaining one or two experts on systems management will contribute to a high-level system in the future. For concrete results, it will be advisable to hold regular meetings with the corresponding staff in the treasury and other governmental departments.

4-3-5 Staff Training

Since training for the computer staff in the Government Store is centered on operations, it will require some amount of time initially, but after that only periodic inspection of the operations conduct will be sufficient. Staffing can be obtained by a personnel reshuffle.

However, for the systems management staff, who should have extensive knowledge of computers and keep in working contact with other systems administrators, suitably talented persons should be selected and carefully trained. It is desirable that governmental organizations conduct training of the systems administrators in complete cooperation and in an efficient manner.

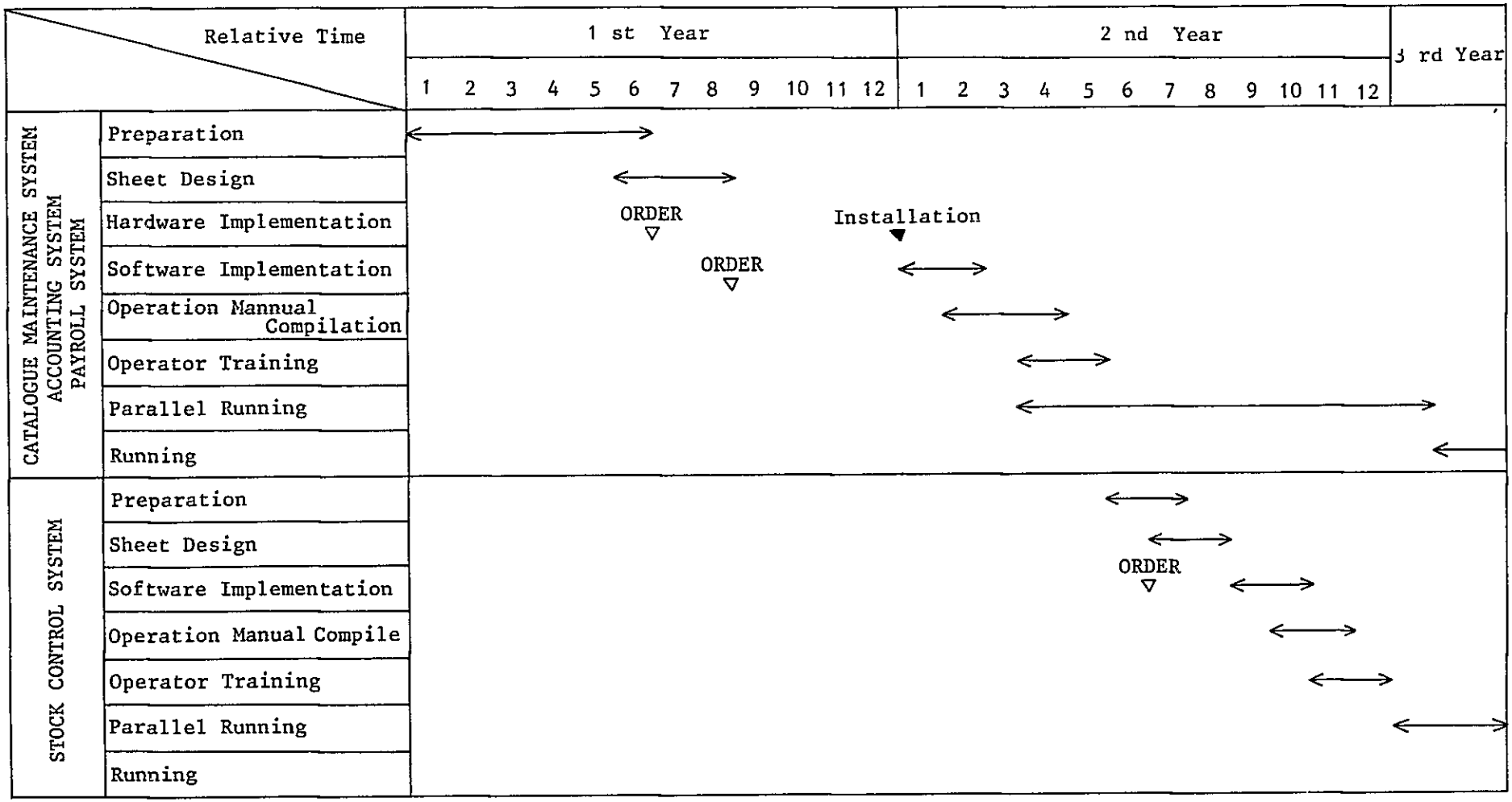
4-3-6 Steps for Realization of the Plan

In the model plan, the study team proposes to complete computerization in the Store on a step-by-step basis. Projects to be computerized first are stock catalog maintenance and stock accounting. Catalog maintanance which is now being made by typewriter is expected to become simplified with a combination of a CRT, a keyboard and a simple retrieval system. If possible, the wage payment system will be added to the first step

Projects to be computerized in the second step may include stock control, which is one of the main supply functions.

In the introduction of computer systems, it is recommended to use existing software packages as much as possible and to avoid self-development of software. With these software packages, systems manuals are often included. Because these are general-use manuals, they should be chosen to suit operations of the Store and rearranged in a form which is easily usable for operators.

Fig. III-4-6 The Term Chart of the Computerization Plan for the Government Store



5. Commodities Board

5-1 Scope of Work for the Study

The Commodities Board is practically the exclusive dealer purchasing and exporting copra, bananas, and vanilla. Concurrently, the Board is also a builder and in this role runs retail stores where it sells construction materials. Furthermore, it runs factories processing metal, lumber, soap, and coconuts.

The study team has made a general survey on all projects and made a priority investigation of the accounting, payroll, account settlements, export costings, purchase control, and sales management functions, which are to be integrated in the Head Office.

5-2 Analysis of Work for the Study

5-2-1 Organization and Functions

The organization of the Commodities Board is to be partially changed in 1984. The main purpose of the change is to integrate the accounting sections, formerly decentralized, into business divisions in the Head Office.

The headquarters is set up in the Head Office in Havelu and provides management services to every business section.

There are three business divisions: Construction, Research & Processing, and Raw Materials.

The Construction Division has five retail construction materials stores, with annual sales of $3,200,000 to the general public. At the same time, this division is also performing actual construction work and producing various products at its metal, lumber, and stone processing factories.

The Research & Processing Division is producing goods such as soap from raw materials such as coconuts.

BOARDS LOCATIONS FOR STORES ADMINISTRATIVE OFFICES, ETC.

A. TONGATAPU ISLAND

1) Havelu (Main Office)

Administrative Office for all Divisions
Central Construction Store
Desiccated Coconut Factory
Soap Factory
Joinery Workshop
Plumbing Workshop
Blacksmith Workshop

2) **Downtown Nuku'alofa**

Chemical Store

Tungi Arcade Construction Store

Primary Produce Division – Purchasing Station for Sundry Produce, Vanilla, Kava.

3) **Within 2 miles of Nuku'alofa**

Oil Mills of Tonga

Pili Quarry

4) Copra Purchasing Stations on Tongatapu. Copra however is only stored overnight at either the Mu'a or Havelu Station.

B. **'EUA ISLAND**

1) **'Ohonua**

Branch Office

Construction Store

Purchase of Copra

Purchase of Sundry Produce

C. **HA'APAI ISLANDS**

1) **Pangai**

Construction Store

Copra Buying

Branch Administration Office

2) Throughout Ha'apai Islands there are 6 copra buying stations.

D. **VAVA'U ISLANDS**

1) **Neiafu**

Construction Store

Vanilla Buying

Copra Buying

Branch Administration Office

2) Throughout Vava'u Islands there are 6 copra purchasing stations.

E. NIUATOPUTAPU ISLANDS

1) Hihifo

Small Administration Office

Primary Produce Division – Store (General Merchandise)

Copra Buying

Also there is 1 copra purchasing station.

F. NIUAFO'OU ISLANDS

1) 'Esia

Small Administration Office

Primary Produce Division (General Merchandise Store)

Copra Buying

There is 1 copra purchasing station.

The Raw Materials Division purchases copra, bananas, and vanilla from growers and mainly exports them.

The Board has branches on Vava'u, Ha'apai, and 'Eua Islands, each of which is performing as a business division and a Head Office.

860 people are employed in the Board, and the construction division includes 400 employees (approximately half of the total).

5-2-2 Data Processing Flow

Data in the Commodities Board is mostly concentrated in the Head Office.

(1) Payroll Data

In every business division, time sheets are collected and approved before they are sent to the Head Office. The payroll clerk in the Head Office makes an overall record aggregation and entry into the employee record, and prepares a report for the I.R. (Inland Revenue) Department.

(2) Sales Data

Sales data are collected in each store and sent to the Head Office where the data is summarized. The data is divided into credit sales, cash sales, and internal transactions, and entered in appropriate ledgers.

Information on Tongatapu Island can be collected, even in the present situation, within half a day.

Fig. III-5-1 The Organization Chart of the Commodities Board

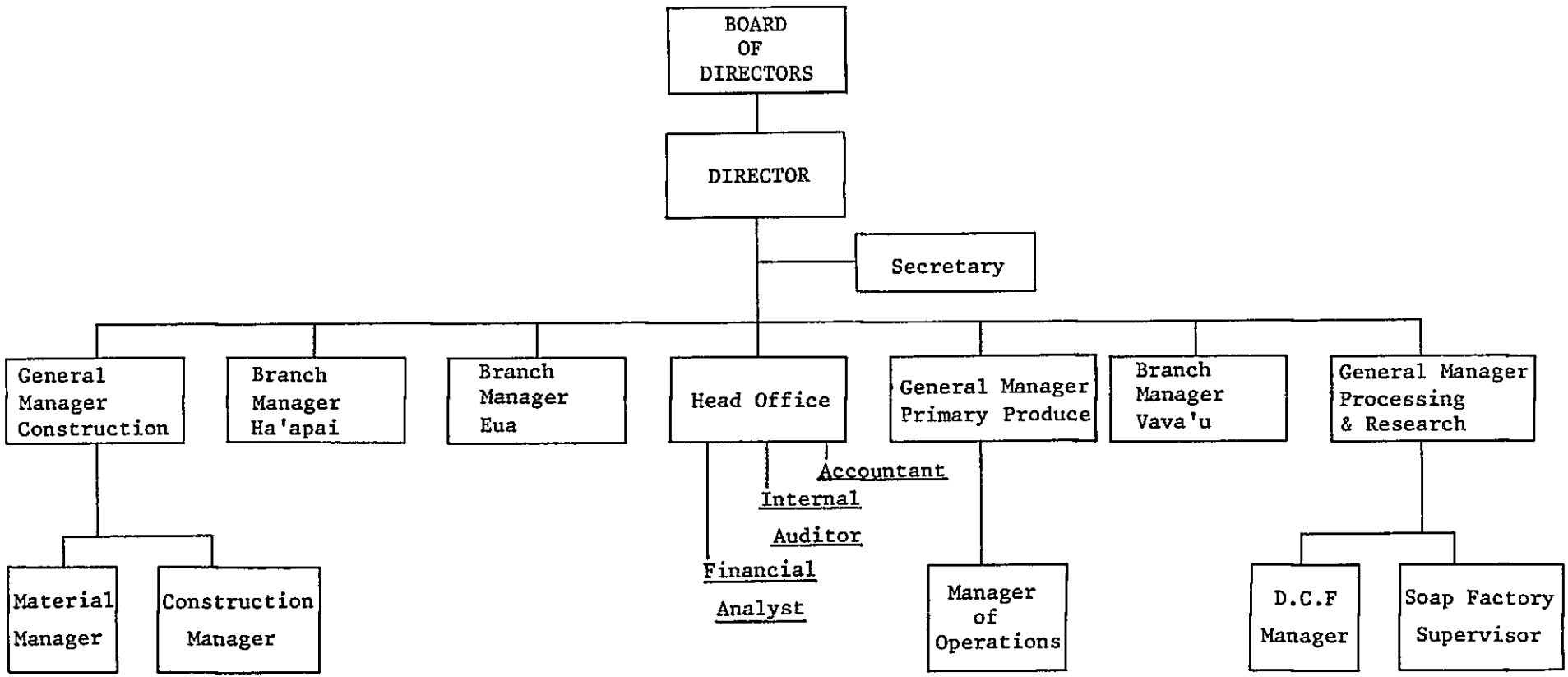


Fig. III-5-2 The Flow of Payroll Data

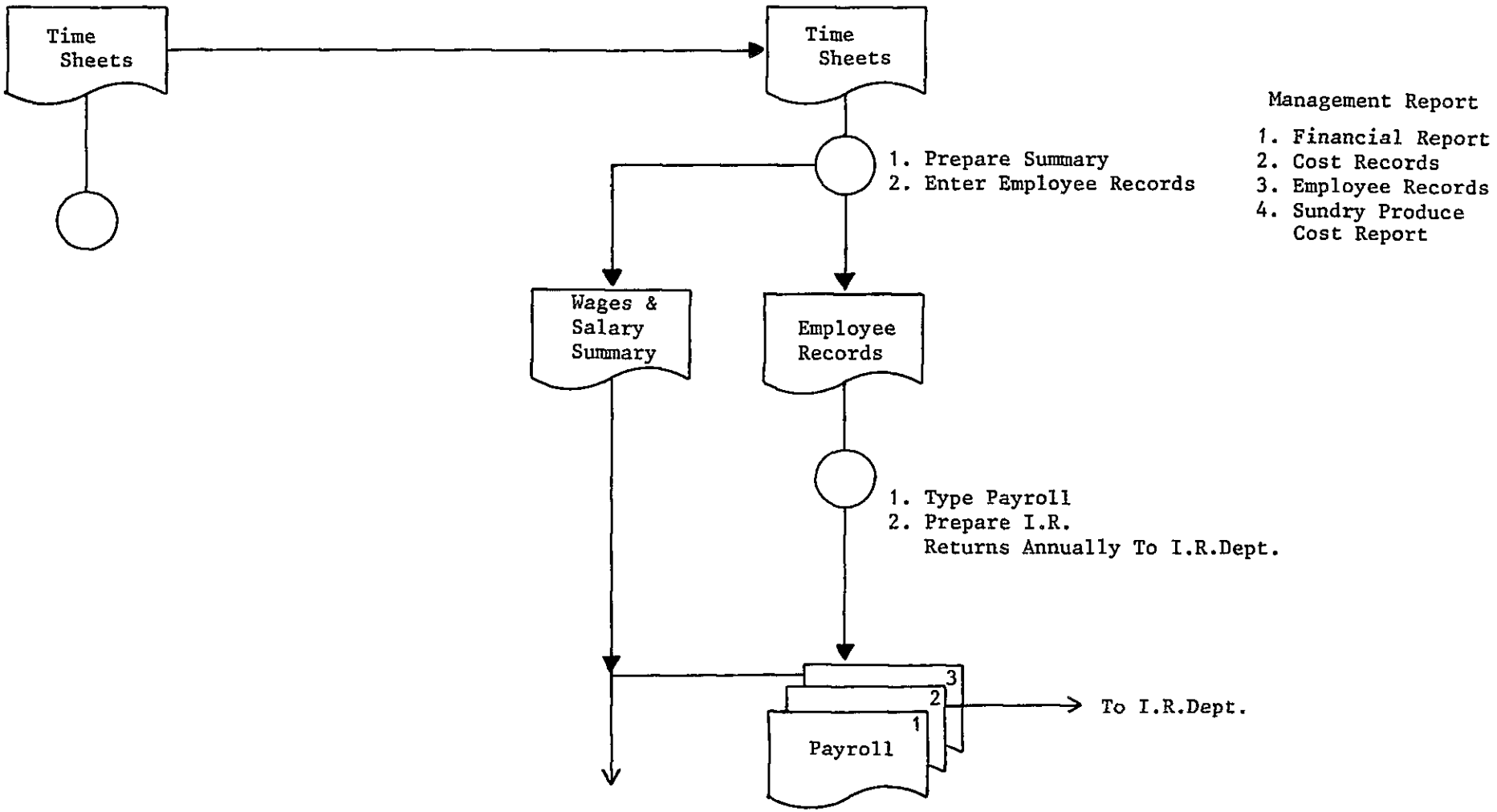


Fig. III-5-3 The Flow of General Sales Data

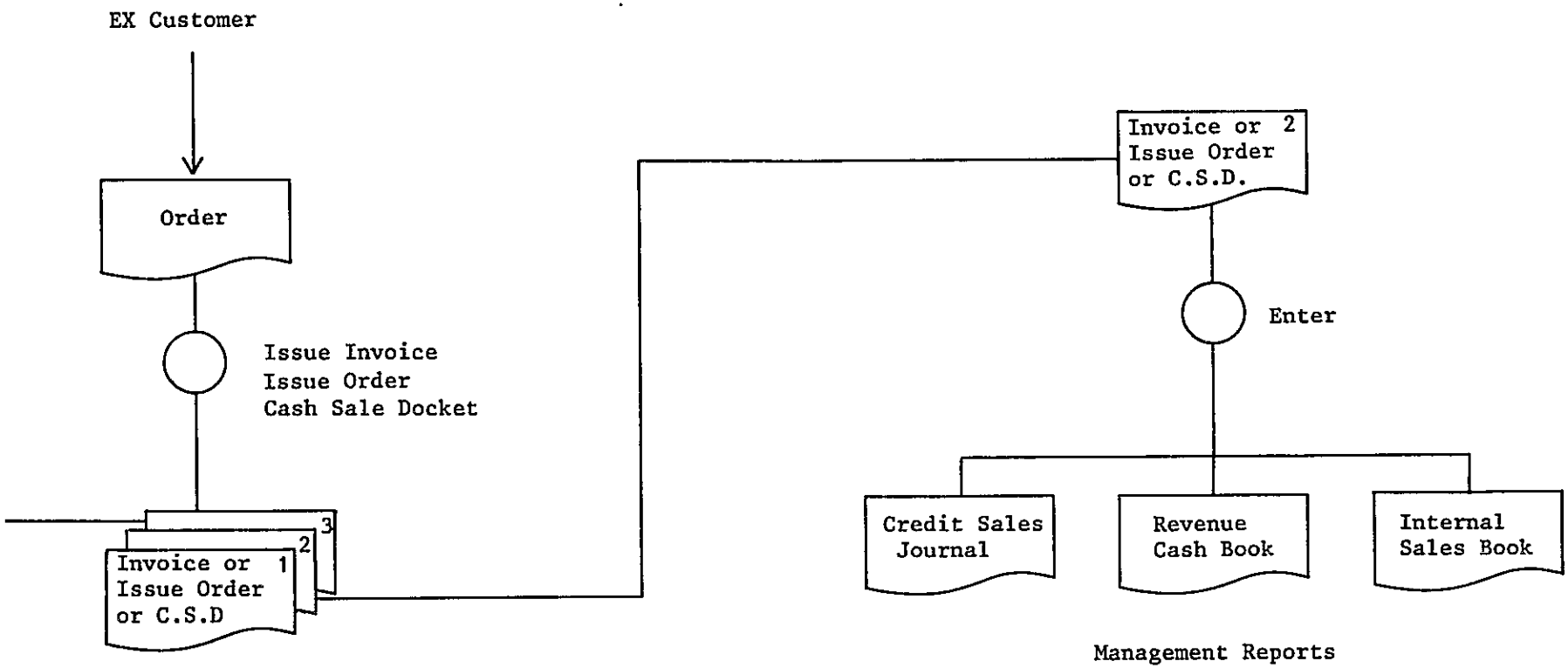


Fig. III-5-4 The Flow of Primary Produce Data
Purchase (Copra, Cocoanut, Sundry Produce)

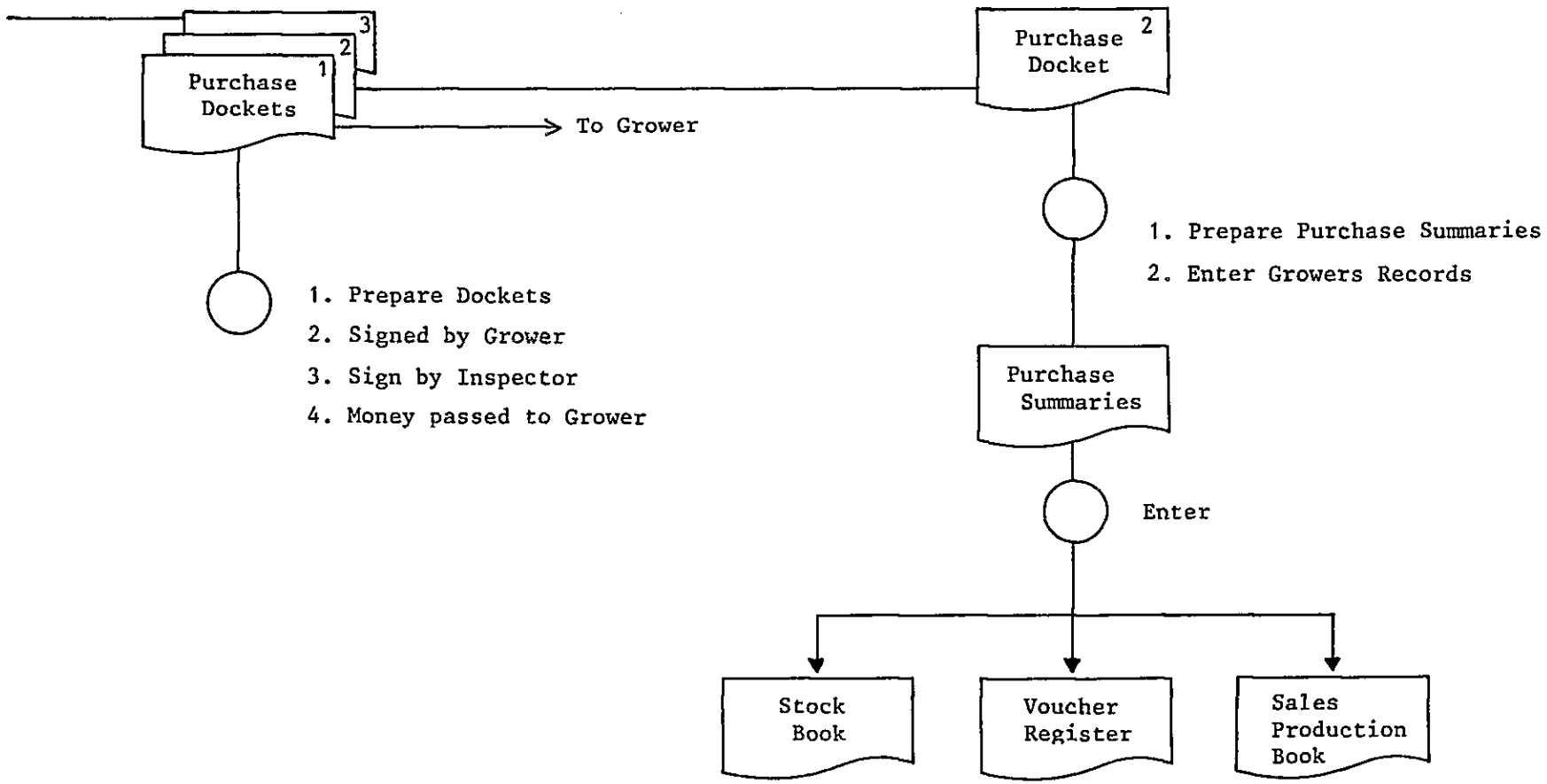
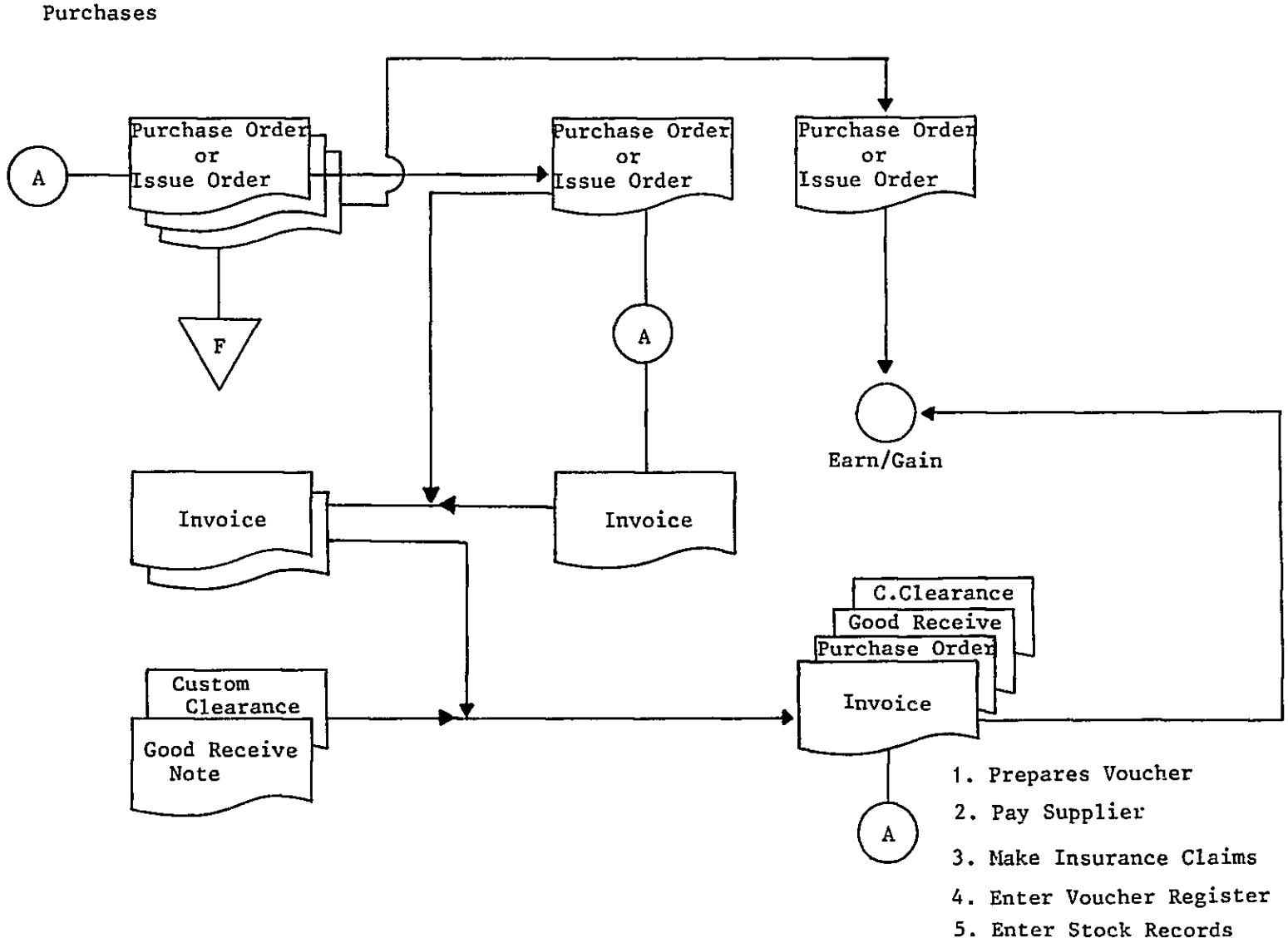


Fig. III-5-5 The Flow of General Purchases (Expenses) Data



(3) Purchase Data

The purchase of raw materials such as copra and coconuts is entered on triplicate forms. These forms are collected in the Head Office and summarized before the total amounts are entered in the Stock Book, Voucher Register, and Sales Production Book. Information on each grower is also entered on the Grower's Card.

(4) Procurement Data

The procurement of various materials takes place individually for each construction project, factory, office, and construction materials retail store. Among these materials, for those which can be procured in the Board, such as construction materials, an Issue Order is made, and for those which cannot be procured in the Board, a Purchase Order is issued. These two kinds of orders are entered in each account.

5-2-3 Type and Characteristics of Data

As seen in Table III-5-1, a considerable amount of data on purchase and sales of copra is generated and amounts to 200 data items per day on the average. Accordingly, in this case, it is more efficient to collate the date beforehand than process it together.

The daily average of issued checks and debtor ledger cards ranges from several to quite a few, which will not create such a heavy burden.

Table III-5-1 Estimate of Yearly Transaction Volume

Transaction \ Division	Head Office	Construction Division	Raw Materials Division	Research & Processing Division
Purchase Orders	300	1,000	2,000	300
Checks Issued	600	1,200	800	500
Sales Invoice Issued	400	9,000	1,100	200
Debtors Ledger Cards	-	400	500	50
Cash Receipts Issued	750	8,000	2,000	700
Copra Purchase Dockets	-	-	40,000	
Coconut Purchase Dockets	-	-		

5-2-4 Bottlenecks in the Current Situation

(1) Accurate Information on Raw Material Producers

As tax reports on Raw Material Producers are required to be sent to the Inland Revenue Department by the growers, it is necessary to collect accurate information on the situation of these materials.

(2) Discrepancies between Figures on Account and Actual Inventory Value

The stores are well organized and Bin Cards are generally filled in accurately, but discrepancies are still occurring.

5-2-5 Plans for Computerization

At present, the Board has no particular plan for computerization, but recognizes the significance of obtaining various information rapidly and accurately. Such information items are listed below.

A. Costs for Construction and Contracts
B. Cash Flow
C. Running Costs of the Construction Materials Store and Factory
D. Payroll Information
E. Growers' Information
F. Sales Analyses of Produce and Customers
G. Credit Information
H. Others

It will contribute to computerization in the Board if the management sections are integrated in the Head Office by organization reforms made recently. This means that organizational integration makes possible collective data processing in the management section. As shown by the fact that in the course of introducing computers, current various systems have been created through stages of mass batch-processing, the basis of the EDP system. Administration work (accounting, finance, payroll, personnel) is most suited for batch processing.

5-3 Future Plans

5-3-1 Outlines of the Plan

Introduction of computers should be made from the beginning by planning of the Commodities Board, which has various tasks. Reorganization, such as the integration of management sections, will be done continually. Therefore, the plan should have sufficient flexibility to cope with such reforms.

In descending order, the plan should be as follows:

First Step	1.	Payroll System
	2.	Growers' Information System
	3.	Sales Information System
Second Step	1.	Accounting System
Third Step	1.	Stock Control System

5-3-2 Process Flow of the Plan

A simple description of the planned payroll system, growers' information system, sales information system, and accounting system is as follows:

(1) Payroll System

The working hours entered in the Time Sheet are input into the computer semi-monthly for regular staff and weekly for non-regular staff. All data is summarized and entered in the personnel file at the same time. Semi-monthly or weekly individual details and totals are then output. Individual tax data are input and referred to in the payroll. Furthermore, the report to the Inland Revenue Department is output in fixed form.

(2) Growers' Information System

Each growers' data is input at the time of registration, and purchase records are input everyday by keyboard. The input data are collected daily in the daily trial balance, and are also entered in the individual growers' purchase files, to provide output of individual data.

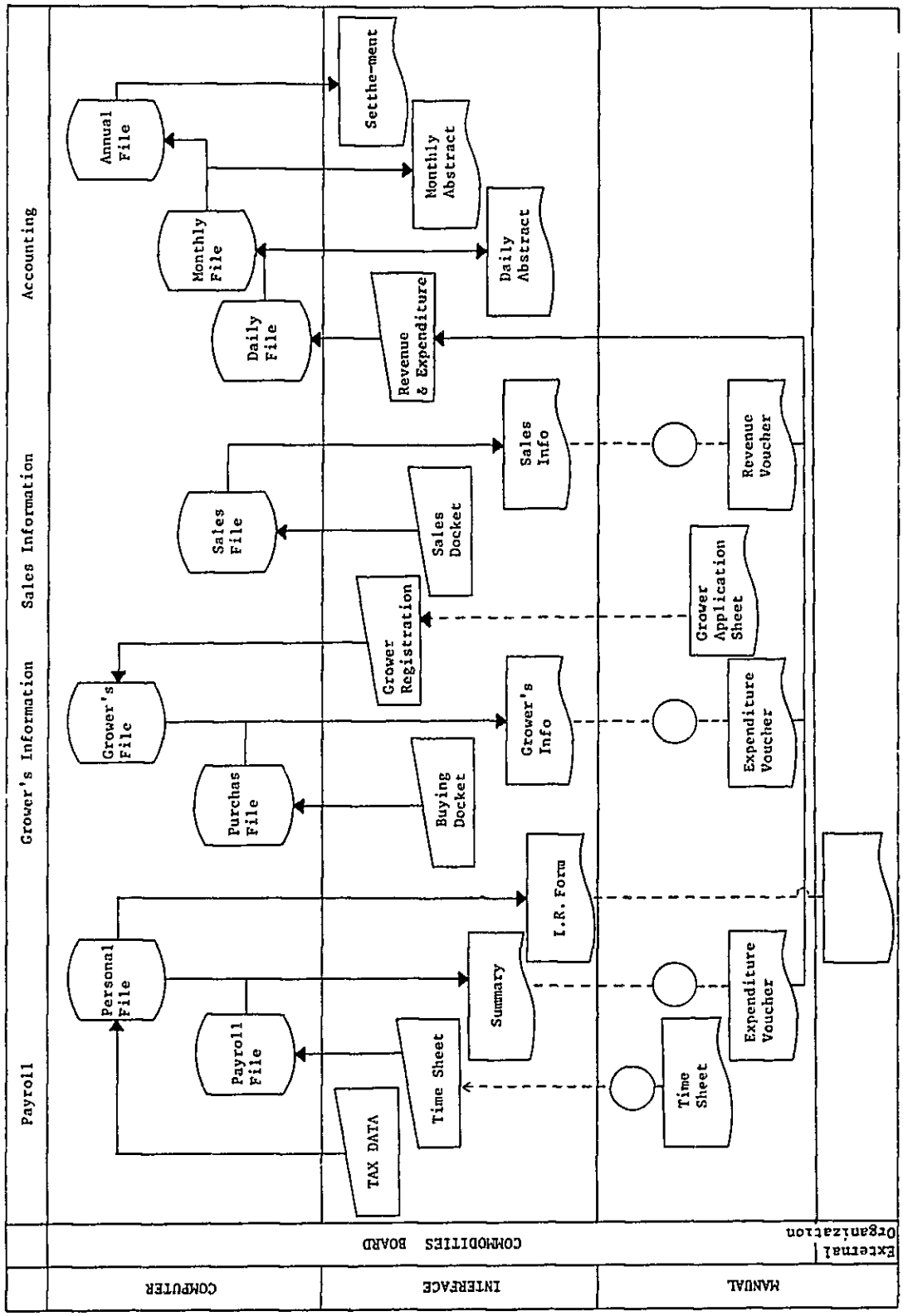
(3) Sales Information System

Cash Receipts and Invoices issued from the stores are totaled and results for each store and commodity are output.

(4) Account System

Every day, entries from expenditure vouchers, revenue vouchers, and other work forwarded from the three above-mentioned systems are made and input data is collected for each account in order to allow output of a daily abstract. Further, the summary is recorded in the monthly file and a monthly abstract can be output. Account closing information is also output.

Fig. III-5-6 The Proposed Process Chart after the Computerization of the Commodities Board



5-3-3 Hardware and Software

(1) Hardware to be introduced for the Commodities Board is expected to be as follows:

1) **Central Processing Unit**

16-bit or 32-bit unit with a main memory capacity of more than 256 KB

2) **Hard Disk**

Winchester disk (5¼-inch or 8-inch) with a capacity of 40 – 80 MB

3) **Floppy Disk**

Double-sided, double-density type (8 inch or 5¼ inch)

4) **Printer**

Line printer: 1 unit (Dot matrix Type)

5) **Work Stations**

Sales Information and Purchasing System: 2 units for each

Accounting System: 1 – 2 units

One serial-printer unit at each work station

Each unit is expected to, where possible, have a backup unit. The backup unit will be used for trial operation of new systems and for staff training. If trouble occurs in the regular unit, the backup unit will, after data recovery, takes its place.

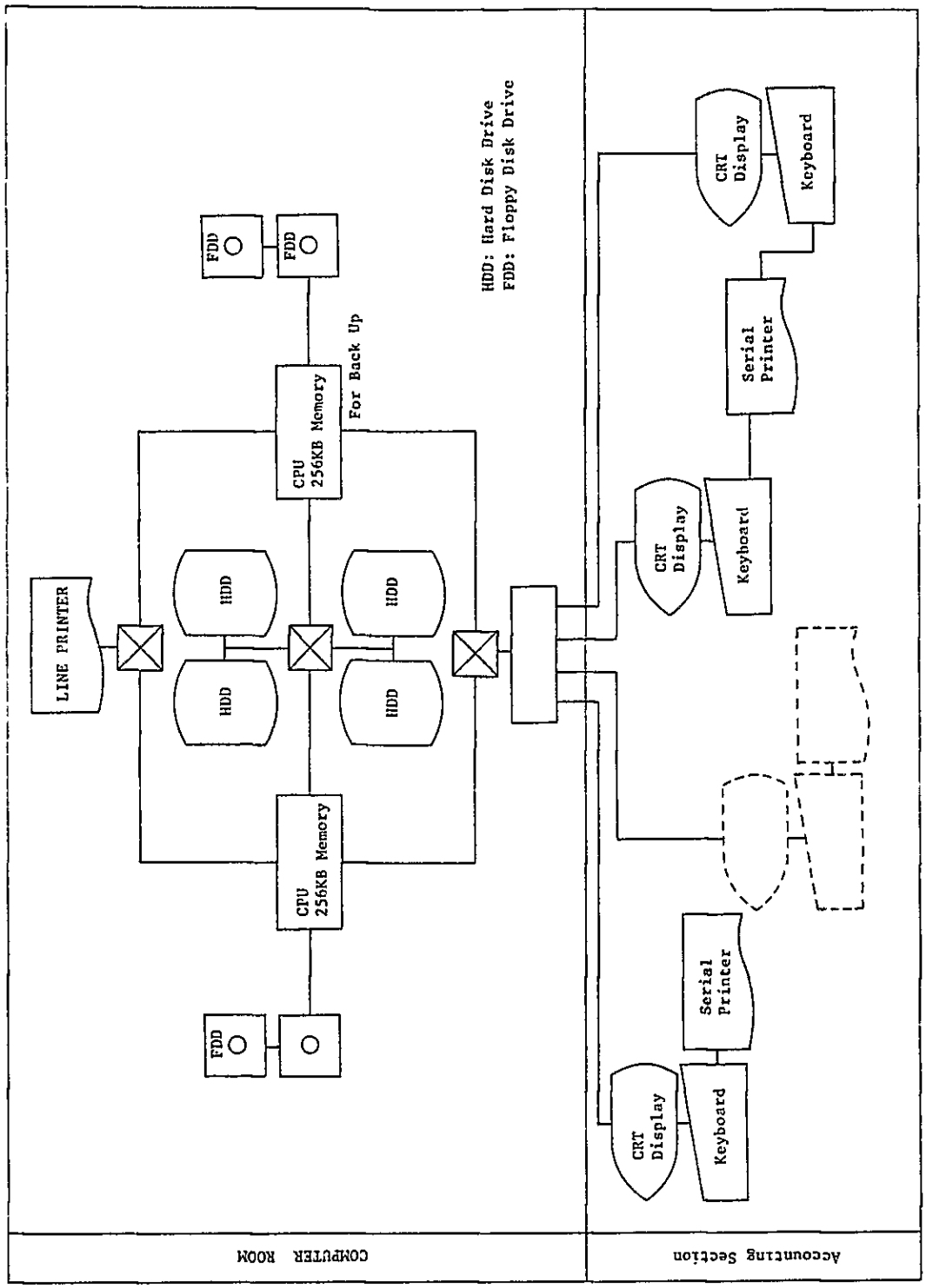
All auxiliary equipment should be able to be connected freely to any other unit individually or in groups. Because data, in the hard disk unit particularly, takes time to be transferred, it is absolutely necessary that this unit be connected individually to other units. Furthermore, important data should be entered dually in two files of the same type.

(2) **Software**

1) The OS should have multiuser and multitask functions. The minimum number of work stations should be four.

2) The introduction of application packages should be considered where feasible.

Fig. III-5-7 The Hardware Configuration Plan for the Commodities Board



5-3-4 Organization for Accomplishment of the Plan

A computer system should be introduced for the Commodities Board in the near future. This will perform most work done in the Head Office and some work in every other division. Each type of work has its own system, making necessary the establishment beforehand of a special section for carrying out the introduction of a computer system. This section, entitled for example, "EDP management Section", will be in charge of the introduction and management of the computer system. At least one EDP manager should be posted in this section full-time. Duties to be performed by the EDP manager are as follows:

1. Hardware maintenance
2. Introduction of Software
3. Education and Training of Operating Staff
4. Materials Supply
5. Preparation and Updating of Manuals for Users and Operators
6. Troubleshooting
7. Regular Contact with Related Staff in Other Organizations
8. Acquisition of New Technology

More than one full-time assistant EDP manager should by all means be posted in order to establish a backup system as soon as possible.

5-3-5 Staff Training

The staff mentioned herein consists of the EDP manager, an assistant, general users, and full-time or part-time operators. A description of training for each staff member follows.

(1) EDP Manager

Training for the EDP manager is described in Chapter IV.

In interviewing for the post of EDP manager, because availability for duty is especially important, several candidates should first be chosen for training before making a decision. Opinions of lecturers in the "EDP Training Center" should be referred to.

to.

(2) EDP Assistant

Since the EDP assistant will work as a trainee in assisting the EDP manager, no special training will be performed. Any training is primarily OJT. An individual interested in computers should be hired.

(3) General Users

General users are to be trained when the computer is not in actual operation.

(4) Full-time or Part-time Operators

Intensive training will be given before the system is put into operation. Operation training should be made with realistic data and centered on error correction. An operation manual should also be prepared.

5-3-6 Steps for Realization of the Plan

For introduction of a computer system for the Board, which performs various types of work, a step-by-step plan is required. Even if several types of work are to be integrated into a single system in the future, it is more practical at first to understand them as individual systems. This is due to the fact that the EDP system manager and staff such as operators will still be inexperienced in the system initially after the introduction of the computer, and will often commit errors in operation and utilization. Accordingly, systems to be introduced at first should be selected from among those being not only directly applicable, but also easily understood and broadly acceptable.

The payroll system is typical one of such system. It has the advantage of being easily applied to operational conditions in other organizations because a payroll system is indispensable in every organization. Therefore, a payroll system should be the first to be introduced for the Commodities Board.

Further, the collection system for purchasing information from copra, banana, and vanilla growers, and, sales information in the construction materials store, can be scheduled to be introduced. This consists simply of collection of data and is easily computerized; however, it should also be considered for integration with the accounting system in the future.

An accounting system should be introduced after careful research. Accounts should be uniformly coded throughout the Board because the accounting system is intrinsically related to other systems. In studies prior to introduction, it will be necessary to coordinate all sections in the Board.

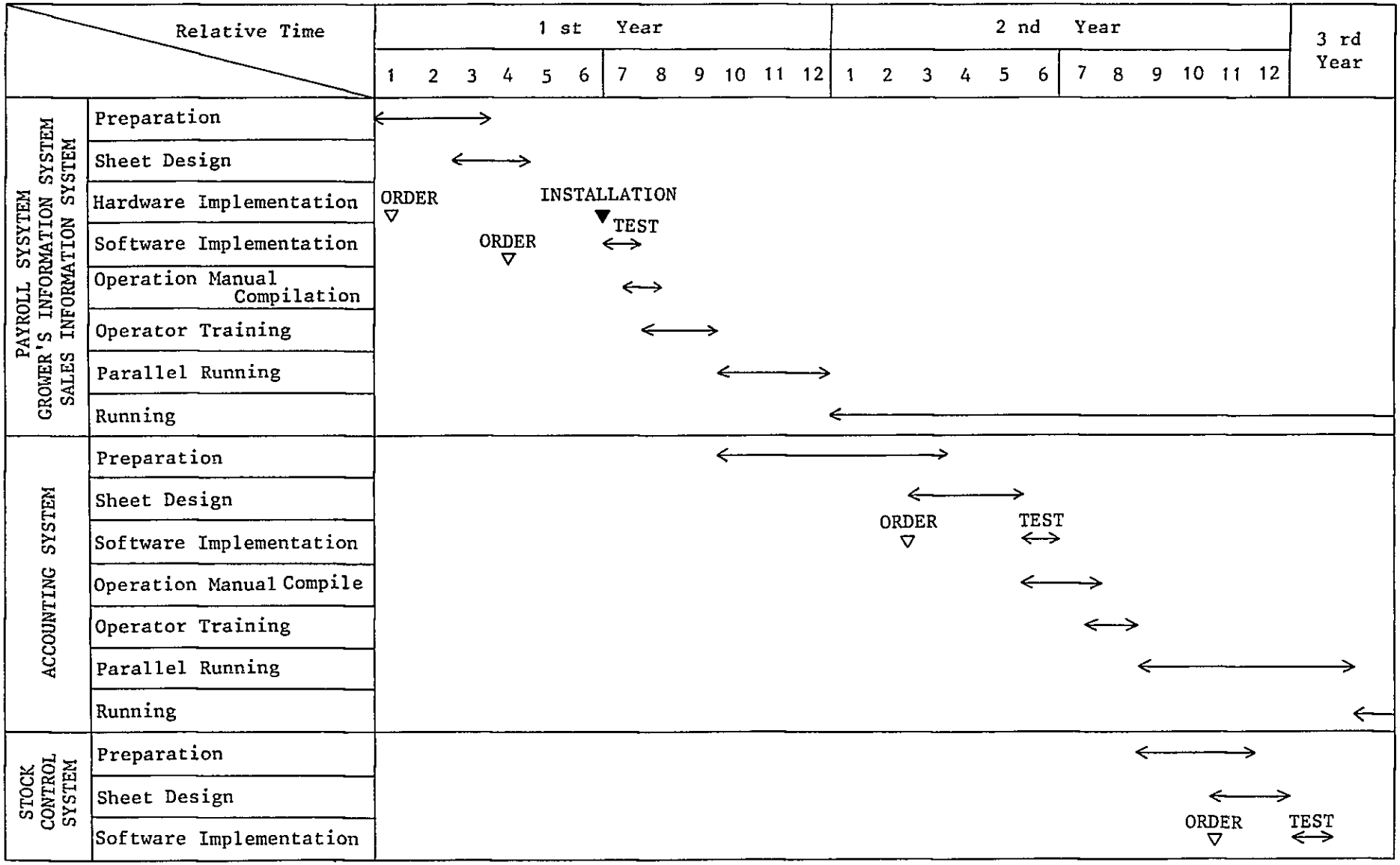
The costing work of construction projects should be performed at first as a function of the accounting system. It is recommended that expenditure vouchers be forwarded to the system, with journal results as output obtained for each account.

The costing system for exports may be designed independently of other systems.

The next logical step is integration of all systems; however, it is too early for this to be discussed.

A schedule for the introduction of computerization in the Commodities Board is shown in Fig. III-5-8.

Fig. III-5-8 The Term Chart of the Computerization Plan for the Commodities Board



6. Tonga Electric Power Board

6-1 Scope of Work for the Study

The Tonga Electric Power Board is a monopolistic enterprise for supplying the whole country of the Kingdom of Tonga with electric power. At present, the Board is supplying electric power only to Tongatapu Island and Vava'u Island, and its generating capacity is still 5,156 KVA in the Popua Power Station on Tongatapu Island and 562.5 KVA in the Neiafu Power Station on Vava'u Island. The electric power supply in the two islands, however, is increasing in volume year by year and will continue to improve. The supply network is being expanded every year and the demand for electric power is also expected to increase along with economic growth and accelerated industrialization. On 'Eua Island and Ha'apai Island, electric power stations are scheduled to be built with Australian Government assistance. As stated above, the electric power supply system in the Kingdom is now being expanded and developed, and the work of the Board will therefore be increased both in quantity and quality.

The electric power supply process consists of generation, transmission, transformation, and distribution. As electrical service is expanded, utilization of computers in various ways is expected. The use of computers is actually being made throughout the world in the fields of operation control at electric power stations, training simulation for operating staff of electric plants, supervisory remote control, system stabilizing control, and automatic load dispatching systems. However, these systems require high-level technology and enormous investment, and necessitate settling many problems extant at present in the Kingdom of Tonga. Moreover, these are too highly specialized fields in view of the objective of this study

On the other hand, if consideration is given to the use of computers in office management of the Board, salary calculations for employees, schedule controls of construction work, and stock control in the Board's warehouses, a high possibility of the realization implementation exists. These jobs are suited to the use of small-scale computers and do not require high specialization and technology; they are actually being carried out everyday by the Board.

The billing system for electric charges was cited at first as the most practical field in which to use computers, but it has been determined not to be suitable for computerization due to the following: the electric charge system of the Kingdom of Tonga is very simple, consisting of charges in proportion to electric power consumed (with a minimum charge), overdue bills, monthly installments, and the purchase price of electric equipment. A meter inspector calculates the charge for each home by reading on-site meters and immediately making billing Since billing is made simultaneously with meter inspection, it is difficult to computerize this billing system.

The Board is retailing electrical appliances other than electric power supply service

equipment, and stocks these goods in the warehouse. The Board has a strong desire to develop and improve stock control, which, along with the expansion of electrical services, will be of great importance.

Taking these situations into account, stock control in the warehouse has been designated as the first step in computerization of the Tonga Electric Power Board.

6-2 Analysis of Work for the Study

6-2-1 Organization and Functions

The organizational chart of the Tonga Electric Power Board is shown in Fig. III-6-1.

At present, the Board is in the midst of preparation of an organizational chart and business report; thus, general conditions and policies are based on information collected in 1980.

The Generating Department is in charge of the operation of generators in Popua Power Station on Tongatapu Island and Neiafu Power Station on Vava'u Island. The data concerning power generation from July 1979 to June 1980 are shown in Table III-6-1. In the Popua Power Station, a medium-sized diesel generator, with sufficient generation capacity for the electric load, is in use. In the Neiafu Power Station, a small-sized diesel generator, which also has sufficient generation capacity, is being used.

The Transmission Distribution Department is mainly in charge of high-voltage transmission at 11 KV or 6.6 KV, and transformation into 415-240 V. High-voltage transmission is carried out at 11 KV on Tongatapu Island and at 6.6 KV on Vava'u Island. On both islands, the amount electric power transmitted and the distance to be transmitted is small, therefore, voltage is not high.

The Wiring Department is in charge of the distribution system from the transforming station to the service entrances of consumers. Its major responsibilities are the installation of electric poles and distribution cables.

The Line Department is in charge of management of various transmission lines.

The Project Research Department is in charge of planning, schedule control, and the study of technical materials Schedule control of construction work has recently begun using the CPM (Critical Path Method). Engineers in this department have hoped to use a computer in a sensitivity analysis of CPM models.

Fig. III-6-1 Organization Chart of the Tonga Electric Power Board

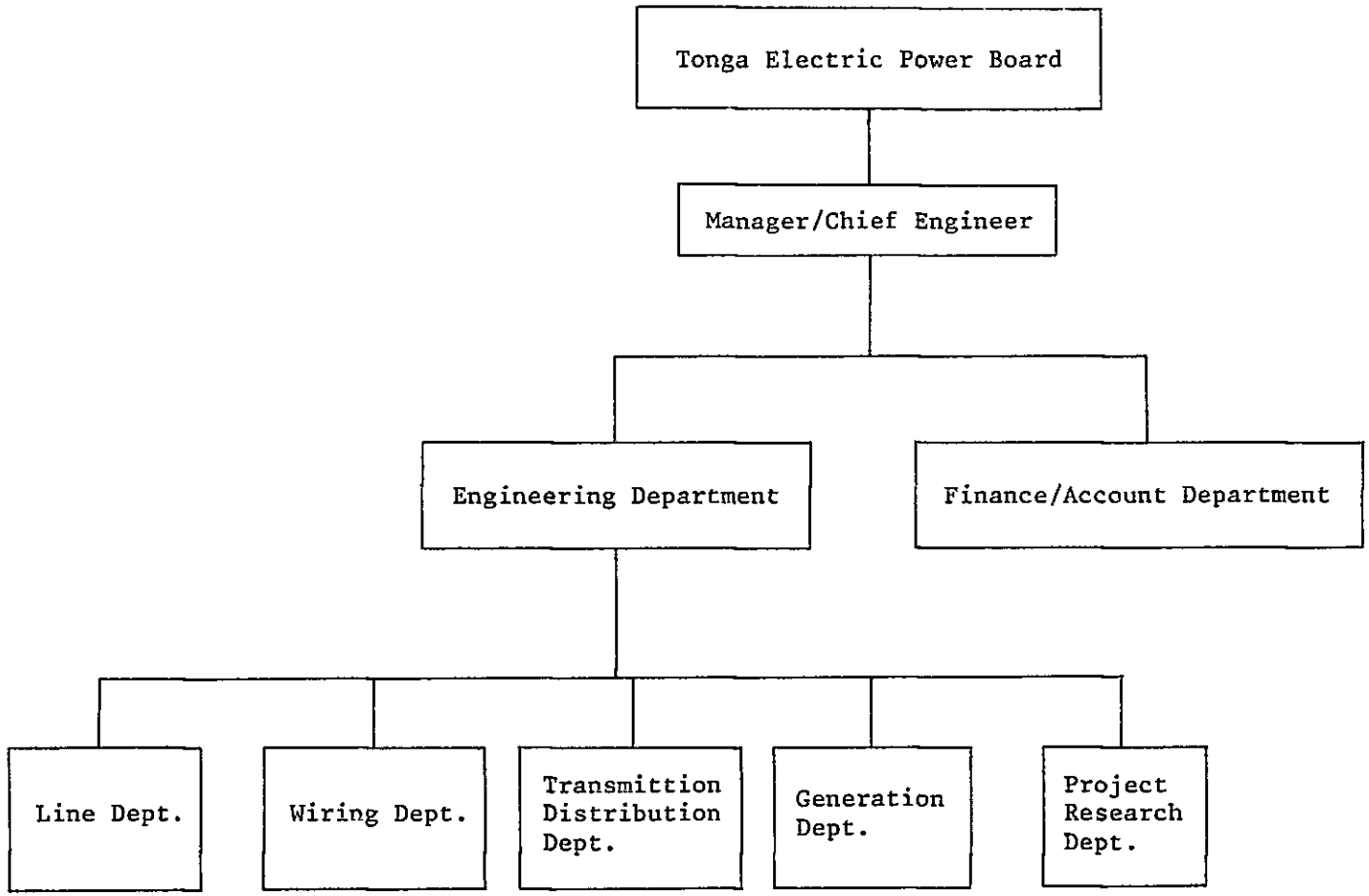


Table III-6-1 Power Generation Data of the Tonga Electric Power Board in 1980

	Popua Power Plant	Neiafu Power Plant
Generator Type	diesel	diesel
Installed Capacity	5,156 KVA	562.5 KVA
Energy Generated	9,740,000 KWH	660,000 KWH
Energy Sold	8,070,000 KWH	560,000 KWH
Transmission Loss	1,090,000 KWH	70,000 KWH
Loss Factor	11.2 %	11.0 %
Fuel Oil Consumed	2,720 Kℓ	2,300 Kℓ
Consumers	4,645 (present.5,800)	424
Maximum Load	2,050 KW	176 KW
Load Factor	54.3 %	42.8 %

6-2-2 Current Stock Control System

The warehouse of the Board houses 2,600 items of electrical parts and materials required by internal departments, and their storage and distribution are controlled from there. The present flow of stock control is shown in Fig. III-6-2.

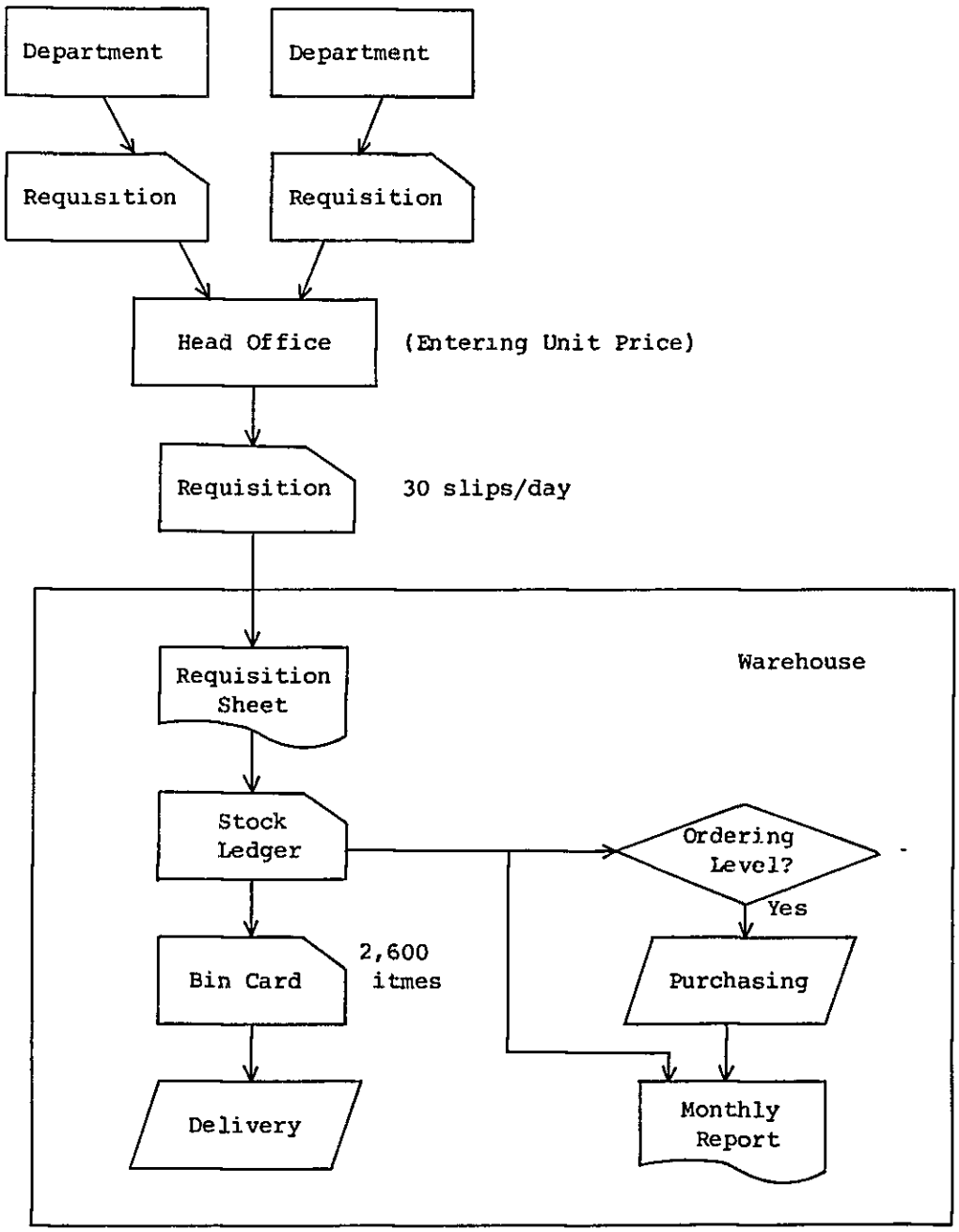
Delivery requirements for electrical engineering projects, repair work, and retail sales are centered in the head office in Requisitions.

In the head office, the unit price of each item is printed with an NCR-299 and requisitions are sent to the warehouse. There are about 30 types of requisitions.

In the warehouse, data on requisitions is posted on a Requisition Sheet. This sheet is posted in the order received from among requisitions sent from the head office every day, and then item costs are calculated. The sheets are made in duplicate and are kept for a lengthy period of time.

When an item is requisitioned for delivery, a change of stock quantity is entered in the Stock Ledger in detail according to the item. When an item is stored, an entry in the Ledger is made also. The minimum allowable stock quantity is also monitored in this Ledger.

Fig. III-6-2 Present Stock Control Flow of the Tonga Electric Power Board



The specifics of the item to be delivered are also entered in the Bin Card attached to each bin in the warehouse and the stock balance is recorded. At present both maximum and minimum stock quantities can be entered on the Bin Card, but the Card will be changed in the near future.

After the above-mentioned procedures, the item requisitioned is delivered at the counter in the warehouse and dispatched.

Additionally, it is determined in the Stock Ledger whether the stock quantity has decreased to a level where supplementation of the item should be made, and if necessary, a request for procurement is made. The items to be procured are all imported, requiring several months for delivery. It was said that the minimum allowable quantity level in the past was around 50 items but now is about 100 items. In this summary, quantity to be ordered, names of the supplier countries, time lag from date ordered to date of supply, and other facts are entered.

For the purpose of keeping up with inventory conditions, monthly reports are made. These reports have begun to be made recently, and require further collection of data; they are aimed at determining optimum stock quantities.

The items in the warehouse are given six-digit codes and other departments' individual codes. In addition, department codes are also used and a great deal of progress in classification of stock items has been made by coding.

Recently, stock inventory has been changed at the end of every month.

From receipt of the requisition to delivery, seven personnel are required. No office equipment, other than an NCR-299 in the head office for printing a part of the requisition, is in use.

6-2-3 Plan for Computerization

The critical bottleneck in the present stock control system has not been mentioned by the Board. When the frequency of orders for shipment, and the number of staff members are taken into account, the daily routine for stock control does not seem to be too busy. However, depending upon the development plan for the electric power supply system, stock items, stock quantities, and delivery requisitions will possibly increase in volume. Decisions on the development plan for electric power supply service in the Kingdom of Tonga enable an estimation of the degree of expansion of stock control. Items in the warehouse of the Board are related to the main service and retail sales business of the Board. The operation efficiency of the Board can possibly be improved, overall, by computerization of the stock control system. Improvement in generating capacity and development of the delivery system should essentially be carried out under well thought-out plans, so that there will be few uncertain factors. However, at present, the stock quantities are not always kept at optimum level because of the complicated work system in the Board. Considering this fact, there seems to be a possibility for optimum stock

quantities to be systematically adjusted by proper use of a computer system.

The Board is interested in economic operation of the electric power supply system through computerization, which makes possible various forecasts regarding electric power development and system maintenance. On the other hand, under the present power situation, stable supply of energy is also an important matter. However, if these problems are to be settled by highly efficient load dispatch, it is indispensable to have a quick response water-power station or pumping power station, and a steam-power station spinning reserve. At present, there are no such plants and no definite plans to construct such plants in the future. Consequently, it is meaningless to consider load dispatch of electric power as an object of computerization.

Next, use of computers in schedule control will be examined. The Board has now begun to study schedule control of electric power development construction through the use of a CPM (Critical Path Method). Even now, the construction of power stations and buildings for the power supply network is under way and such construction will increase in volume in the future. When making plans for such construction, a schedule is usually made; and if pre-determined conditions change in the middle of the project, the schedule is revised and effects of the revision on the whole construction project are examined. However, if such processes are required to be carried out more accurately and quickly, a computer may have to be used. CPM, PERT (Program Evaluation and Review Technique), and PAMPS (Resource Allocation and Multiple Project) are generally recognized as software for such functions. Among these, PERT/COST is now being supplied for personal computers. However, before computerization of schedule control, systematic ideas must be made clear for work estimates, cost estimates, and work diagrams regarding each process. After that, it is necessary and preferable to gain facility in these techniques by practical trial usage. A fee is required for the use of schedule control software for units larger than personal computers. If, therefore, the computer is used only for schedule control, it will have very low efficiency.

6-3 Proposed Plan for Future Data Processing Systems

The diagram of the computerized stock control system is shown in Fig. III-6-3.

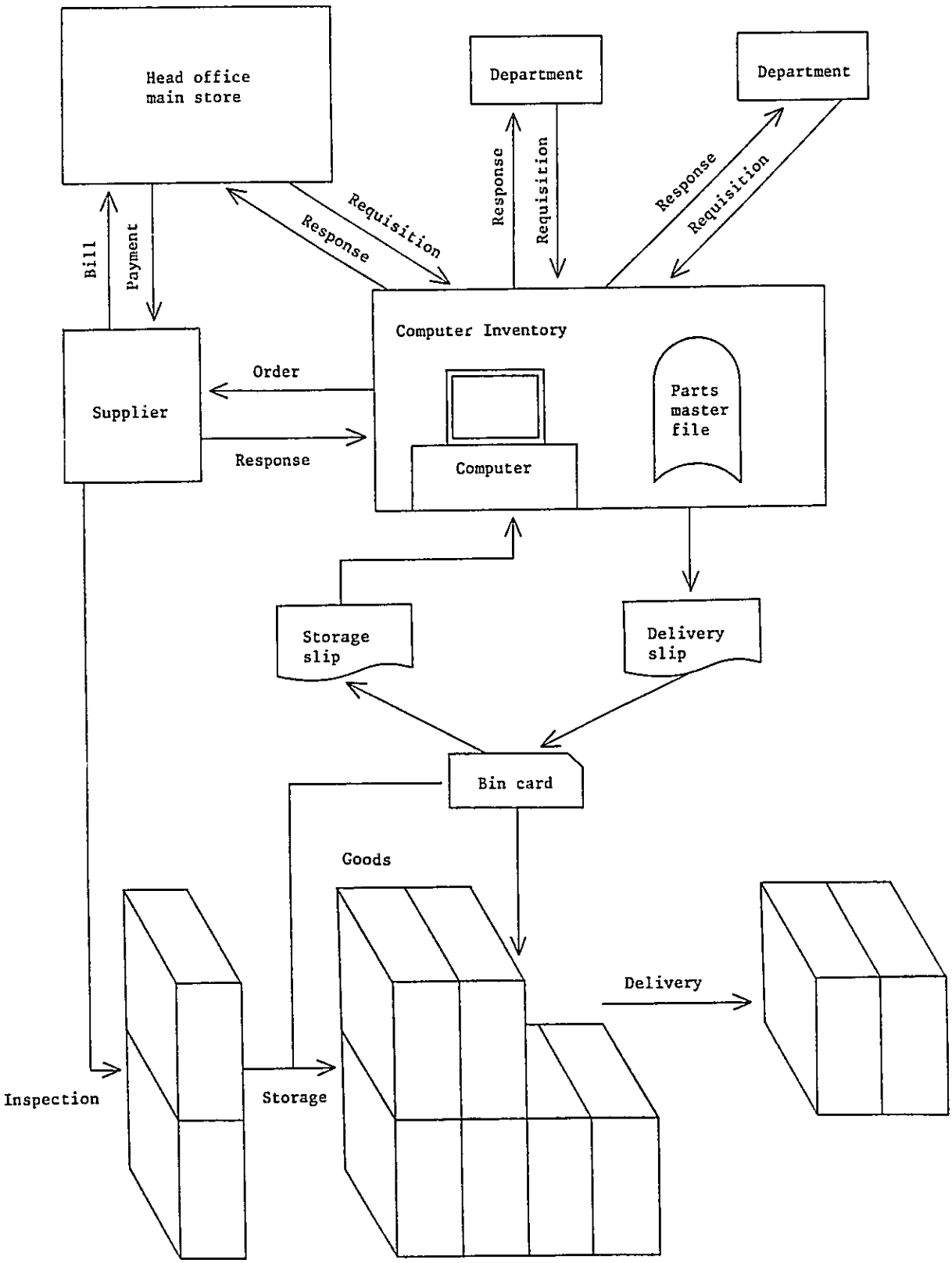
Delivery requests for warehouse goods, other than requisitions from internal departments of the Board or the main store, are made by telephone, and notice of the stock conditions can be given by computer.

When a requisition has been received, an operater inputs delivery directions into the computer, in which the parts master-file is updated and a delivery slip is printed before being turned over to a store clerk.

The store clerk updates the Bin Card before dispatching the item.

If stock quantity in the parts master-file has decreased to the replenishment level, directions for making replenishment are sent out. According to these directions, contact

Fig. III-6-3 Computerized Stock Control of the Tonga Electric Power Board



is made with suppliers and an order is given to a suitable supplier.

When goods have arrived, they are inspected before being stored. Upon storage, the Bin Card is updated and a storage slip is made before the data are input into the computer.

Also, a bill is sent to the cost clerk in the head office. The cost clerk makes sure that the goods have been stored and then makes payment to the supplier according to agreed upon terms.

Input data are as follows:

- Delivery Requisitions (Items, Quantities, etc.)
- Storage Slips (Items, Quantities, etc.)
- Inventory Adjustment (Items, Quantities, etc.)
- Delivery Forecast (Items, Quantities per month, etc.)
- Others

Output data are as follows:

- Delivery Slips (Items, Quantities, etc.)
- Ordering Directions (Items, Quantities, etc.)
- Daily Reports (History of Storage and Delivery, Inventories Balance List, etc.)
- Monthly Reports (Inventories Balance List, Total Order List, etc.)
- Purchasing Lists
- Others

There is little need to change the present organization with the introduction of these new systems. In the warehouse, clerks who are dealing with the Ledgers and Requisitions may become computer operators.

Although a spare computer is required, hardware maintenance for the unit in daily operation is also needed. A period of about one week is required for MTTR.

For software, the Board should have more than one programmer. While the board is required to have several operators, if the programmer is well acquainted with the system, the Board may give its staff operator training within a reasonable amount of time.

7. Ministry of Police

7-1 Jobs Studied

The Ministry is much less functionally linked to the Government than other organizations; thus, it is a somewhat independent body. The Ministry, however, as in most other countries, is of great importance because of its long history and close relations with residents.

The Ministry hopes to be provided with a totally computerized system encompassing criminal information, automobile registration, and immigration management. However, a system for criminal information was deleted from the list of jobs to be studied because, as stated in S/W, the investigation of criminal information may infringe on the right to privacy of the people and is not suited to computer processing.

7-2 Analyses of Jobs for Computerization

7-2-1 Automobile Registration

(1) Organization and Functions

Automobile registration is under the control of the Traffic Department, and its organization chart is illustrated in Fig. III-7-1.

Functions of the Department are roughly grouped into the following three categories.

1) Automobile Registration Control
2) Driving License Control
3) Accident and Violation Control

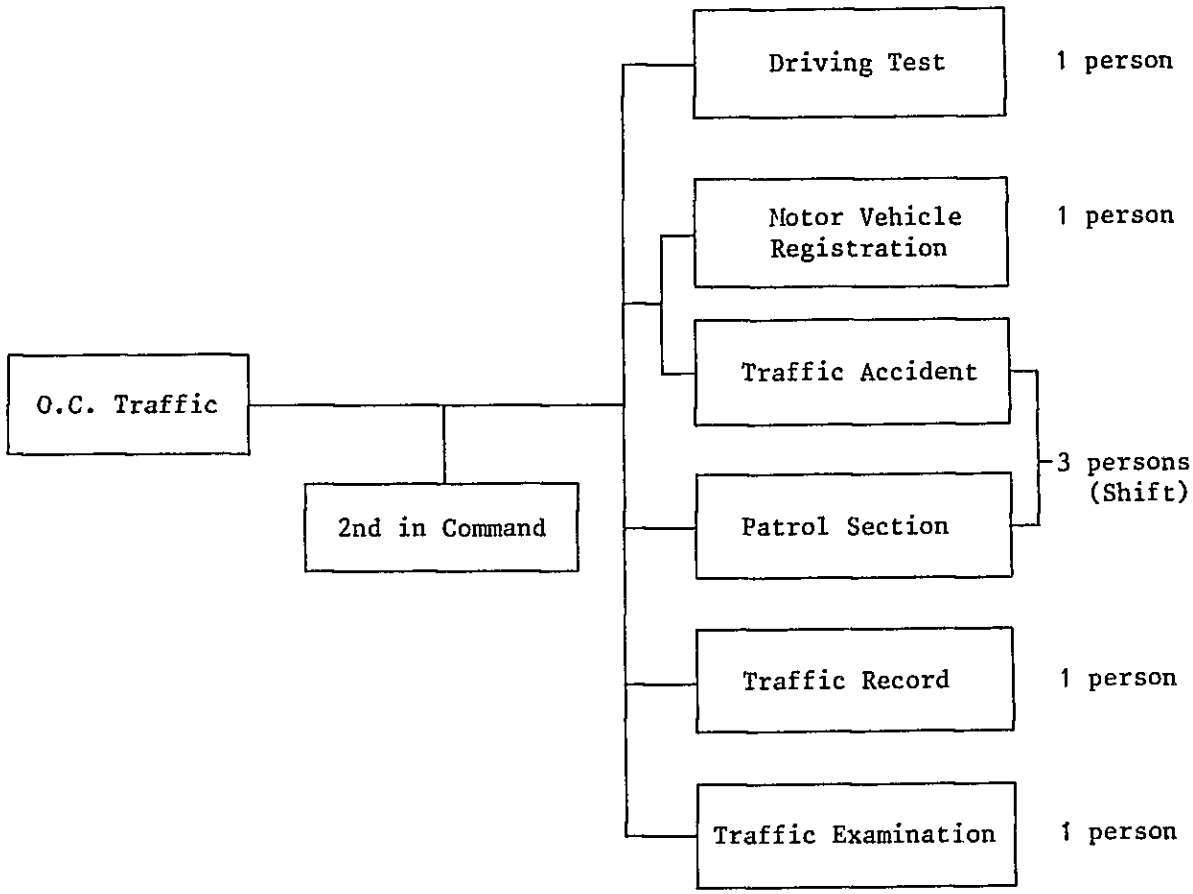
Among the above, the first two are expected to be computerized, and particular attention must be paid to the computerization of driving license control.

(2) Data Processing Procedures

(a) Procedures for Automobile Registration

In the process of automobile registration, an official of the Department fills out a registration card that is then kept, according to specific car type, in the Department, and the official issues a registration certificate to the owner. Registration is conducted by island. The owners must receive an automobile certificate by notifying the Department every quarter (March, June, September, and December), or can apply simultaneously for the whole year. The official then records the receipt of each notification on the back of the corresponding registration card. Any automobile must be inspected once a year before a specified date, and the Department issues a certificate when the inspection results are acceptable. When an automobile is no longer in use, the registration card is cancelled.

Fig. III-7-1 The Organization Chart of the Traffic Department



(b) Procedures for Obtaining a Driving License

When a person has passed the driving examination and applied for a driving license, the license is issued in approximately one month. The minimum age for driving is 18 or older for vehicles for private use and 21 or older for those for commercial use.

The license is in book format indicating ten types of automobiles, those of which the driver may operate being marked. In the Kingdom, the driver is not obligated to carry the license while driving. The Department manages the licenses with registration ledgers listing the licenses in order of issue number.

(3) Type, Quantity, and Quality of Data

There are two types of data: one for automobiles and the other for driving licenses. For automobiles, all items indicated on the present registration card must be kept track of; the number of registered automobiles amounted to 2,490 in 1981 and 3,086 in 1982. Newly registered automobiles amounted to 541 in 1982, and have already exceeded 800 as of December 6, 1983. The exact number of unregistered automobiles in unknown,

but it seems to be fairly high.

For driving licenses, items listed in the registration ledger including license number, full name of the driver, occupation, domicile, automobile type(s) qualified for, and date of issue of the license. All of these must be kept track of. The number of driving licenses issued as of December 6, 1983, stood at 4,526.

(4) Staff and Equipment

As shown in Fig. III-7-1, the members of the Department total nine, and no special equipment is being used. All cards are filed in desk drawers.

(5) Bottlenecks

Current bottlenecks are:

(a) It takes a long time to identify whether an automobile has been registered or not, and who the owner is.

(b) It is difficult for patrolling policemen to confirm whether a driver has been licensed or not.

(c) Similarly, it is difficult to find out which type(s) of automobile(s) a driver has qualified for.

(6) Purposes for and Thoughts on Computerization

Purposes for computerization in the Department have been summarized as follows.

(a) Speeding up of retrieval of automobile related information.

(b) Speeding up of retrieval of driving license related information.

(c) Improvement of quality of the driving license management system.

The Department wants to deal with an increasing workload by the use of a computerized system because addition to the staff is an impracticable idea.

The Department is thinking of, if necessary, sending a supervisory person to an advanced country to learn the required technology.

7-2-2 Immigration Control

(1) Organization and Functions

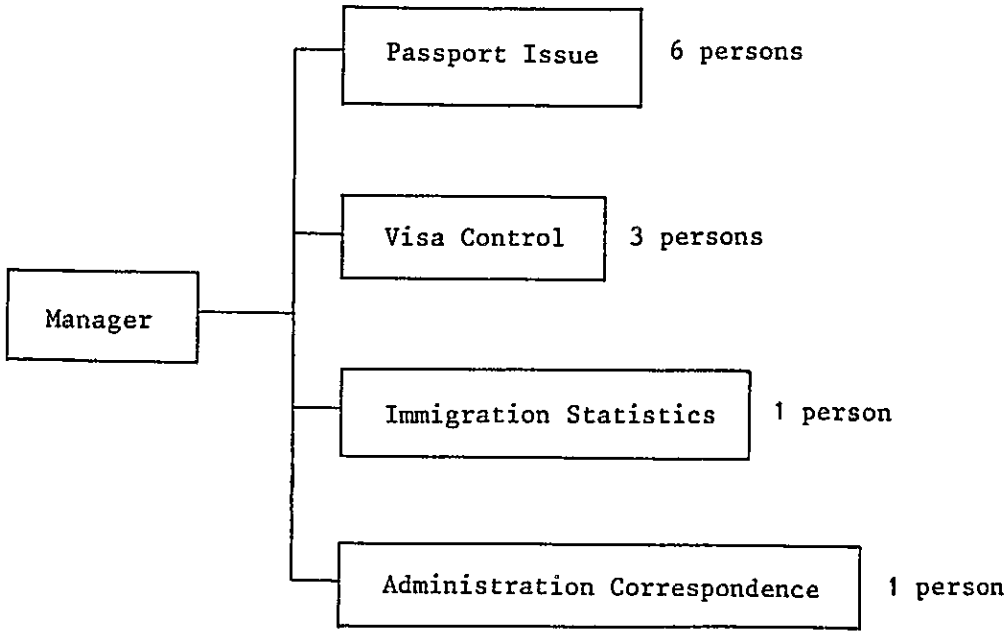
The Immigration Department conducts controls with the organizational structure shown in Fig. III-7-2. Its functions are not only visa control but also passport issue and management, which requires computerization of all immigration procedures.

(2) Data Processing Procedures

(a) Visa Control

When a traveller enters the Kingdom at the airport or the harbor, an official checks immigration status by comparing the immigration card with the

Fig. III-7-2 The Organization Chart of the Immigration Department



passport. All immigration cards are filled alphabetically by name in the Immigration Department, and the Tonga Travel Agency refers to the file. When a traveller has left the Kingdom, the immigration card is transferred to and kept in another file. The Department prepares immigration statistics once a year at the time specified for the Annual Report.

(b) Passport Control

When a person applies for a passport, the official in charge posts the application in the Tongan Voyage Card, files it with the application form, and issues the passport. When a loss of passport is reported, the official checks the file for the identity of the person and then delivers a "Certificate of Identity". No documents of the Department are discarded, even after expiration of the specified filing period. The statistics on passports are also prepared for the Annual Report.

(3) Type, Quantity, and Quality of Data

There are two sorts of data: visa information related only to foreigners, and passport information related only to Tongans; thus, there is no connection between the two, resulting in completely independent management of each.

Travellers to the Kingdom in 1982 totaled 75,415 (this figure is quoted from the Annual Report, while the Tongan Travel Agency indicates the number as 82,000). On the other hand, Tongans holding valid passports totaled 5,978 as of the end of 1982.

The quality of recording of data is poor. This is especially true of Immigration Cards,

in which writing styles differ greatly from foreigner to foreigner, and many important items are either in illegible hand-writing or left blank.

(4) Staff and Equipment

Three officials are in charge of visa control; two of them are working at the airport. The issuance of passports is being performed by six officials, including an accountant. There is no special equipment for the processing of the material, and all documents are filed as they are.

(5) Bottlenecks

Present bottlenecks are as follows:

a) Because no documents are discarded, the time required for retrieval is becoming increasingly longer.

b) The quality of recording of data is poor.

c) It is impossible to find the required document with any key items other than alphabetical name order.

d) It is difficult to determine departures and illegal entries.

(6) Purposes of Computerization

a) Speeding up retrieval operations

b) Improving data control levels

c) Reducing registration workload

(7) Points for Special Consideration in the Computerization

a) Both the Tongan Voyage Card and the Certificate of Identity require photographs, but at present it is very expensive to check photographs by computer. Therefore, the officials are now considering a system that provides a separate file for the photographs (numbered individually) and matches the file with the computer file.

b) The capacity of computer files is limited; thus, it is necessary, during implementation of the computer system, to prepare countermeasures such as converting old data into standard files and saving file capacity with floppy disks.

c) At present, all immigration cards can be filed as they are, but computerization may possibly require a reinput of data, which will adversely increase the workload.

7-3 Future Plan for Data Processing Systems

(1) Possible Data Processing Systems

Although the Traffic Department and the Immigration Department belong to the

Ministry of Police, practical functions and working locations differ from one another, so introduction of computers should be carried out separately, provided that the mode of data processing, consisting mainly of registrations and retrievals, is the same.

For future data processing systems at the Ministry, the following three ideas are practical.

(a) Introduction of Filing Systems

A lot of business machines of high performance other than computers appear in the offices of developed countries. This suggests that introduction of a computer system is not the only solution to the problems; but even a review of the existing filing systems and a change to more up-to-date systems (through the use of office equipment) will considerably improve processing. Possible advantages are.

1) All cards can be filed as they are.
2) Cost is low.
3) The systems can be brought up to date quickly.

(b) Introduction of Computers

Changing the existing systems into electronic filing systems controlled by a micro-computer or mini-computer makes it possible to process the data quickly and at a high level of accuracy impossible with the current systems. Concrete merits are:

1) Very rapid retrieval is possible even under complex conditions.
2) The system can handle processing of the data, and provides outputs of high accuracy.
3) It also prepares ample statistical materials for management.

(c) Introduction of Microfilm (COM)

This system puts existing paperwork on microfilm (rolls and microfiches) for management of information. In addition to the COM, a system utilizing optical disks also exists but is not practical in terms of cost. Advantages of the COM are:

1) Much less space is required for storage of microfilm materials.
2) Required processing is only photographing of the documents (posting unnecessary).
3) Retrieval can be carried out by a simple key operation.

Appropriate measures have to be decided by comparing the respective merits and demerits of systems from the points of view of economical efficiency and future utility.

(2) Future Plans for Computerized Systems

Future expectations for the introduction of computers are noted in the following.

The expectations and their reasons are:

1) This system has a high possibility of implementation because it performs complex processes with outputs of high accuracy.
2) The Ministry of Police is strongly in favor of introducing the system.
3) Introducing computers will bring about the greatest changes in the current processing system.

Studies must be conducted separately in the Traffic Department and the Immigration Department. Table III-7-1 shows prospective uses, including processing, data, organization, and staffing for each Department.

Table III-7-1 (1) Prospective Uses for the Traffic Department

	Automobile Registration	Driving Licence Management
Processing Flow	1) Registration: Application by owner 2) Retrieval and Renewal: o During accidents or police patrols o Notification of alteration o Inquiries 3) Statistics: Preparation of annual reports 4) Deletion: Notification of scrapping	1) Registration: Upon issue of license 2) Retrieval and Renewal: Same as in the left-hand column 3) Statistics: Same as in the left-hand column 4) Deletion: When no notification for renewal is received before the expiration date, or due to an accident or violation requiring mandatory cancellation.
Type and Quantity of Data	1) Input: Items on the "Automobile Registration Card" such as registration date, car-type, color, use, etc. 2) Output: "List of Registered Automobiles" in the order of registered numbers, colors, car-types, etc. 3) Data quantity: Around 0.9 MB for 3,500 cars (256 bytes each).	1) Input: Items concerning Driving Licenses, such as license number, full name, occupation, vehicles qualified for, etc. 2) Output: "List of Licensed Persons" in order of license numbers, full name, etc. 3) Data quantity: About 1.3 MB for 5,000 persons (256 bytes each).
Organization	Seven personnel other than the Chief and the Deputy Chief will be dispatched to the following sections: 1) Physical Services: Security, accident control and investigation; can be subdivided. Four personnel. 2) Data Operation: Input into and retrieval from the computer. Two personnel. 3) Machine Maintenance: Maintenance of hardware. One personnel.	
Staff	1) The staff of the Date Operation section must be trained in general knowledge of computers and in the operation of the computerized systems (three to six months). 2) The staff of the Machine Maintenance section must be trained in details of the hardware and the software of the computer, and on aspects of the computerized systems (six to twelve months).	

Table III-7-1 (2) Prospective Uses for the Traffic Department

	Visa Control	Passport Control
Processing Flow	1) Registration: Upon application for entry 2) Data pass: Notification of the Tonga Travel Agency 3) Retrieval: Upon accident and investigation 4) Deletion: Upon application for departure 5) Statistics: In preparation of annual reports	1) Registration: Upon application for issuance 2) Reissue: Upon notification of loss of passport 3) Retrieval: Same as in the left-hand column 4) Deletion: When no application for renewal is received before expiration date. 5) Statistics: Same as in the left-hand column
Type and Quantity of Data	1) Input: Items in the "Immigration Card" including full name, nationality, birth date, frequency of entry, scheduled date of departure, occupation, etc. 2) Output: "List of Entrants" by country and occupation, statistical tables, etc. 3) Data quantity: Around 20 MB for 80,000 persons (256 bytes each).	1) Input: Data concerning passport or certificate of identitity issued upon notification of loss, such as full name, domicile, birth date, passport number, etc. 2) Output: "List of Passport Holders" in order of passport number, alphabetical order of name, etc. 3) Data quantity: About 1.5 MB for 6,000 persons (256 bytes each).
Organization	Eleven personnel in addition to the Chief will be dispatched to the following four sections: 1) Passport Issue: Procedures for passport issue. Four personnel. 2) Visa Control: Visa control procedures. Three personnel. 3) Data Operations: Input into and retrieval from the computer. Three personnel. 4) Machine Maintenance: Maintenance of hardware. One personnel.	
Staff	Same as the Traffic Department.	

8. Tonga Cooperative Federation

8-1 Scope of Work for the Study

The Tonga Cooperative Federation (TCF) was founded in 1977 as a confederation to conduct importing and wholesaling of consumer goods for primary organizations (members of the Federation). Initially, business was profitable and the Federation could supply goods to the members at low prices. However, after the first Secretary-Manager resigned, business declined, almost resulting in bankruptcy. This decline was due to faulty purchasing methods, inexperience in management, and low morale of the employees. As a result, only the Peace Corp's Secretary-Manager and two employees remained with the Federation, stock amounts reached a low, business was depressed, the Ha'apai Branch closed, and the Vava'u Branch was conducting minimal business due to a lack of purchasing funds. The initial business prosperity, however, still provides great motivation for the rebuilding of business.

For rebuilding the TCF, an Assistance Agreement was concluded in September, 1981, between the United States Agency for International Development (USAID) and Agricultural Cooperative Development International (ACDI). The Agreement includes the following items.

- Capital increases should be made by the Federation's members themselves.
- Assistance loans will come from the Government of the Kingdom of Tonga and the Tonga Development Bank.
- Machine equipment and specialists will be provided by the Canadian and British Governments, the British Commonwealth, and the U.S. Peace Corps.
- Financial assistance and the dispatch of a manager will be provided by the U.S. Government.

With assistance from the U.S. and other nations, the TCF has made a fresh start and is conducting the following activities.

1) Supply of imported and domestic consumer goods, especially those with a high turnover rate, to the primary organizations.
2) The sale of domestically caught fresh fish utilizing the benefits of the growing numbers of refrigerators and iceboxes in the Primary Organizations.
3) Entering vanilla purchased from Vava'u Island into the international market with careful quality control in the curing of unripened beans.
4) Domestic sale and export of handicrafts.
5) Sales expansion of fishing tackle.
6) Sales of agricultural machinery from Vava'u and Ha'apai Islands.

In addition, for stable financing, measures such as paying back operating income to the members in the form of stocks have been taken. Under these management policies, the re-organized TCF resumed its business in 1982. Despite damage from a hurricane

which hit in March, 1982, business has been good. Revenues are more than $2,000,000 in the wholesale sector, $200,000 or more in the vanilla trade, and about $55,000 in handicraft sales. Revenues are growing in all fields and thus will yield profits in the fiscal year. Capital contributions to the re-organized TCF are shown in Table III-8-1.

In the TCF, the most important section is, of course, the wholesale business, which is naturally required to be computerized first. Wholesale business at the Nuku'alofa store, which needs a stock control system, most requires the use of a computer, and would seem to benefit from computerization. The wholesale store is the center of business not only for Tongatapu Island, but also for Vava'u, Ha'apai, and other islands.

Working procedures in the wholesale store are precisely fixed and the work is conducted on a regular basis. At present, business is sufficiently large to be considered itself as a bottleneck in the system. With the use of microcomputers, business is expected to be more easily conducted.

In view of the past problems in business, it can be said to be important, as a business strategy, for management to know about fluctuations of stock and prices and other purchasing data as quickly as possible.

For these reasons, stock control in the Nuku'alofa Wholesale Store has been taken up as an object of computerization.

Table III-8-1 Capital Contributions in Tonga Coorperative Federation

Source	Amount	
Tonga Government	20.000	00
Agricultural Co-operative Development International, U.S.A	103.943	56
Canadian Aid	17.400	00
U.S.A.I.D.	4.585	00
New Zealand High Commission	1.000	00
Christian Aid-United Kingdom	17.442	69
	164.371	25
Pacific Partnership for Human Development-New Zealand	3.074	53
	167.445	78

8-2 Analysis of Work for the Study

8-2-1 Organization and Functions

The structure of the Tonga Cooperative Federation (TCF) is shown in Fig. III-8-1.

The TCF has about 3,600 members and they elect committees. Primary organizations were formed through the committees. There are 70 such organizations, which are participating in the management of the TCF through the Management Committee and Sub-Committees elected from among them.

The Government of the Kingdom of Tonga has relations with the TCF through the Cooperative Department, whose roles are as follows:

- Promotion of the growth of cooperatives
- Managerial training and suggestions for cooperative members
- Inspection of cooperative activities and accounting audits
- Rules enforcement of cooperative activities

Moreover, if the Government recognizes a need for the TCF to be given any assistance in funds, materials, or specialists, it will look for support and request assistance.

The organization of the TCF is shown in Fig. III-8-2.

The Secretary-Manager is in charge of actual management but he is under control of the Management Committee. The manager's assistants, the administrative assistant(s), and the cashier(s) are in charge of the handling of cash.

There are managers on Vava'u and Ha'apai Islands both, and the Vava'u manager, in particular, has sales clerks who control wholesaling, handicrafts, and refrigerated marine products, and an Inspector for the buying and curing of vanilla.

On Tongatapu Island, 15 employees are working in handicrafts sales and the Wholesale Store, and 5 in the accounting department in the Head Office.

The detailed organization structure of the Wholesale Store is shown in Fig. III-8-3. In the Store, a Tongan Wholesale Manager controls overall affairs and a store manager, his assistant, controls the Nuku'alofa store. Work in the Store consists of store sales, which involves goods receiving and costing, and delivery. The Costing clerk keeps records of daily activities, and inspects the prices of goods and their sales invoices. The Goods Receiving Clerk inspects goods received and has store sales staff under his control. The sales clerks make sales invoices on goods being sold. The store clerks move heavy goods in and out of the warehouse. The store cashiers deal with and take care of the handling of cash.

The details of the organization of the Accounting Department in the Head Office are shown in Fig. III-8-4. The Financial Manager controls all departmental affairs, and his assistant is the Chief Accountant. The General Ledger Accounts Clerk is in charge of entries and calculations for the general ledger. The Sales Clerk Accountant totals sales invoices and compares them with cash amounts. The Accounting-Costing Clerk inspects goods unloaded from ships and makes a cost accounting. The Typist takes care of typing,

Fig. III-8-1 Structure of the Tonga Cooperative Federation

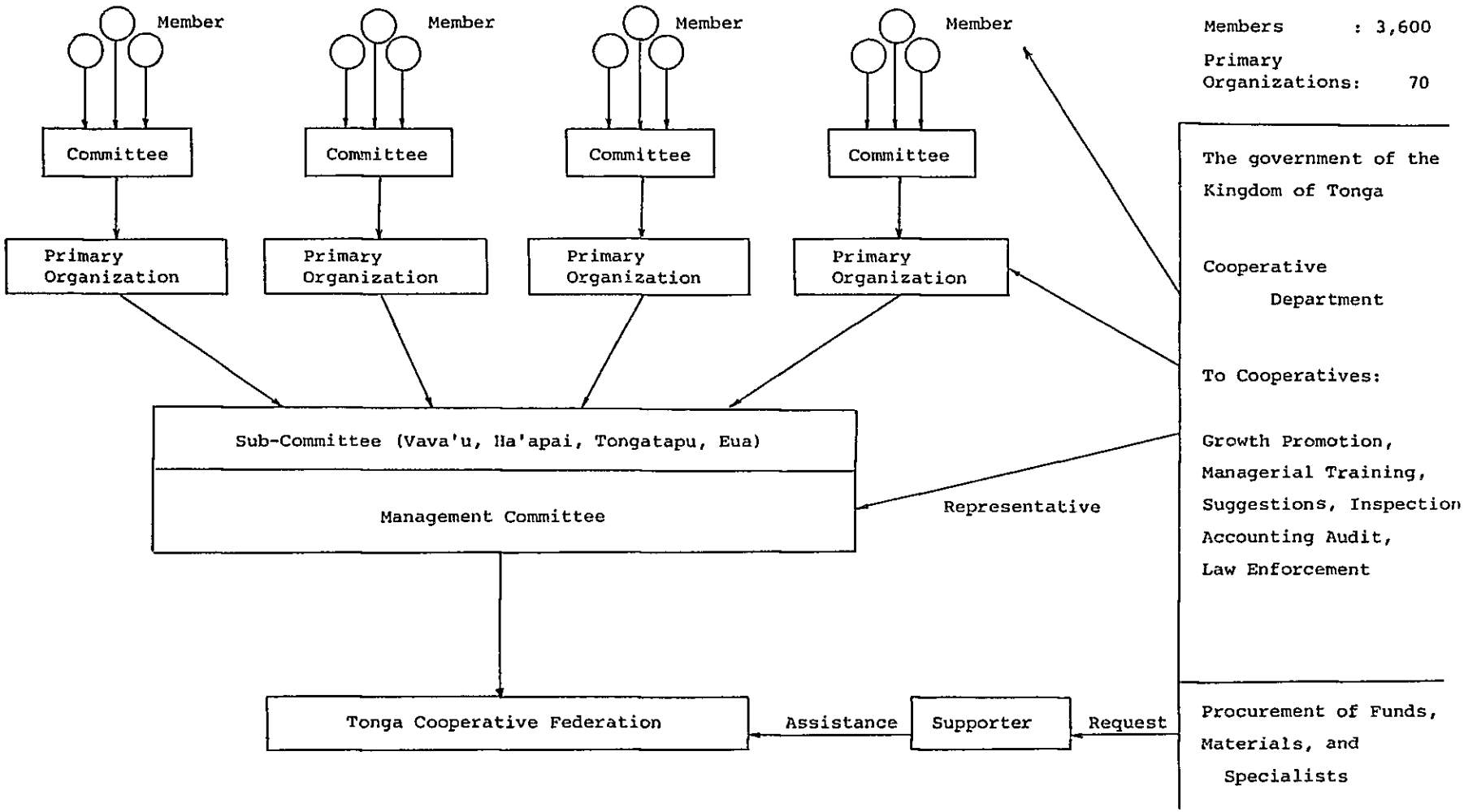
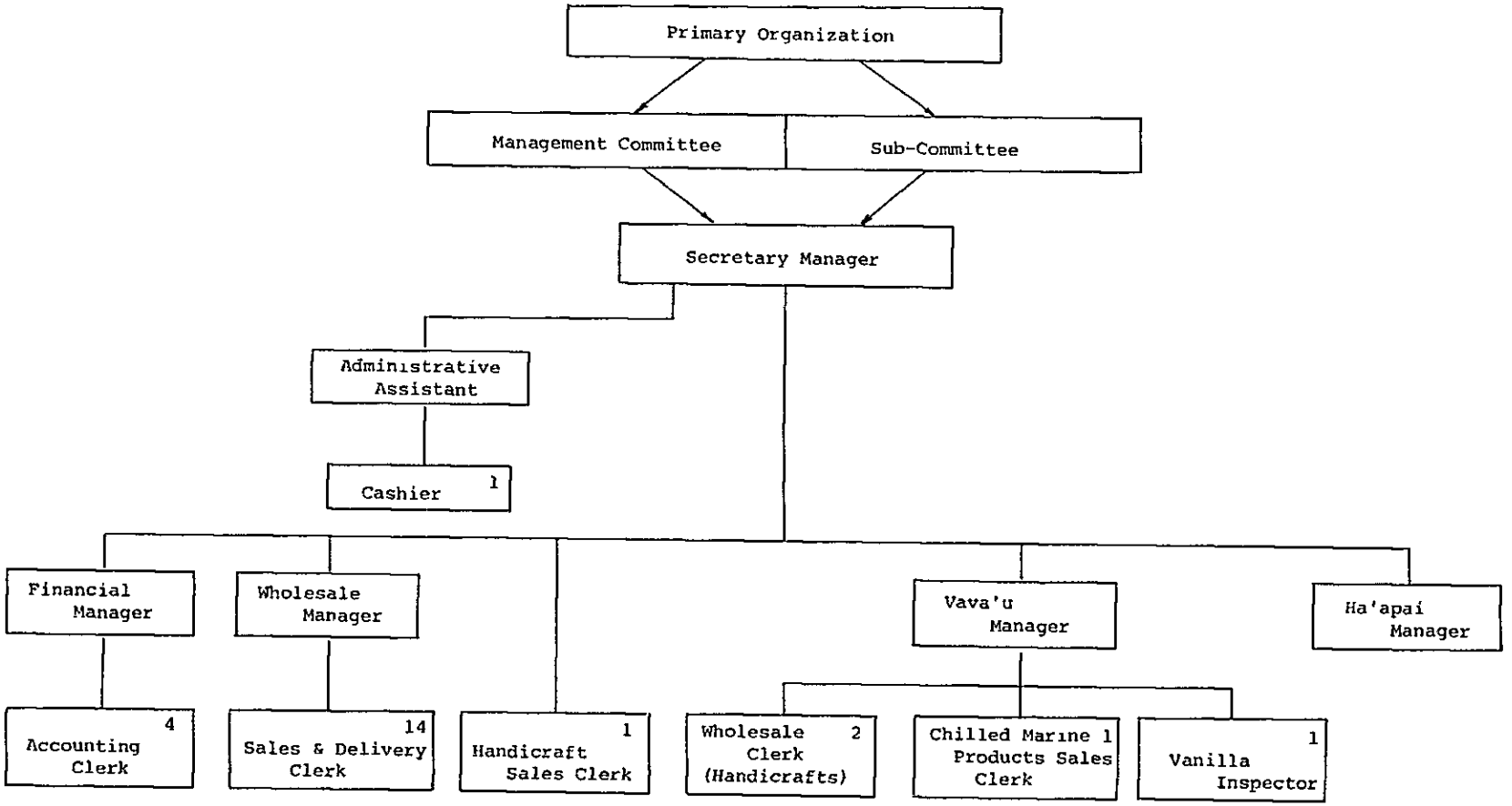


Fig. III-8-2 Organization of the Tonga Cooperative Federation



Figures show the number of staff members.

Fig. III-8-3 Organization of the Wholesale Department of the Tonga Cooperative Federation

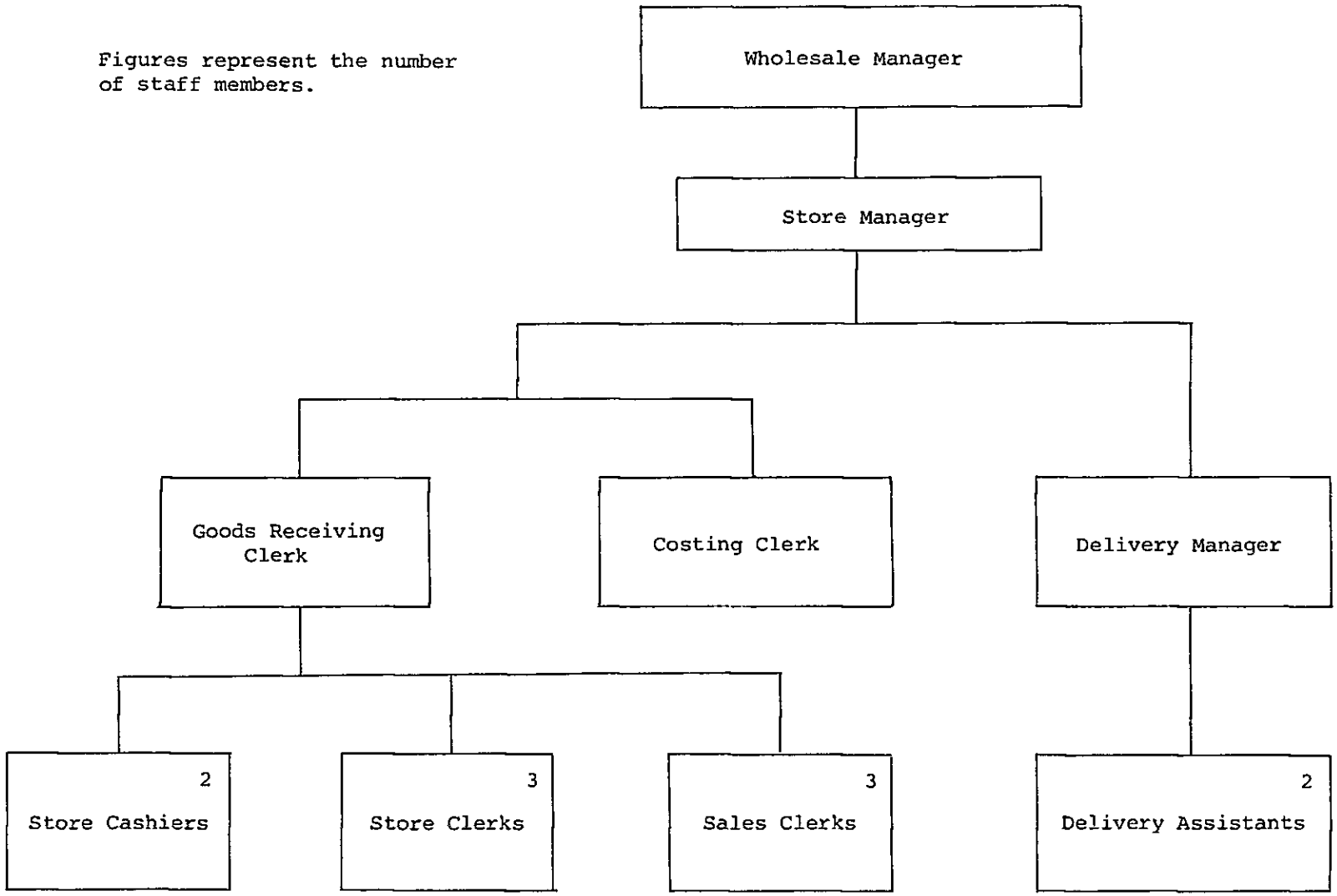
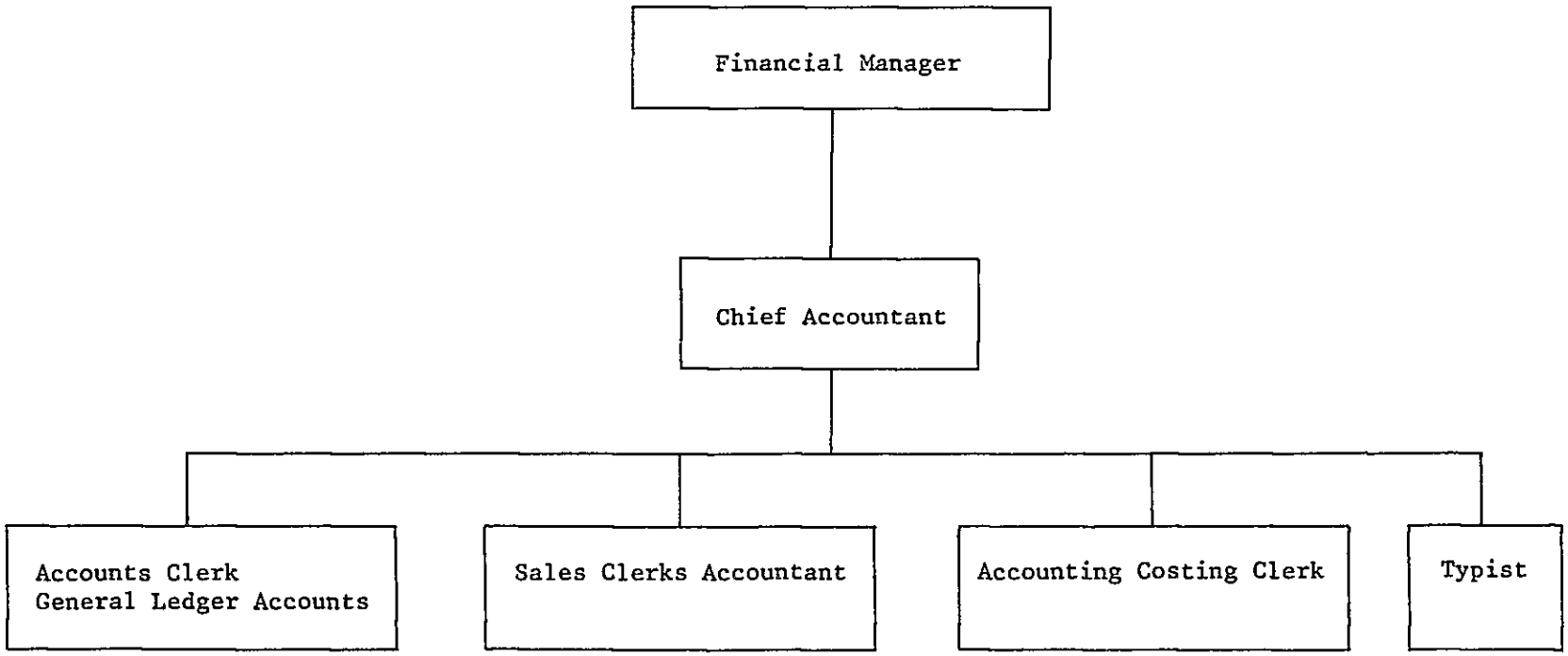


Fig. III-8-4 The Organization of the Accounting Section in the Tonga Cooperative Federation



telephone switchboard operation, and other miscellaneous duties.

Eventually, the goal is to manage the TCF with Tongans only, but, at present, major posts such as Secretary-Manager and Financial Manager must be assumed by expatriates. However, Tongans are intentionally assigned as assistants for such posts and are undergoing managerial training.

8-2-2 Current Wholesale System

The Nuku'alofa Wholesale Store of the TCF is dealing with about 400 consumer items, 15% of which are bought domestically and 85% of which are imported. Domestic products include only 5 – 6 items such as crackers, soap, and toilet paper, and other items (the majority of goods) are brought in by ship. All items are sold to both members and non-members. The number of non-member customers is estimated to be approximately 200.

The flow of transactions with customers in the wholesale store is shown in Fig. III-8-5. During this processing flow, the making of sales invoices takes place at a different time from that of receipts, and disbursement of cash is done in a manner to allow for stricter checking procedures. The sales invoice volume is estimated at about 75 on weekdays, and on Saturdays, the busiest day, it goes up to as many as approximately 200. For domestic customers the TCF permits sales on credit; thus, the Sales Clerk identifies the customer as domestic through a special directory before he dials with the invoice as a credit sale. The equipment used in these transactions is a common cash register.

The checking flow of daily sales is shown in Fig. III-8-6. The Store Cashier sends sales invoices to the Sales Clerk Accountant and cash to the Office Cashier. The Sales Clerk Accountant, with the duty of totaling sales invoices and comparing them with cash amounts, is busiest. The cash receipt issued by the Office Cashier is shown in Fig. III-8-8.

Concerning stock inspection, on Tuesday to Thursday when business at the store is comparatively light, inventory is made on 20 major items consisting of goods with a high stock turnover rate such as sugar, flour, and corned beef (15 kinds).

The Costing Sheet is prepared for goods imported by sea or air. The total cost consists of C.I.F., local charges, landing costs, and mark-up.

Preparation of the Costing Sheet is more or less dependent on the time of ship arrival. The total number of forms to be prepared is approximately 200 pages per month, but when ships arrive, approximately 50 pages must be prepared within a three day period. This work is now performed alone by the Accounting Costing Clerk in the Head Office and is usually done in concentrated periods.

Fig. III-8-5 Customer Transaction Flow in the Wholesale Store of the Tonga Cooperative Federation

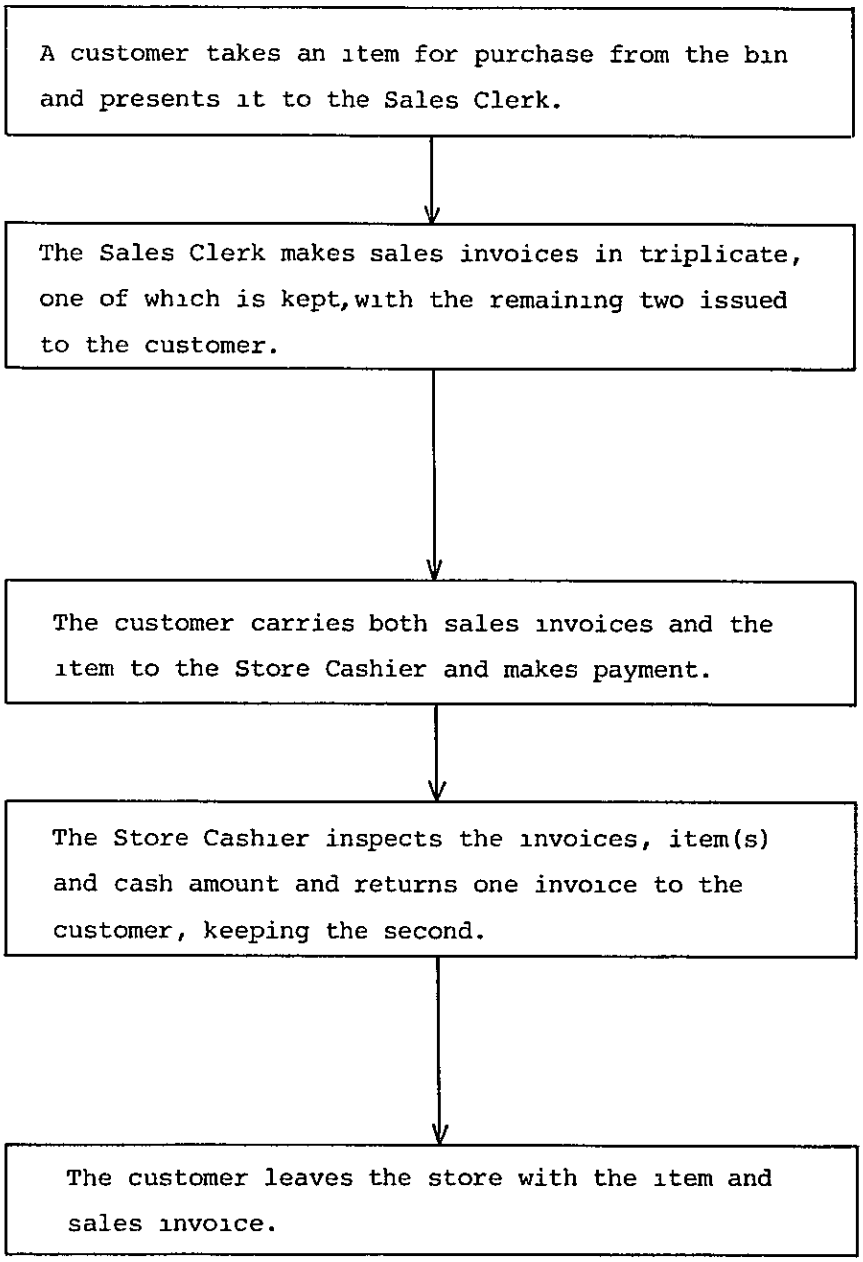
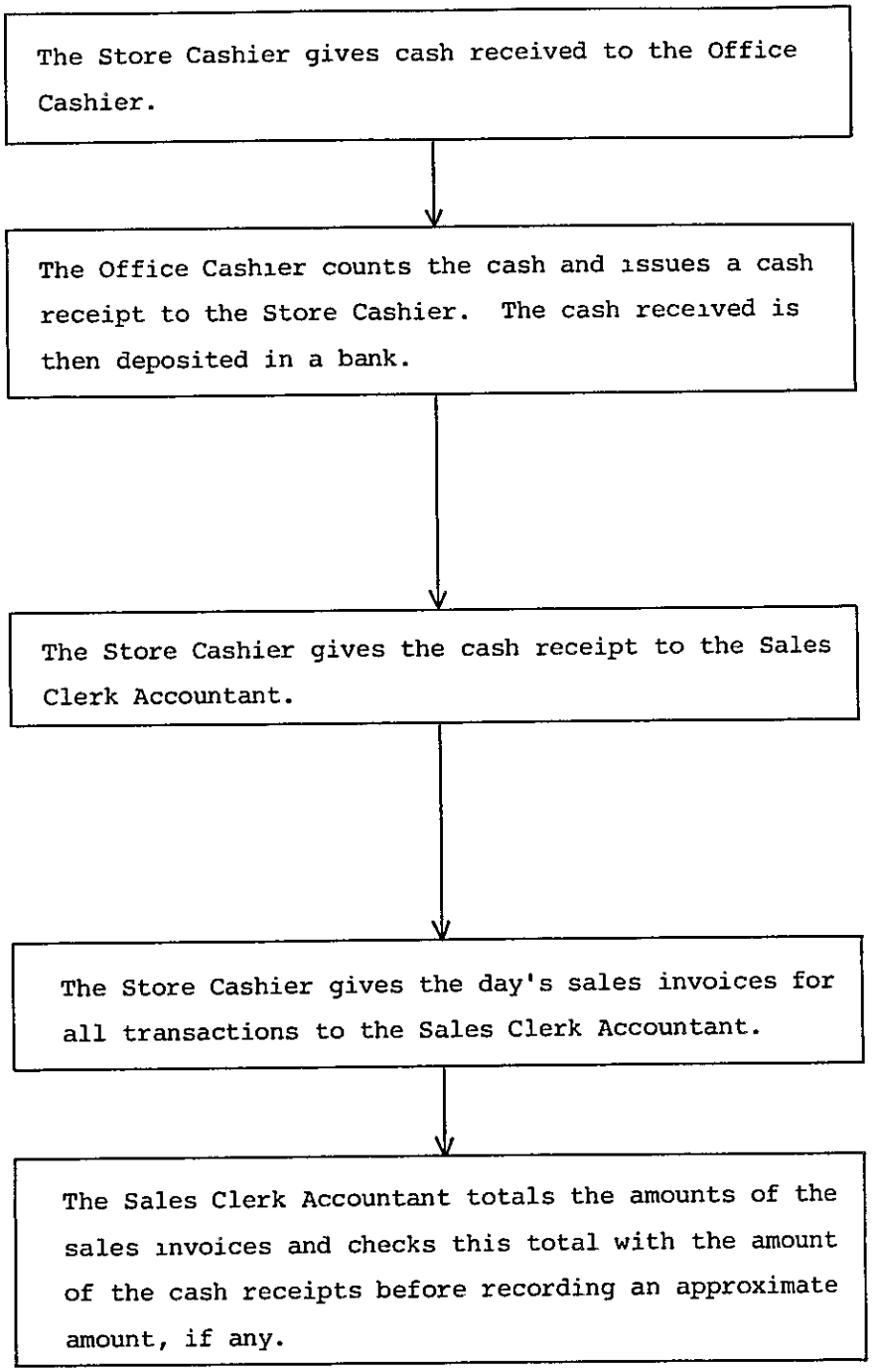


Fig. III-8-6 Daily Sales Check Flow of the Tonga Cooperative Federation



8-2-3 Expected Application of Computers

One bottleneck in the current wholesaling system is the heavy workload of the Sales Clerk Accountant and Accounting Costing Clerk. The former is required to total sale invoices daily, and the latter, during a brief period after the arrival of a ship, has to work hurriedly preparing a large number of Costing Sheets. These types of work are expected to be suited to the use of computers for easing the workload.

Mr. John Kreag, Manager of the TCF, pointed out the following as goals in the use of a computer in the wholesaling system.

1) Identification of a certain stock quantity level in order to prevent loss of time in reordering and in meeting customer demands.
2) Notice of unusual changes in customer purchases and collection of related data as quickly possible.
3) An increase in efficiency in the handling of bottlenecks and the raising of performance as a whole, without an increase in employee numbers.

Mr. Kreag clarified his plan with a draft of items necessary for the realization of his goals and the contents of which are as follows.

- Required file types

  Customer File, Price File, Inventory File, Stock Master-file, Customs-tariff File, Wharfage File, Landing Cost File, Mark-up File, Domestic Supplier File
- Sales Invoices
- Sales Daily Reports
- Sales Monthly Reports by Customers
- Inventory Daily Reports on Major Items
- Price Fluctuation Monthly Reports
- Stock Adjustment Monthly Reports
- Delivery Receipt Daily Reports

Since the Federation's other systems seem to be similar to the wholesale system, the computer system proposed is expected to be a common system used for computer operations in other departments. In addition, the computerization of the wholesaling system is said to be significant for the TCF staff's deeper comprehension of computer systems.

8-3 Proposed Plan for Future Data Processing System

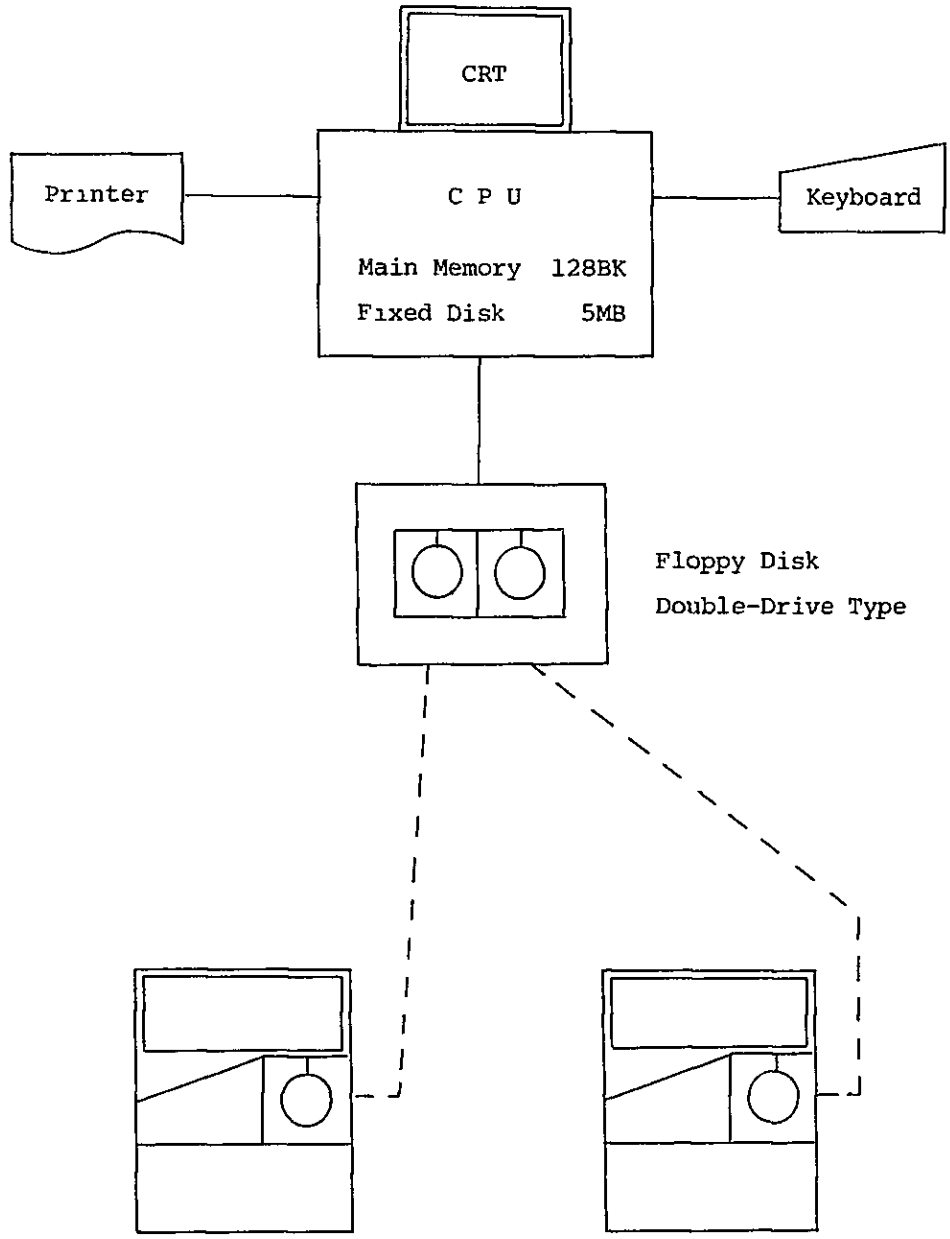
The equipment to be used in the TCF wholesaling system is shown in Fig. III-8-7.

In the Head Office, a CPU, keyboard, printer, and floppy disk (double-drive type) are necessary.

With this system, the daily total sales, the daily and monthly reports, and the Costing Sheet are all output as well.

In the Store, stand-alone type POS terminals (2 – 3 units) will be used for daily wholesale business. Data on sales invoices is stored on floppy disks, the information being

Fig. III-8-7 Equipment in the Computer System of the Tonga Cooperative Federation



Stand-Alone Type POS Terminal

[Keyboard, Floppy Disk, Cash Register]

later input into the computer.

If POS terminals are used in the wholesaling system, sales invoices are not required, but cash receipts to be issued to customers are necessary. Under this system, one person can act as both Cashier and Sales Clerk, and cash is kept in a cash register connected to the terminal. The cash is sent to the Office Cashier as is done at present, however, checking of sales amounts will be carried out by a computer in the sales totaling on the daily report input stored on floppy disks.

In the Head Office, when goods arrive, the Costing Sheet, Delivery Receipt Daily Report, and other various daily and monthly reports are made under the costing program.

Major programs to be input into the computer are as follows.

1) **Sales Totaling Program**
   - Input: Sales Data (Floppy Disk)
   - Output: Sales Records
     Sales Daily Report

2) **Inventory Program**
   - Input: Inventory Data (Keyboard)
   - Output: Inventory Daily Report

3) **Costing Program**
   - Input: Local Charges, C.I.F. (Keyboard)
   - Output: Costing Sheet
     Delivery Receipt Daily Report

4) **Sales Monthly Report Program**
   - Output: Sales Monthly Report by Customer
     Stock Quantity Monthly Report on All Items

5) **Price Fluctuation Monthly Report Program**
   - Output: Price Fluctuation Monthly Report

6) **Stock Adjustment Program**
   - Output: Stock Adjustment Monthly Report

7) **File Management Program**
   - Input: File Alteration Transactions

8) **Checking Program**
   - Output: Sales Amounts by Customer (CRT)
     Stock Quantity (CRT)
     Bill Management Sheet (CRT)

The organizational structure will be well-suited to the new system if and only if the Store Cashier and Sales Clerk functions are performed by the same individual. Thus, an individual highly skilled in terminal operation will be appointed to this position.

While a back-up computer unit is necessary, a proper maintenance system for the

hardware should also be implemented. MTTR must be approximately 24 hours or less in a system utilizing two computers. Protracted downtime in the system may cause problems in the correcting of stock data.

It is impossible for the TCF to maintain a special software staff. Therefore, thorough operational training in software and preparation of the proper manuals are indispensable.

9. Bank of Tonga

9-1 Jobs Studied

The Bank of Tonga is the only bank that plays an intrinsic role in the Kingdom; it consists of the following shareholders:

a) The Government of the Kingdom of Tonga: 40%
b) Bank of Hawaii International Inc.: 20%
c) The Bank of New Zealand: 20%
d) Westpac Banking Corporation: 20%

Key points in which the Bank of Tonga differs from most banks are as follows:

1) On the basis of the 1974 "Agreement with the Government," the Bank is recognized as utilizing foreign currency services.
2) The Bank has an account for Government related payments.

According to instructions from the Ministry of Finance, the amount of loans from the Bank is controlled so that it does not exceed either of the following limits.

1) Fifty percent of the average amount of imports for the preceding three months.
2) Sixty percent of the sum of deposits.

In fact, however, the Bank has never been forced to stop lending because of the above controls, and is constantly making efforts to implement self-control measures so that the amount of loans does not reach the control limits. As described in S/W, the Bank desires to conduct accounting with an EDP system.

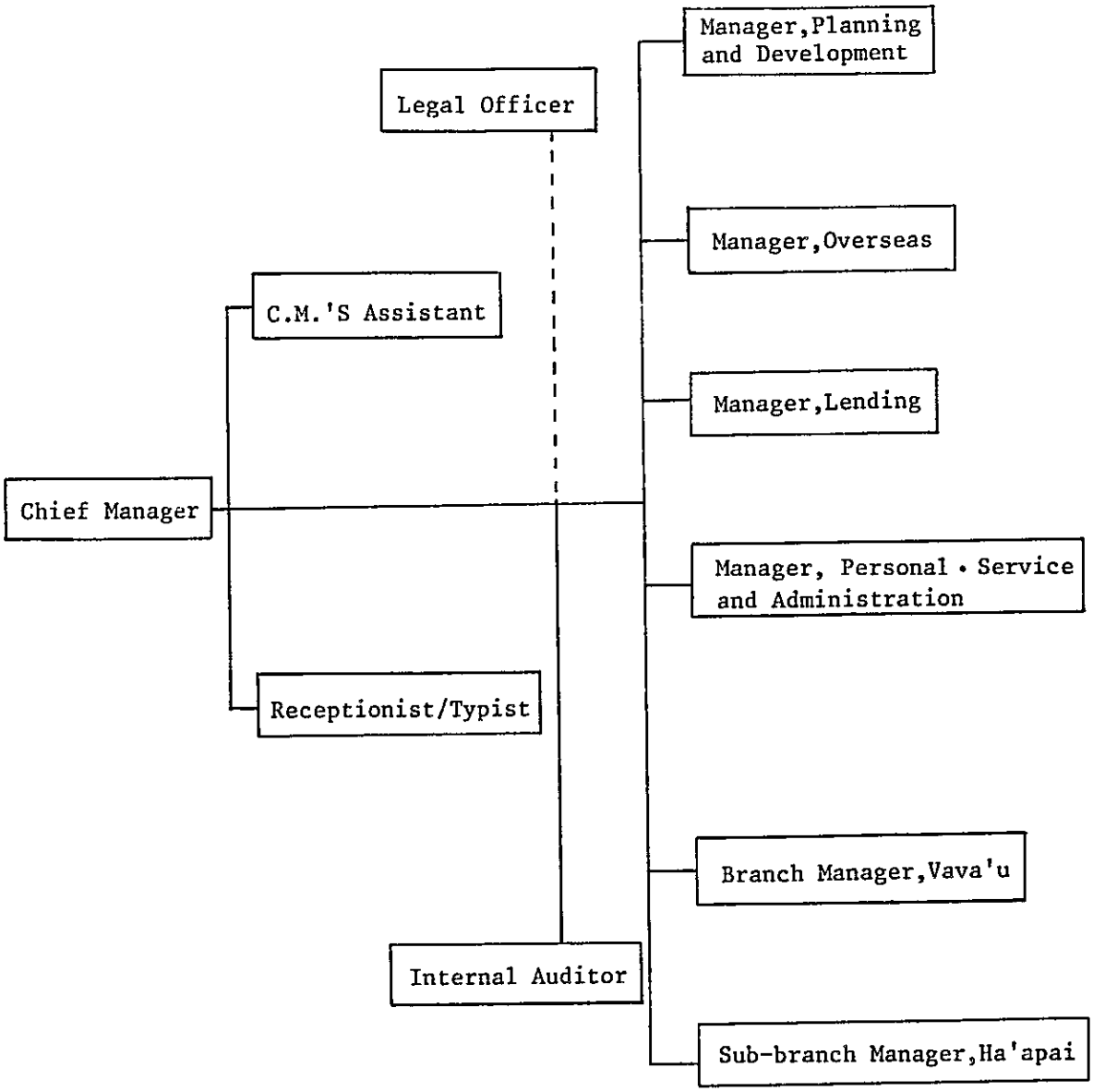
9-2 Analysis of Jobs Studied

(1) Organization and Functions

Offices of the Bank are located on every island: the main office at Nuku'alofa, three agencies on Tongatapu Island, a branch office at Neiafu on Vava'u Island, a sub-branch office at Pangai on Ha'apai Island, and agencies on 'Eua, Niuatoputapu and Niuafo'ou Islands.

The staff number is 120 in total, and Executive/Senior staffing is shown in Fig. III-9-1. The jobs of the Bank are similar to those of most banks (dealing with savings, loans, checks, foreign exchange, issueing letters of credit, and investigating customers).

Fig. III-9-1 Executive/Senior Staff



(2) Data Processing Procedures

Refer to Fig. III-9-2.

(3) Type and Quantity of Data

The actual financial conditions of the Bank by the end of September 1983 were as follows:

Type	Amount	Number of Accounts
Saving accounts	T$ 4,902,000	42,980
Check accounts	T$ 7,297,000	2,862
Term deposits	T$ 7,736,000	354
Loans & advances	T$ 10,258,000	5,582

General Ledger accounts amount to approximately 130.

Average daily transactions by the end of December 1982 in the Nuku'alofa main office consisted of:

Saving accounts	Cr:	372	Dr:	679
Trading accounts	Cr:	624	Dr:	761
Cash (T$)	In:	246,283	Out:	241,026

(4) Equipment

The Bank uses a total of nine accounting machines: seven NCR 299s and two NCR 32s; all of them receive maintenance service once a month. The Bank performs minor maintenance on the NCR 299s itself, and provides similar services to the Tonga Development Bank.

(5) Bottlenecks

(a) The two NCR 32s are obsolete with only two or three years of life reamining.

(b) The seven NCR 299s have frequent breakdowns, and due to a lack of spare parts, delays in sorting, processing of vouchers, and posting often occur.

(c) Staff payroll preparation and calculations of interest for savings and loan accounts take up much of the operation time.

(d) Correct data is not provided on a timely basis, including information concerning the total debt, loans, and advances.

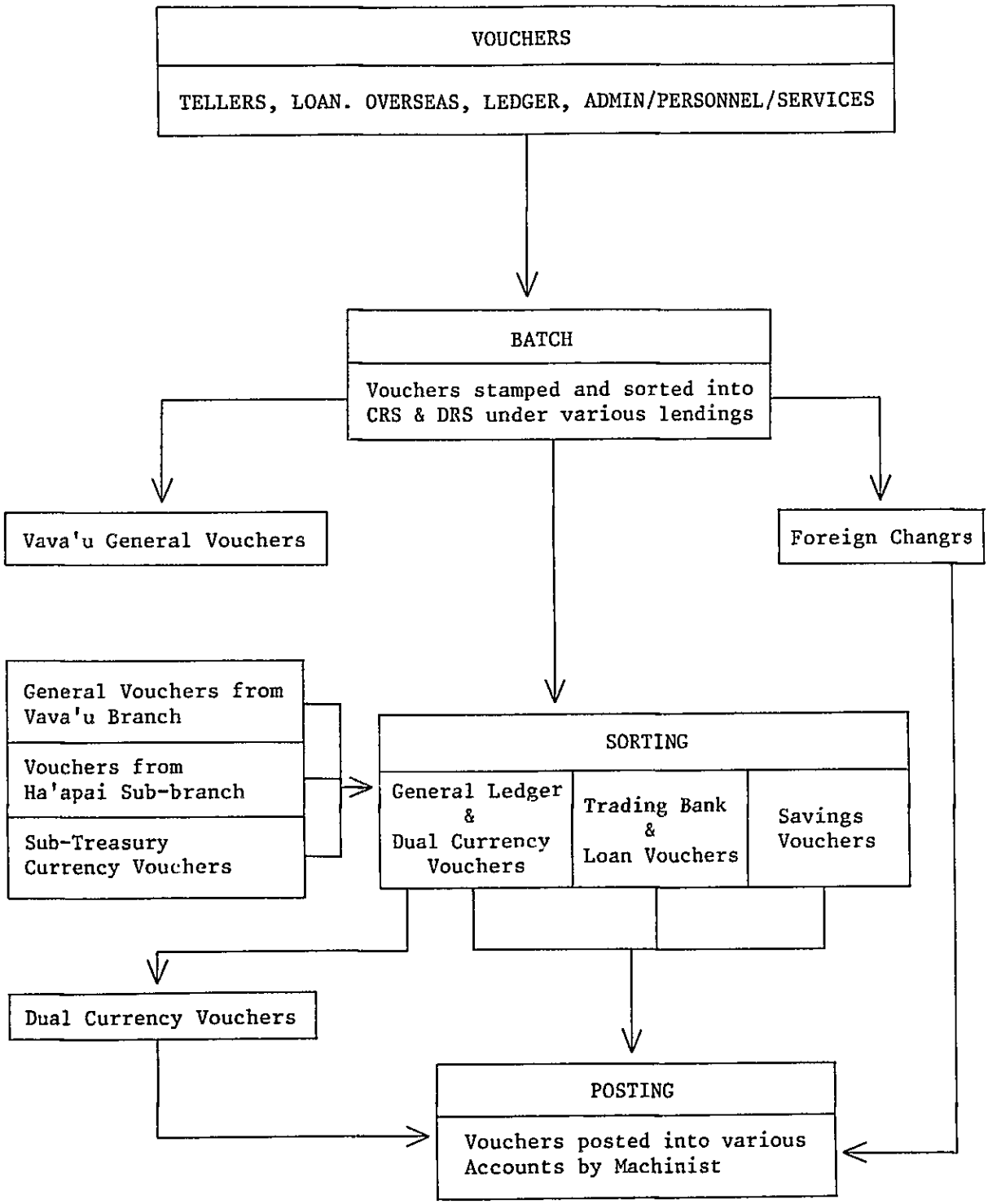
(e) Errors in the updating of accounts cannot be uncovered in daily operation.

(f) There are many statistics whose collocation, if late, delays preparation of reports for the Bank's management.

(g) The machine often causes delays in balancing and, occasionally, other errors.

(h) The expansion of the Bank and the increased workload has made work done by hand much less efficient.

Fig. III-9-2 Flow of Data and Processing Procedure



9-3 Future Plan for Data Processing Systems

9-3-1 Plans Proposed for EDP Systems by the Bank

The Bank is an organization well-suited to the use of an EDP system due to the following.

- o Considerable funds
- o High suitability for an EDP system
- o Few speciality jobs
- o High data quality

The Bank, however, wants to institute an EDP system of its own because of the peculiarities of its functions as a bank, and the necessity of safeguarding information.

Planning is as follows.

(1) The unstable supply of electric power requires a stailizing mechanism. It may be possible to draw electric power directly from a trunk line or to install a standby generator.

(2) A backup unit, although it is expensive installation is an absolute necessity.

(3) The Bank does not require a separate computer section, because it has no internal staff preparing programs. Operators are necessary, however, and OJT may be possible.

(4) The Bank wants to increase computerization in a step-by-step manner for the following order of operations.

a) General Ledgers
b) Common Deposits
c) Commercial Trade Accounts
d) Loans, Advances, and Repayments

The computerization of foreign-related functions will require a great deal of time.

(5) The Bank is interested in the "South Pacific Banking System" software package. This package was originally developed in New Caledonia (in French), but an English version has recently been prepared in the Solomon Islands and is expected to be tested in the near future, the results of which the Bank of Tonga is eagerly waiting for.

(6) There is no special need to provide interface with Government programs because actual functions of the system differ completely from those of the Treasury Department. The Bank wants its operations to be as inconspicuous as possible in order not to be put under the control of the Treasury Department.

(7) Remaining life of the current accounting equipment is some two or three years.

9-3-2 Points of Consideration for Implementation of an EDP System

(1) Selection of Hardware

There are many types of and large volumes of vouchers (input information), data (processing information) and reports (output) in the Bank of Tonga, and their processing is complicated. Thus, at least two mini-computers including a backup unit will be necessary, and the following should be considered carefully:

a) The computer should have a variety of auxiliary equipment, much of which can be connected directly to the computer.

b) The computer should have many function extensions and be operational for at least five years (with memory supplementation and auxiliary storage).

c) The computer should have excellent on-line functions.

d) If possible, the computer should be so constructed that maintenance is simple.

These points suggest selection of a machine from a reputable maker. The hardware must be selected with prudence.

(2) Implementation of Software

There are two methods of implementing software: use of existing packages or development of software by the user itself. However, the former is more suitable for the Bank because of the following:

a) The remaining life of the accounting machines is short (two or three years); thus rapid development of software is necessary.

b) Reliability of the software has already been established.

c) The cost is low.

Because the organization and procedures of the Bank (under the control of the Westpac Banking Group) are the same as in the United States and Australia, these packages will be applicable to the Bank's operations with few alterations. However, it may be prudent to schedule approximately six months for modifications. There seem to be no problems concerning the data quality and codes.

9-3-3 Staff Training and Organizational Response

The maintenance of hardware should be left to the maker; thus, staff training for this purpose will be unnecessary. Concerning software training, several front-line operators must be trained as soon as possible. Because the Bank will implement the EDP system by itself, the training of system engineers should be undertaken with great care; they must be educated in the knowledge and technology of software for one year or longer in countries like Japan and Australia, and should then be charged with the maintenance of the actual system of the Bank. As users, their participation in designing the EDP system at the beginning of development will result in the development of superior systems.

A section promoting development of the EDP system may be required to be added to the Bank's present organizational structure. For the time being, there is no need to separate this section into operation and maintenance sub-sections, but several personnel should be deployed to provide technical (maintenance) support for the Bank's computer. Initially, the staff will be working at only the main office, but as the EDP system expands, staff members should be dispatched as needed to branch offices and agencies.

(1)

Organization	Sc	Current Staff	
1. Statistics Department	Natio - Tr - Co - Ba - Na	Regular Staff	26
2. Treasury Department	Budge	Total Staff EDP Section	50 4
3. Tonga Development Bank	Loan - Lo - Lo - Di - Re	Total Staff Loan Section	62 18
4. Government Store	Stock - Ca - Re - Ac - Re		
5. Commodities Board	Growe Stock Sales Accou Costi	Total Employees Construction Division	860 400
6. Electric Power Board	Stock	Staff Daily Paid Workers	36 120
7. Ministry of Police	Autom Drive Passp Immig	Traffic Department Visa Management Passport Issue	9 3 6
8. Tonga Cooperative Federation	Sales	Wholesales Accounting	15 5
9. Bank of Tonga	Gene	Total Staff	120

Existing Circumstances and Future Plans for Computerization in the Organizations (1)

Organization	Scope of the EDP Study	Kinds of Data, Number of Transaction	Current Staff
1. Statistics Department	National Statistics - Trade Statistics - Consumer Price Index - Balance of Payment - National Account Statistics	Trade Statistics Import 1,000/month Export 200/month	Regular Staff 26
2. Treasury Department	Budget Control	Expenditure Accounts 2,600 Development Accounts 375 Revenue Accounts 125 Underline Accounts 265 Expenditure Vouchers 80-200 day	Total Staff 50 EDP Section 4
3. Tonga Development Bank	Loan Management - Loan Application - Loan Approval - Disbursement - Repayment	Loan Approved 3,422/year Loan Application plus 20% Loan Disbursement 9,127/year Repayment 32,887/year Arrears Cards 4,000	Total Staff 62 Loan Section 18
4. Government Store	Stock Control - Catalogue of the Stock Items - Receipt and Issue of Goods - Accounting - Reorder	Stock Items 13,000	
5. Commodities Board	Grower's Information Management Stock Control Sales Information Management Accounting and Payroll Costing for Construction Projects	Stock Items 3,000 Copra Purchase Dockets 40,000 Cash Receipt Dockets 11,000 Invoice 10,000	Total Employees 860 Construction Division 400
6. Electric Power Board	Stock Control	Stock Items 2,600 Orders 30/day	Staff 36 Daily Paid Workers 120
7. Ministry of Police	Automobile Registration Drivers License Registration Passport Issue Immigration Control	Automobiles Registered 3,086 Driver's Licenses Issued 4,526 Passports Issued 5,978 Immigration Cards 75,415/year	Traffic Department 9 Visa Management 3 Passport Issue 6
8. Tonga Cooperative Federation	Sales Information Management	Stock Items 400 Invoices 75/weekday 200/Saturday Costing Sheets 200/month 50 at peak	Wholesales 15 Accounting 5
9. Bank of Tonga	General Banking Work	Deposit Accounts 42,980 Current Deposit Accounts 2,862	Total Staff 120

Existing Circumstances and Future Plans for Computerization in the Organizations (2)

Organization	Bottlenecks in Current Job Flow	Data Processing Devices in Use	Attitude toward Computerization
1. Statistics Department	Lack of Staff due to Expansion of Statistical Jobs (Especially, Lack of Statistics Experts)	Calculators, etc.	Feels Necessity of Computerization Hopes to Use Computers Exclusively
2. Treasury Department	Delay in Calculation of Balance Incomplete Checking System for Excess Expenditure due to Manual Accounting Process and Delay of Data from Other Organizations	AEDs-100 x 2 sets (Multi-task Multi-terminal Type) Used for Journalizing, Aggregation and Payroll Processing	Feels Necessity to be Computerized Currently Developing its Own System with AEDs-100s
3. Tonga Development Bank	Overlapped Works between Interest Calculation and Interest Registration Frequent Updation of Loan Register Preservation of Records	NCR299 (Accounting Machine) x 1 set Used for Loan Ledger Cards	Feels Necessity to be Computerized Needs External Aids to be Computerized
4. Government Store	Delay in Approval Process by Other Departments Discrepancies between Actual Stock Value and that on Records	Calculators, etc.	Feels Necessity to be Computerized
5. Commodities Board	Lack of Overseas Commodities Market Information Time-consuming Reporting to Inland Revenue Department	NCR299s (Accounting Machine)	Expects Cost Reduction Effects After Computerization Needs External Aids to be Computerized
6. Electric Power Board	Nothing in Particular		Doesn't Feel Necessity to be Computerized Considering the Use of Computers for Planning of Development Projects of Power Supply Networks
7. Ministry of Police	Lack of Retrieval Capabilities for Automobile Owners Delay in Checking System of Driver's License Time-consuming Retrieval of Visitors Cards		Strongly Hopes to be Computerized Needs External Aids
8. Tonga Cooperative Federation	Excess of Throughputs at Peak Time	Calculators, etc.	Strongly Hopes to Use Micro-Computers Needs Technical Supports
9. Bank of Tonga	Obsolete Accounting Machines Time Consuming Preparation of Payroll for Staff and Calculation of Interest	NCR32s and NCR299s 9 sets	To be Computerized Is Inevitable Hopes to Realize it within a couple of years with its own Efforts

Existing Circumstances and Future Plans for Computerization in the Organizations (3)

Organization	Computerization Plan or Study	Adaptability to be Computerized	Scale and Type of Computer to be Installed
1. Statistics Department	Actively Sending its Personnel to EDP Related Seminars Abroad Already Sent 11 Persons out of Total 26 Staff	Having High Potential in its Personnel Abilities High Adaptability in Aggregation and Analysis of its Statistical Data	A High-Speed Small Computer for Statistical Aggregation and Analysis
2. Treasury Department	Installation of AEDs-100s Currently Developing its Own Programs	High Adaptability in Journalizing and Payroll Jobs	Expansion to Currently Installed AEDs-100s with Disks and other Peripherals
3. Tonga Development Bank	Only Getting Advice from ADB, etc.	High Adaptability in Accounting and Other Routine Work	Two Sets of Small Computers with Functions of Multi-tasks and Multi stations which Support 4 or More Stations at each
4. Government Store	Developed Catalogue List of Stock Items for the 1st Step to Computerization Hopes to Implement Computers in 2 years	High Adaptability in its Routine Work	Same as Above
5. Commodities Board	Nothing in Particular Compiled General Requirements for Computerization	High Adaptability in its Routine Work	Same as Above
6. Electric Power Board	Nothing in Particular		
7. Ministry of Police	Nothing in Particular	Not High but Enough Adaptability in Immigration Control with Load of Initial Data Input High Adaptability in Vehicle Registration	Single-task Type Microcomputers with Hard Disks of Large Capacity are currently Enough
8. Tonga Cooperative Federation	Nothing in Particular	Adaptability in its Routine Work	Single-task Type Microcomputers with Floppy Disk Drives are Currently Enough
9. Bank of Tonga	Following the Trends in Banking Systems in South Pacific Region	High Adaptability in its Routine Work	At Least Minicomputers with Peripheral Devices like Magnetic Tape Drives, Line Printers

Existing Circumstances and Future Plans for Computerization in the Organizations (4)

Organization	Suggestion to Computerization
1. Statistics Department	Can Develop its Own Systems, Provided with Implementation Aids (Hardware and Basic Soft)
2. Treasury Department	Should Concentrate on Currently Being Developed Systems with AEDs. Requires Some Technical Supports
3. Tonga Development Bank	Necessary to be Provided with Mentioned Hardware and Software Inevitable to be Supported with its Design and Program Development
4. Government Store	Necessary to be Provided with Mentioned Hardware and Software Enough to be Supported with its Program Development
5. Commodities Board	Necessary to be Provided with Mentioned Hardware and Software Inevitable to be Supported with its Design and Program Development
6. Electric Power Board	Currently not necessary to be Computerized
7. Ministry of Police	Necessary to be Provided with Microcomputers and its Technical Supports
8. Tonga Cooperative Federation	Necessary to be Provided with Microcomputers and its Technical Supports
9. Bank of Tonga	Leave this to the Bank's own Efforts

Chapter Ⅳ

Conclusion and Recommendations

Chapter IV Conclusion and Recommendations

The Kingdom of Tonga is striving for modernization of the country and, in such process, betterment of management is most important. For this reason, streamlined information management is indispensable. In the administration, timely publication of statistics is much desired. Take for instance, changes in external trade balance seem to have influence upon the government budget to a considerable extent. In the meantime, the government of this country runs stores to stock them with various commodities, its budget management must be based upon efficient data processing system that includes stock control in its ultimate form. Considering very high percentage ratio of overseas Tongans to the total population, importance of passport control is by no means negligible.

In the field of industrial activities, there are various government related organizations being engaged in commercial, financial, construction, public utility and other activities. In order to keep them active without running them into bureaucratic inefficiency, introduction of the management based upon modern data processing is undisputedly useful.

Advantage of computer over conventional accounting machine not the economy of labor but efficient storage, retrieval and use of information, which help decision makings in business management and administrations. More than two decades have passed since computers were introduced into governments and businesses in Japan. Much of experiences acquired in the process of computerization is recognized as the due necessities of management. Althoug the land of Tonga houses relatively small number of population, it is a nation that performs administrative as well as various industrial activities. It will be litte wonder that Tongan organizations involved in such activities introduced computers. However, following constraints and measures must be taken into consideration.

1. Constraints on the introduction of EDPS into the Kingdom of Tonga

In summary, we will make recommendations concerning the introduction of computers into the Kingdom of Tonga.

The government of Tonga is the largest organization in the country and contributes to employment considerably. However, most people are now engaged in routine office work which is less creative than such work as that related to planning, etc. If less creative work is carried out more efficiently by computers, more people could be engaged in productive work and positive results from computerization could be expected.

As for the effects of introduction, they should be discussed case by case; general discussion will be of little use. This chapter, therefore, focuses on relatively technological aspects concerning how computer should be introduced. At first, particular characteristics

of the Kingdom of Tonga must be understood and proper measures should be taken accordingly.

(1) **Smallness**

Basic public services must be provided, however small the scale of the country may be. Therefore, number of administrative organizations are responsible for different services dealing with relatively small volume of work. Under such situation introduction of EDP would better start with distributed use of small computers, despite a centralized use of sophisticated machine may have advantage in maintenance, procurement of parts and economy of human resource.

(2) **Remoteness**

The fact that Tonga deeply depends upon imports from abroad, in terms of computer resources, shows that a decision on a system for uninterrupted supply is very important. In particular, it takes from a few weeks to a few months for supply of goods connected with hardware; the ensuring of backup support will be essential. Smooth operation demands holding of spare parts and imposes higher cost on Tongan users than those in countries with easy access to suppliers.

(3) **Lack of Computer Personnel**

This problem is much critical for Tonga, which has not introduced many computers so far. That is to say, Tonga must inevitably lay emphasis on Technical assistance from industrials countries.

(4) **Unstable Electric Power Supply**

Indeed, electric consumption has decreased because of the introduction of a LSI, but middle or large size computers still consume a large amount of electric power. In proportion to the amount, the backup power sources become larger and the location of computer rooms in a proper enviroment costs a considerable amount. Taking the above restrictions into consideration, the following method is the most realistic for the effective introduction of computers into Tonga.

a) The standardization of hardware and basic software should be introduced.
b) The installment and the operation of a maintenance and training center by the government is necessary.
c) The introduction of small size computers.

2. Measures to be Taken

(1) The Standardization of Hardware and Software

Standardization of hardware should be one of the most important measure to be taken. It is necessary that the manufacturers be able to adopt an uninterrupted hardware supply system and that the product has already been in use to some extent. It is also necessary that the hardware can be disassembled simply. This is because there are no available technologists to maintain microboards and internal instruments.

The standards for basic software must be considered next; however, the standards, depending also upon the system scale, cannot be definitely fixed. Therefore, according to size, an operating system must be chosen.

The basic software consists of an operating system (OS), language processor, and end-user tool (simplified language, data base management system, and so on). Among these, the OS is thought to play a leading role from the viewpoint of the effective use of computers.

The OS which the team recommends are as follows:

OS for Multi-User/Muti-Task	OS for Single User/Single Task
UNIX and UNIX-ALIKE MP / M (OS / 9)	MS-DOS (PC-DOS) CP / M

The OS of medium and small size computers seem to be tending toward the development of UNIX and its highly achieved OS. Accordingly, the standard is so that UNIX should be chosen on a priority basis.

It is desirable that the selection of the basic software is made as strictly as possible. The data base management system (DBMS) and the language processors of various kinds are applicable in this case. The operation and the management of the data base system with DBMS requires, considerable skill and maintaining various DBMS according location is unfavorable for the effective use of personnel. Concerning language processors, COBOL should be the standard language because it is the most suitable for business data processing. Therefore, the other language processors will be used only in special occasions. BASIC is an exception, because the introduction of COBOL is impossible for such small size systems as 8-bit microcomputers. More and more computers have been provided with 16-bit capacity, because any system of considerable operation quality requires an architecture of 16-bit capacity or higher.

(2) The Creation and the Operation of the Maintenance and Training Center by the Government

The maintenance of hardware and software and the training given to the personnel in each organization using computers will both be very effective in such a small country. In a remote country like Tonga, communication of technological information often stagnates, and the technology having been obtained with great effort often becomes old-fashioned without having been used effectively. Such a problem can be solved to some extent by the installment of an organization controlling technology from abroad. The personnel in the organizations using the technology must, within a fixed period, have practical training in basic knowledge and the applied technology with computers. The technology being obtained by the personnel will be used to operate the computers in their organizations. Troubles occurring during operation, as well as other information, will be reported periodically to the maintenance and training center. The center will classify and arrange this information, which will be used to advise organizations having similar troubles and improve training given to people in the next term.

In the center, service and instruction with regard to the maintenance of hardware as well as software will be given. This will be effective when personnel on-site perform such operations as changes of configuration. The maintenance center, keeping in stock parts used in each organization, will have overseas ordering functions and supply functions. Also, selection of computer hardware in Tonga, leading to interchangeability of the training machines in the center with the machines in each organization, will be helpful when the machines break down. In this way, the computer introduction service of the center to organizations introducing machines for the first time, will be considerably smooth.

For the time being, the employment of foreign staff is essential in the operations of the center. Further, several competent Tongans, who will take a leading part in operating the center, should be employed as assistants so that the center can be profitable for Tongans.

The maintenance and training center consists of stock storerooms, operating rooms, technical training staff waiting rooms, and lecture rooms. More than one kind of small size computer will be installed in the lecture rooms. The center will be equipped with books concerning computers (manuals, etc.), which will be able to be lent out to each organization. It is true that establishment of the center will cost considerably. However, in considering that there might not be a center, the expenditure can be considered worthwhile.

(3) The Distributed Introduction of Small Size Computers

Tonga should introduce small or medium size computers. So far as there are no special changes in the future, the introduction should be done continuously. Future trends in technological development show clearly that the integration to a high degree will make

computers more compact and inexpensive, and it is expected that the computers will be more functional in the future without an increase in its physical size. Therefore, in a country like Tonga, where computerization will be carried out from now, the machines of the same size as present microcomputer will be able to perform information management for the whole country. In other words, the country should not invest in large scale hardware equipment (which will shortly be out-of-date); fully equipped computer rooms are not necessary. Instead, small size computer systems, which will be helpful in instructing Tongans, should be introduced.

These small size computers would have to be distributed to the organizations introducing computers for the first time. This is because business management forms vary in quality and are small in quantity, as mentioned before, and also because the present small size computers are not functional enough to allow that unfixed and numerous users can utilize them commonly. Computerization in developed countries progressed in such a way as the unfixed and numerous users utilized the large size general purpose computers alternately according to time tables. However, a small country such as Tonga needs not follow such process. That is to say, the idea was that hardware was shared and software was used individually is changing to the idea that hardware is used individually and software is shared.

3. Future Conceptions of the Diffusion of EDP in the Organizations under Study

Based on the above lines of work and analysis, the program for the introduction of computers into the nine organizations under study and the maintenance and training center is explained below.

The future conception of the diffusion of EDP in the organizations under study is shown, as a whole, in Fig. IV-3-1. Also, Table IV-3-1 indicates the number of computers to be introduced into the organizations for a five years period. Of the total 29 computers, there are 27 microcomputers and 2 minicomputers in the Bank of Tonga.

(1) The First Year

In the first year of the 5-year plan, the immigration control system by the Ministry of Police and the loan management system by the Tonga Development Bank, which have been both selected as objects of the case studies, are to be developed, as well as the budget control and the payroll system for the Treasury Department. Furthermore, in this year, preparation for the operation of the training center is to be made by the government.

1) Treasury Department

In this department, the budget control system and the payroll system are being

developed with computers supported by the Australian Government. These systems, being reinforced with auxiliary equipment if necessary, must be developed continuously until completion. However, a transfer or loss of personnel who have been engaged in development is conceivable. Therefore, the organization for system planning and the system control business should be reinforced and stabilized.

2) **Ministry of Police**

The ministry is to introduce an immigration control system. For the development and the operation of the system, it is necessary that foreign technical staff stay for a fixed period of time.

Also, considering the characteristics of the business, it is also necessary that Tongan personnel will have technical training abroad.

3) **Tonga Development Bank**

A loan management system is to be introduced. Instruction by foreign technical staff is necessary in Tonga.

4) **Maintenance and Training Center**

This year, preparation for the establishment of the center and the choice of personnel will be made. The organizations, to which the services are to be provided, will be studied, and the needs of maintenance and training will be made clear. For the time being, instruction by foreign technical staff will be necessary.

(2) The second year

In the second year, computers will be introduced into the Statistics Department, Government Store, Commodities Board and Cooperative Federation, and the business which is assigned to each organization will be computerized. Within this year, the maintenance and training center will begin operations. In the center, the training of personnel for the above organizations will be given, and maintenance services will be given for hardware already being installed.

1) **Statistics Department**

The information on import and export statistics will be input into small size computers. A simplified tabulation language and statistical analysis package will be input as software. In the case of the input of information, no other technical support than machine offer and relevant instructions will have to be given by foreign countries.

2) **Government Store**

The system of registering, referring to, and amending the stock control items will be introduced. Also, the possibility of utilizing the present software product will be studied for the payroll system to be introduced in the next year and the stock control system in the year after next.

3) **Commodities Board**

A system for gathering data concerning growers which sell the goods to Commodities

Board will be introduced. It is desirable that the systems have the multi-station and multi-task function, because the payroll system and the stock control system will be added to them in the future.

4) **Cooperation Federation**

A microcomputer will be installed in the sales control system of the shop. In introducing the system, instruction will be given by the maintenance and training center.

5) **Maintenance and Training Center**

This year, computer instruction service, hardware maintenance service, and other consulting service will begin to be provided. The contents of the instruction to be given are as follows: the operating methods of software, the simplification of maintenance, the outline of the operating system, the types and the functions of the software package, and the methods of programming in basic languages.

(3) After the Third Year

In the third year of the 5-year plan, the payroll system should be introduced into the Government Store and Commodities Board. Also, in the Ministry of Police, the computerization of vehicle registration, which is the second project for the ministry, will have to be performed. In computerization, a hardware which is different from that in immigration control will be introduced. The Tonga Development Bank will level-up the first system through the management of information gathering from the Bank of Tonga and other organizations. By this time, the Bank of Tonga will have started to introduce banking systems independently. After the fourth year, a system in the Treasury Department will have to be developed and a stock control system will be implemented in both Government Store and Commodities Board.

Fig. IV-3-1 Master Plan for The Computerization in Govermental Organization

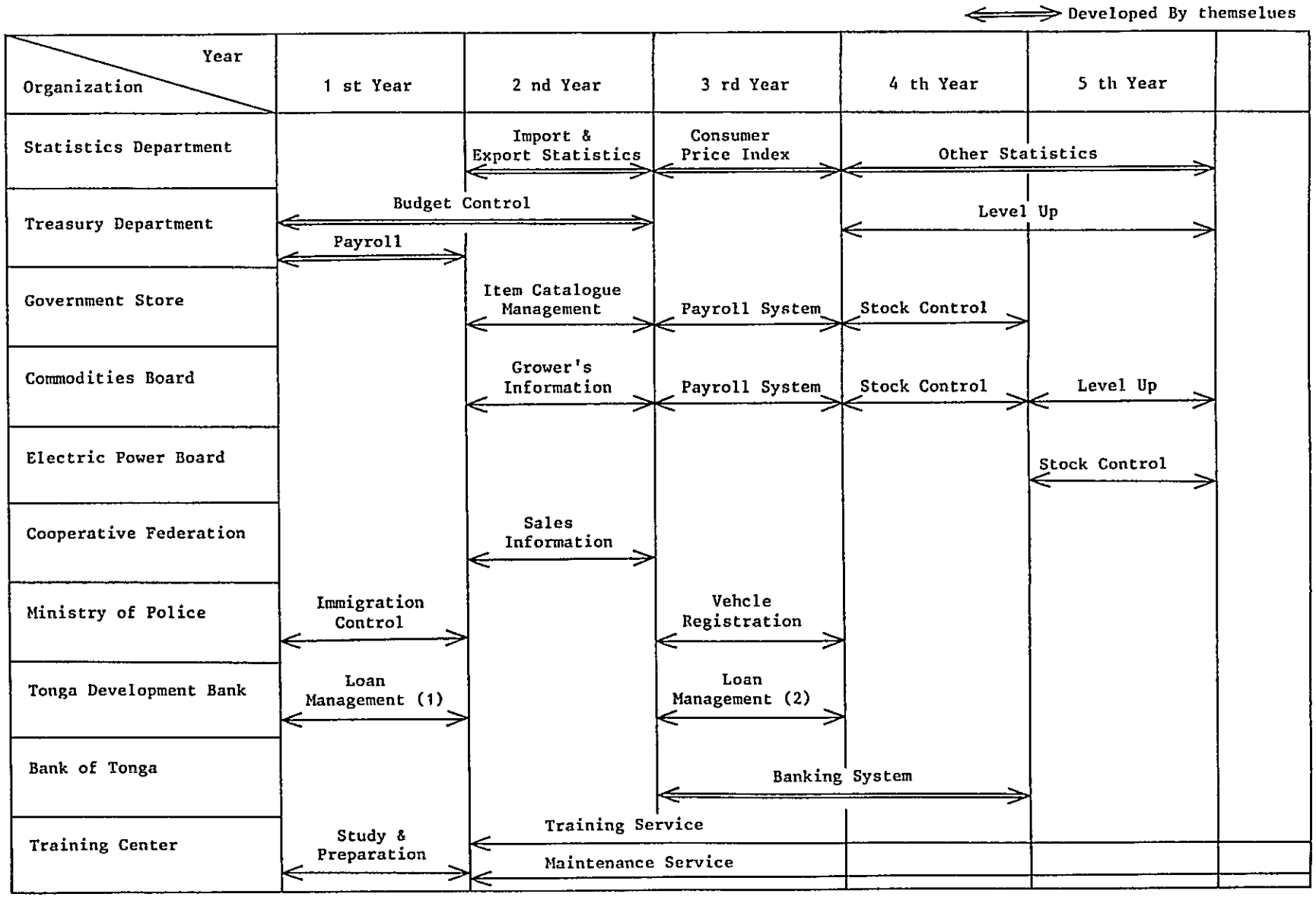


Table IV-3-1 Number of Installations by Year

Organization \ Year / Types of Computer	1		2		3		4		5		Total	
	Micro	Mini	Micro	Mini	Micro	Mini	Micro	Mini	Micro	Mini	Micro	Mini
Statistics Department			1		1						2	
Treasury Department	(2)*						2*				(4) 2	
Government Store			1*		1*						2	
Commodities Board			1*		1*				2*		4	
Electric Power Board									2		2	
Cooperative Federation			2								2	
Ministry of Police	3				2						5	
Tonga Development Bank	2*										2	
Bank of Tonga						2*						2
Training Center	1		1*		2		2*				6	
Annual Total	(8) 6		6		7	2	4		4		27	2

* Shows multi-station/Multi-Task Systems

Chapter V

Case Studies for Computerization

Chapter V Case Studies for Computerization

1. Ministry of Police – Immigration Control

1-1 Scope of Work for the Basic Plan of the System

Immigration control is taken up as a subject in the case studies because of the following reasons.

(1) The Tongan Government gives top priority to this matter.
(2) The Ministry of Police strongly desires computerization and will cooperate positively with the plan.
(3) The work is fairly standardized and easy to computerize.
(4) Because the work has no connection with other organizations, a system can be developed independently.
(5) Data are in such quantity that they are difficult to handle manually.

Work to be computerized is as follows:

(1) Immigration Control and Statistics
(2) Control of informations on passports, from registration to cancellation, together with statistics compilation.

Actual immigration checking is still done at airports and seaports. While most of the office work can be taken care of by a computer, passport photograph control, which is very important, must still be done manually.

1-2 Input Design

There are two types of data: immigration control data, and passport control data.

(1) Immigration Control

All data necessary for immigration control are covered in items on the immigration card (shown above in Fig. III-7-5). The input appears in a visual display and its format is shown in Fig. V-1-1. The following items should be coded.

a) Nationality
b) Race
c) Purpose of visit
d) Occupation
e) Country arrived from (by air or by sea)
f) Country departed to (by air or by sea)

For a) and b), new codes should be created. The codes make possible a maximum of 99 registration combinations, but a minimum of about 10 codes seem to be sufficient.

For c) and d), there is a maximum of nine codes for the present immigration cards. For e) and f), countries are coded with two Roman letters: e.g. Fiji – FJ, New Zealand – NZ, and Australia – AR.

(2) Passport Control

Data required for passport control are certain items in the identification card (shown above in Fig III-7-6); photographs and fingerprints are excluded. Because data is entered with a display and keyboard as in immigration control, the input format is as shown in Fig. V-1-2. The items 'Profession or Occupation' and 'For travel to' may be coded, because volume is small, but with a such a small volume of data at present, they are entered according to the identification card. A space, for items other than nationality distinction between Tongans and foreigners, is also specified. The nationality codes should be effectively shared with immigration control.

1-3 File Design

An immigration file and a passport file are necessary data files. Other files may be added if required. The data entered from the display are stored intact in the data files. Because computer processing efficiency is kept high with a record length of a multiple of 64, both record lengths are fixed at 256 bytes. The formats of each data file are shown in Fig. V-1-3 and V-1-4. The Filler is an unused space, which is kept for future expansion of the system. C (character) for the character attribute and N (numeric) for the numeric attribute are employed (Note 1).

If the N code is specified on an item, calculations using the item should be permitted. Integers are used for the numeric attributes.

1-4 Output Design

Various outputs can be considered according to purpose. Two types, output on paper (hard-copy) and on a display (soft-copy) can be performed. For the latter, the format has the same layout as the input image. Some samples of hard copy output are as follows:

a) Immigration lists
b) Daily departure lists
c) Passport holders lists
d) Passport validity period checklists

These are only examples; other lists may be added if necessary. Samples of a) and c), which are considered to be the most important, are shown in Figs. V-1-5 and V-1-6. Process charts shown later should be referred to.

Fig. V-1-1

IMMIGRATION REGISTRATION SCREEN

SCREEN LAYOUT

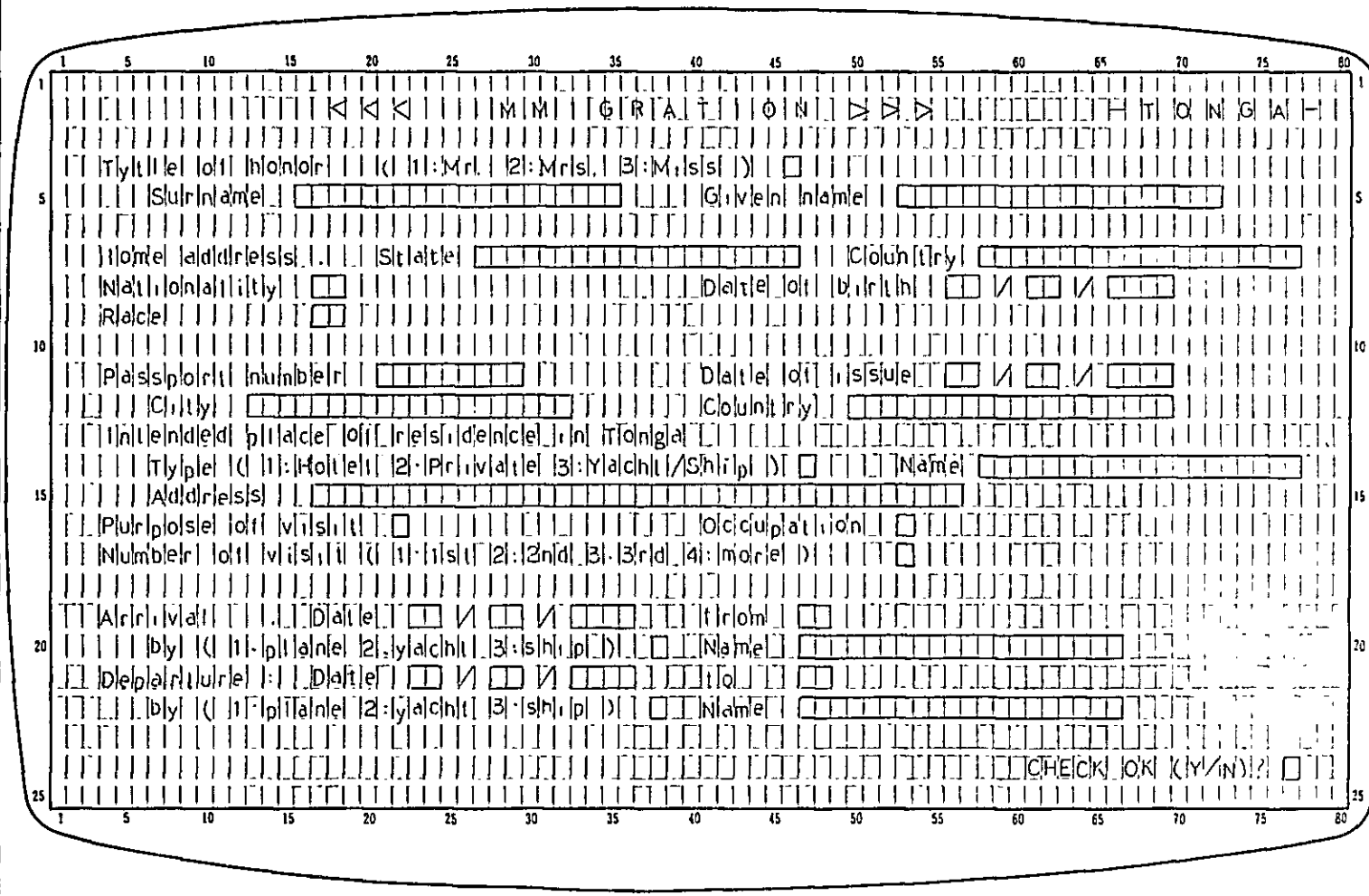


Fig.V-1-2

PASSPORT REGISTRATION SCREEN

SCREEN LAYOUT

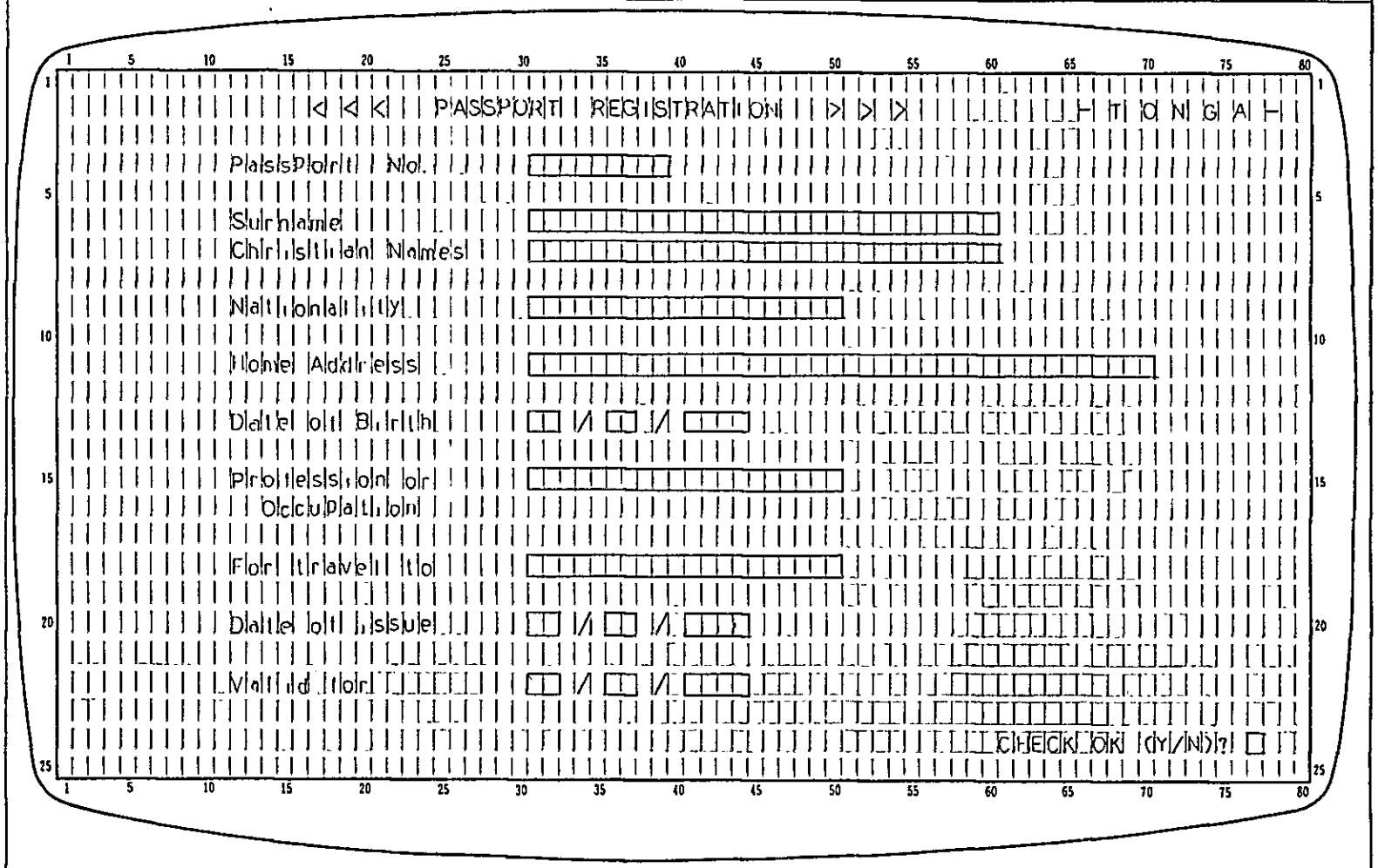


Fig. V-1-3

IMMIGRATION FILE

Block Record	Record 256 Character	Library Name		Date	Page

Word Character	NAME			HOME	Remarks
	TITLE	SURNAME	GIVEN NAME	STATE	
Type	N	C	C	C	
Length	1	20	20	20	

Word Character	ADDRESS	NATIONALITY	DATE OF BIRTH			RACE	PASSPORT			Remarks
	COUNTRY		DAY	MTH	YEAR		NUMBER	DATE OF ISSUE	CITY	
	C	N	N	N	N	N	C	N N N	C	
	20	2	2	2	4	2	9	2 2 4	20	

Word Character	PLACE OF			Remarks
	COUNTRY	TYPE	NAME	
	C	N	C	
	20	1	20	

Word Character	RESIDENCE	PURPOSE	OCCUPATION	VISIT NO.	ARRIVAL					Remarks
	ADDRESS				DATE	FROM	BY	NAME	DATE	
	C	N	N	N	N N N	C	N	C	N N	
	40	1	1	1	2 2 4	2	1	10	2 2	

Fig. V-1-3 (2)

Block | Record | Library Name | Date | Page

Record | Character

Word / Character | Remarks

DEPARTURE

	TO	BY	NAME
N	C	N	C
4	2	1	10

Fig. V-1-4 (1)

PASSPORT FILE

Block | Record | Record 256 Character | Library Name | | Date | Page

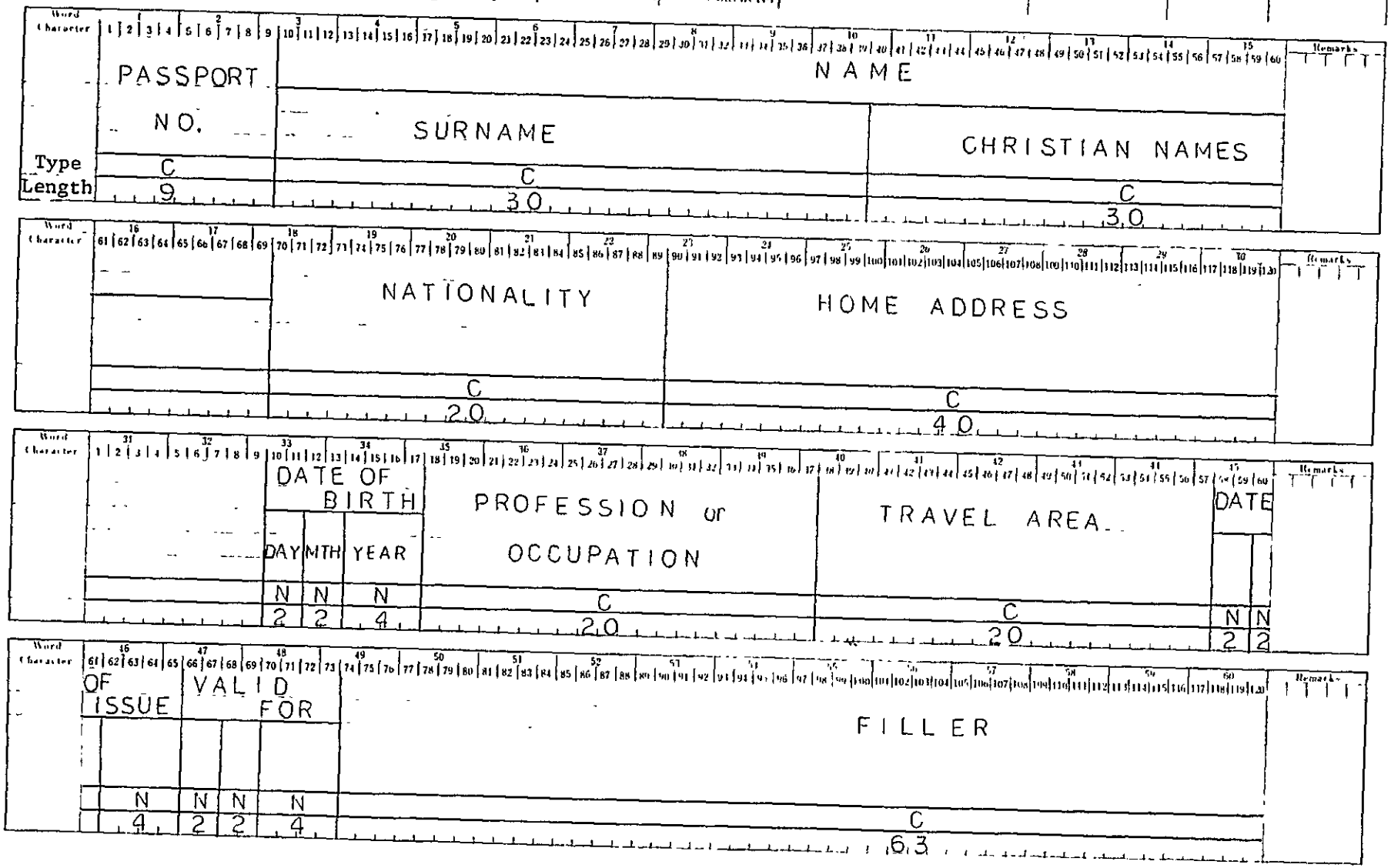


Fig. V-1-4 (2)

Block	Record	Library Name		Date	Page
Record	Character				

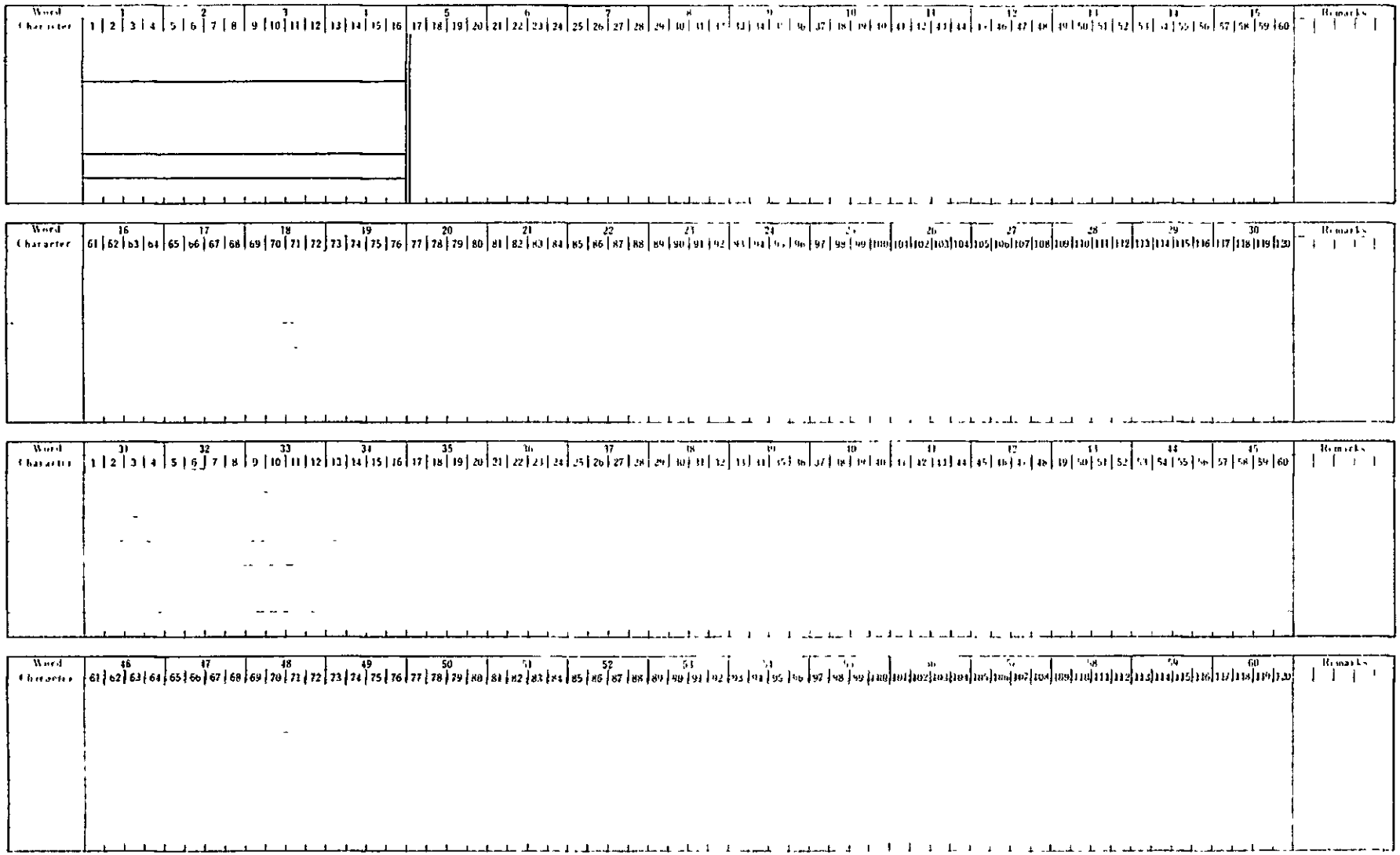


Fig. V-1-5

IMMIGRATION LIST

Line		Date	Page
66			

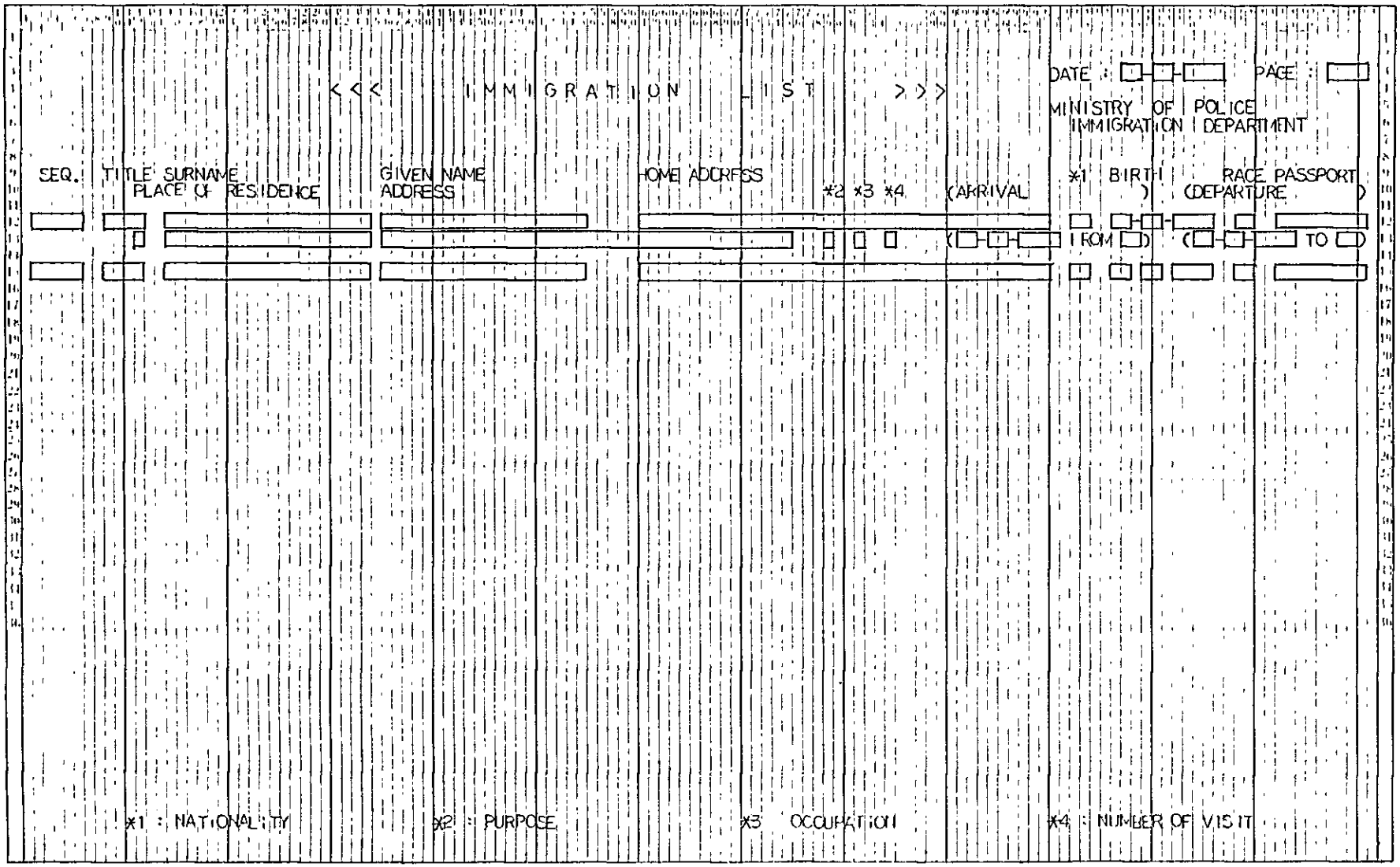
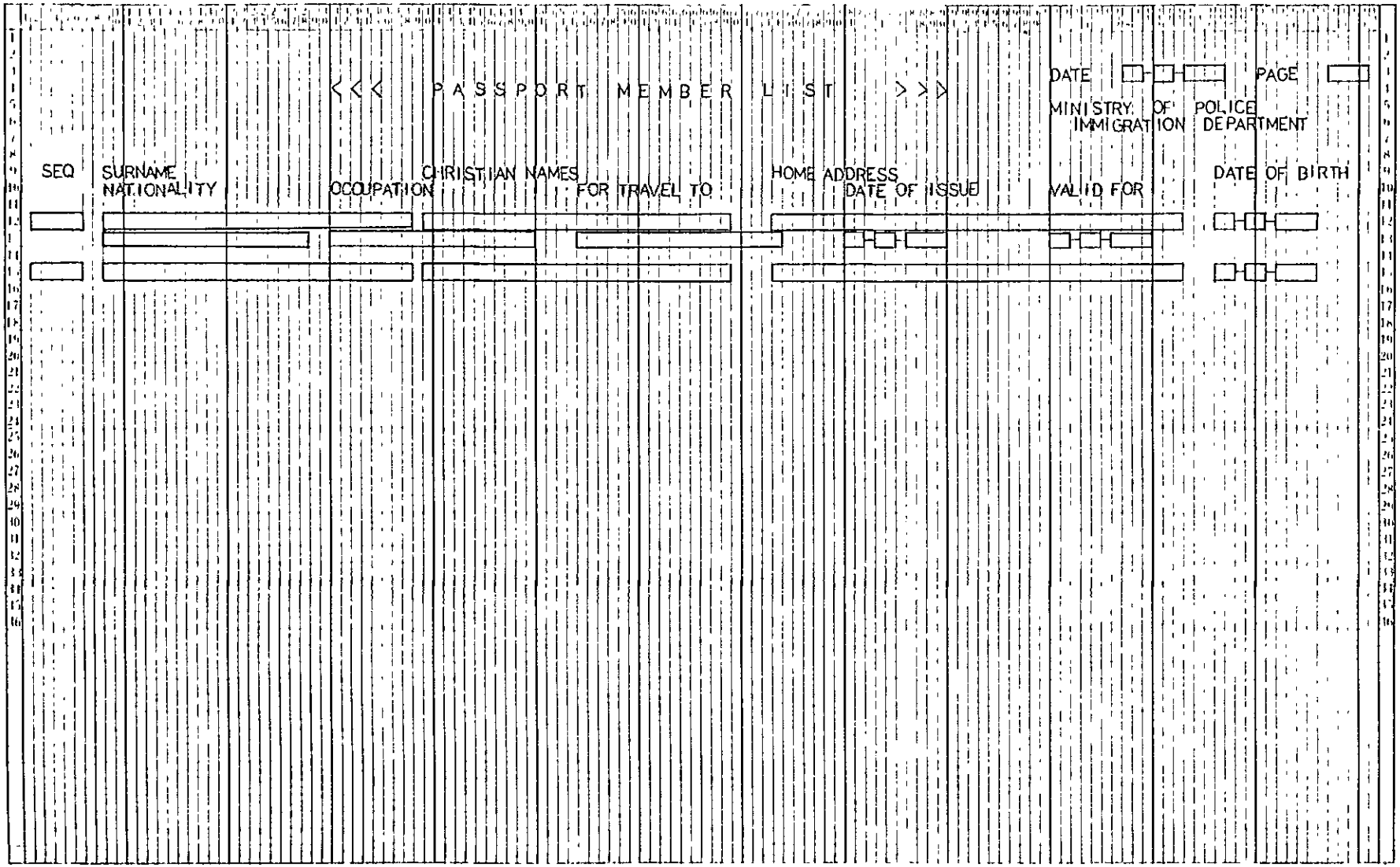


Fig. V-1-6

PASSPORT MEMBER LIST

Line		Date	Page
66			



(1) Fig. V-1-5

Two lines of the display screen are used for each traveler, with a sequential number at the beginning of each line. An additional one-line space is left between the numbered lines for details. Honorifics (Mr., Mrs., and Miss) should be indicated. Lengthy entries, such as nationality, are explained below as comments.

Note 1: Coding is the same as the item definition rule for dBase-II.

(2) Fig. V-1-6

Two lines are used for each passport holder, with a sequential number at the beginning of each line. An additional one-line space is left between the two numbered lines for details.

1-5 Process Design and Process Charts

(1) Immigration Control

The program for immigration control is as shown is Fig. V-1-7. Each processing function is performed as follows:

a) Menu

The menu is used for selection of each process mode after the program starts, and if necessary, for initializing the display and the printer.

b) Immigration Process Mode

The data are entered into the screen according to the information on immigration cards and registered in the immigration file. If any error is found in registration, it can be corrected instantly. Furthermore, a proof-list, bearing important items only, is output from the printer to certify registration.

c) Retrieval Process Mode

When an inquiry is received and a search made for a visitor whose period of stay has expired, this process mode is used. The immigration file can be retrieved through various key items such as name and arrival date, and the data output can be either soft or hard copy. It is also possible to give this process mode the function of data correction.

d) Departure Process Mode

This process mode is used when an individual has left the Kingdom of Tonga. A departure mark is put on specific records in the immigration file showing that a person has already left the country. Since this information is kept in the computer, the record of the visit to Tonga can be examined in the future. A simple

Fig. V-1-7 Program for Immigration Control

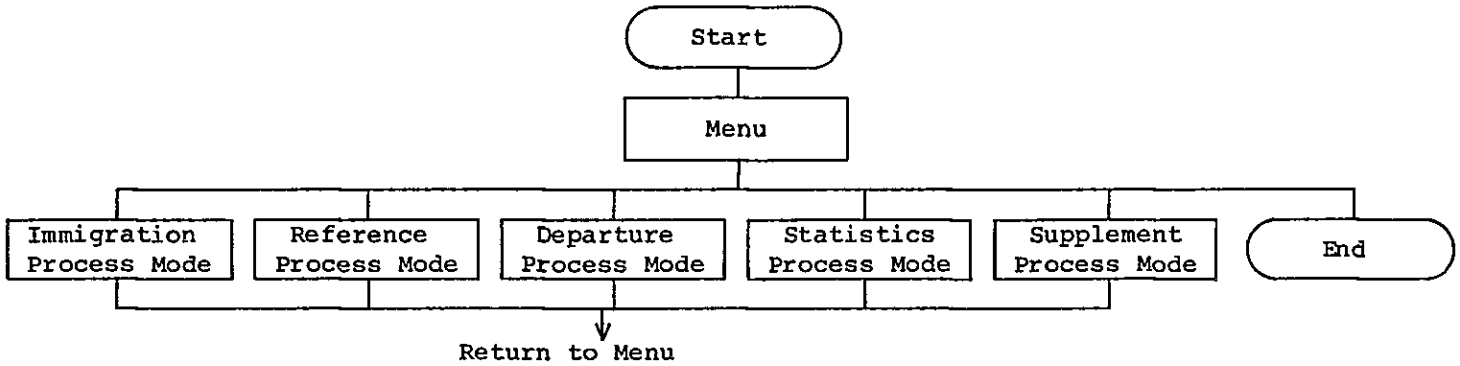
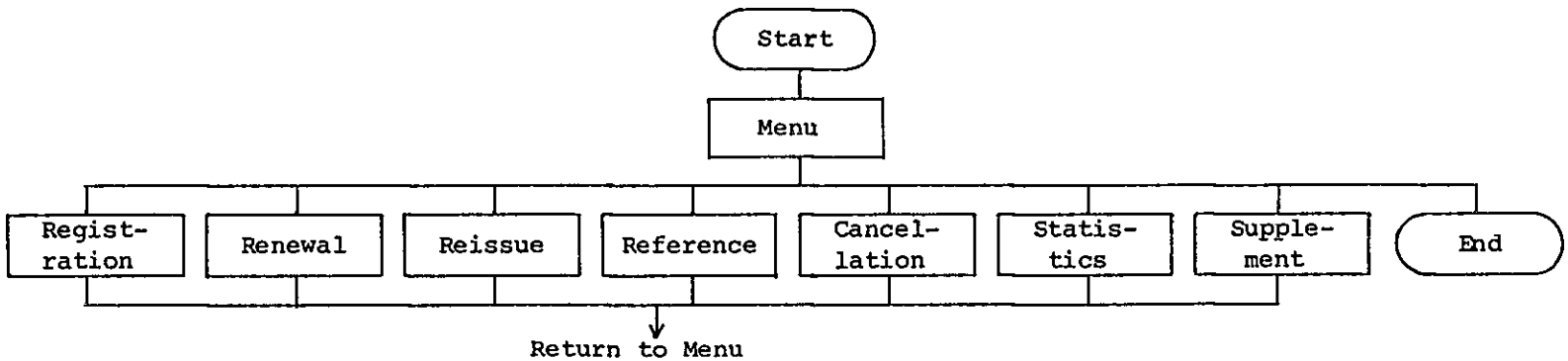


Fig. V-1-8 Program for Passport Control



proof-list is also printed out with the departure process mode.

e) Statistics Process Mode

This process mode is used for preparing management information such as annual reports. The output is mainly hard-copy.

f) Supplement Process Mode

This process mode has various functions required for carrying out work such as the maintenance of data files and updating of codes; it supplements the roles of the other process modes. The data file can be completely cleared by the program in this process mode, or can be copied onto other media for storage. The correspondence between the nationality and race codes can also be changed by this program.

(2) Passport Control

The program for passport control is as shown in the Fig. V-1-8. Each processing function is performed as follows:

a) Menu

The menu is used for initializing the display and the printer, and for selecting a process mode.

b) Registration

The data are entered through the display according to passport applications and registered in the passport file. In order to prevent double application, stored input concerning passports already issued will show up as an error.

c) Renewal

The renewal of passports is performed by this process mode; additionally, in this mode, the expiration date of passports can be extended.

d) Reissue

If a report of the loss of a passport is submitted, a check is made into whether there is a registration in the passport file or not, and if there is, an identification card is issued within the limits of the validity period.

e) Retrieval

When an inquiry is received about a passport or when a problem occurs, retrieval of information on the holder is performed from the passport file. The findings can be output by the display or the printer.

f) Cancel

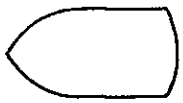
When this program is executed, the records of expired passports are marked in the file, but not deleted.

g) Statistics

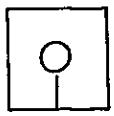
This process mode is used for preparing management information such as annual reports (mainly hard-copy).

h) Supplement

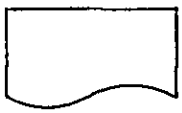
This process mode is used for the maintenance of data files and updating of codes.



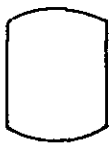
: Screen Symbol (command)



: Floppy Disk File Symbol



: Printed Sheet Symbol



: File on Hard Disk Symbol

: Processing Program Symbol

(3) Process Chart

The process chart of immigration control is shown in Fig. V-1-9 and that of passport control in Fig. V-1-10. The meanings of symbols used are as follows:

1-6 Hardware Configuration

(1) Computer Unit

Three sets of micro-computers, with a main memory of about 0.5 MB (megabyte) and an auxiliary memory of about 20 MB, are required (hereinafter to be called MICRO). Usually two sets are used in immigration control and the other in passport control. If a unit breaks down, each control system will use one unit a piece.

The configuration of one of these sets is shown in Fig. V-1-11.

Fig. V-1-9 Process Chart of Immigration Control

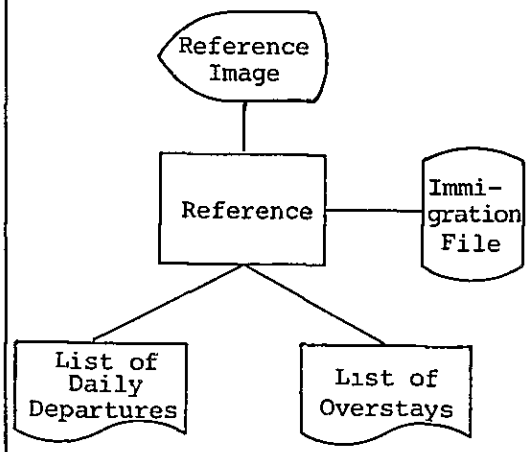
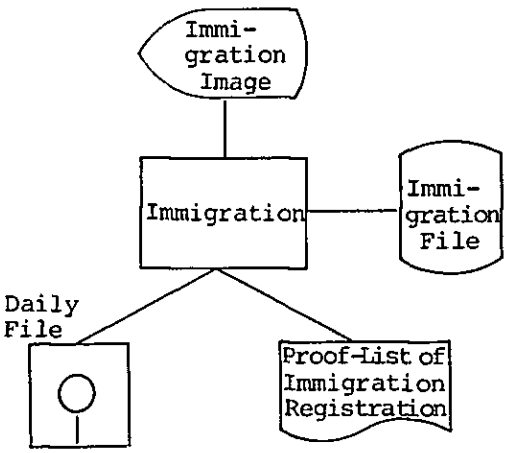
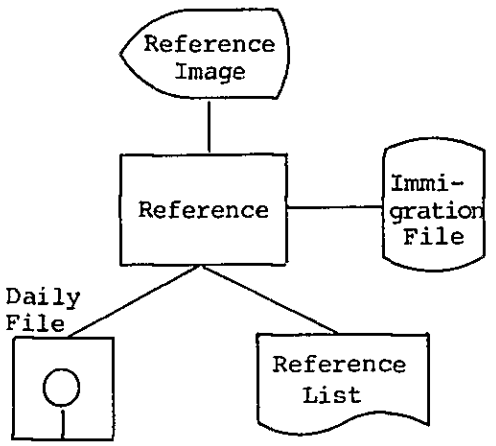
Time	Flow	Explanation
Every Morning	<Daily>	1. The list of daily departures is printed and prepared for the exit procedures (at the airport, etc.).
		2. A list is prepared of visitors whose period of stay has expired, and details are checked during the day.
Daytime		3. Registration data is entered into the immigration file according to immigration cards forwarded from the airport and other entry points. Details of those registered can be confirmed on a proof-list output by the computer. Because the data are entered also on floppy discs (FDD), preventive measures can be taken against future problems. The FDD is only used on a one day capacity basis.
		4. Retrieval is made upon inquiry. The results can be output on a reference list, if necessary. Data corrections (intended place of residence, departure date, etc.) can be made for visitors. Data corrections are also recorded in the daily file.

Fig. V-1-9 (cont'd.)

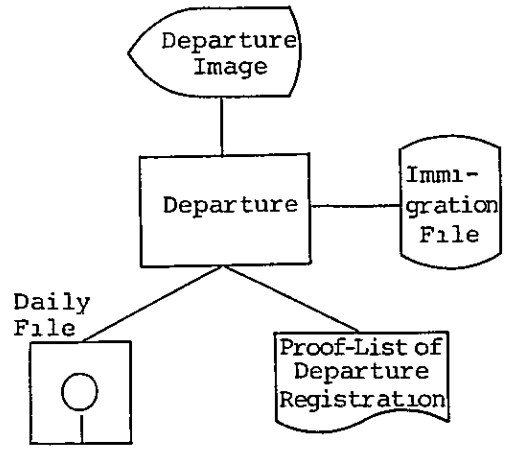
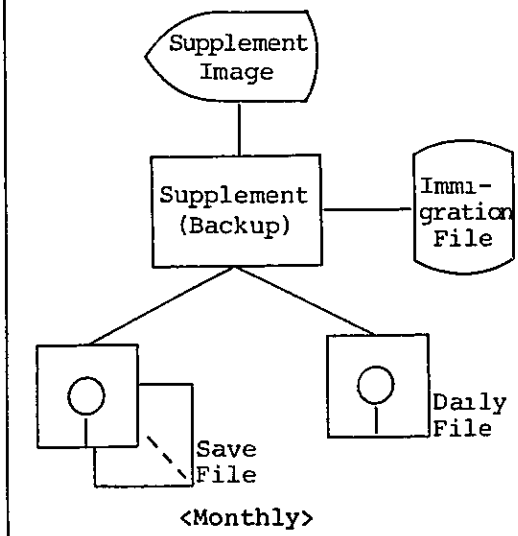
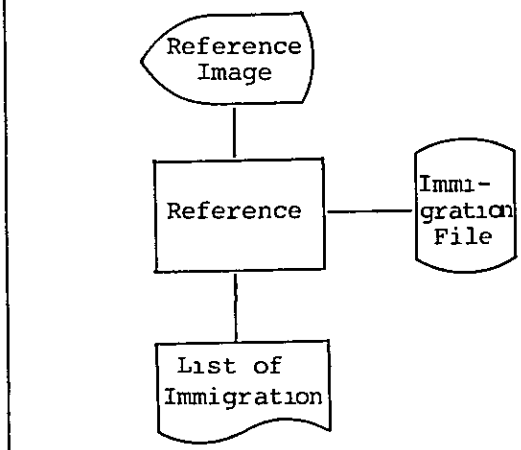
Time	Flow	Explanation
		5. Departure marks are entered in the specific records in the immigration file according to the list of departures which has been made in the morning and forwarded after checking. At the same time, a proof-list is printed out and data is recorded in the daily file on a floppy disk.
Evening	 <Monthly>	6. Using the backup function of the support screen, the immigration file is copied into the storage (SAVE) file (FDD). The daily file is then cleared.
End of Month		7. A list of all visitors staying in the Kingdom of Tonga as of the end of month is printed out.

Fig. V-1-9 (cont'd.)

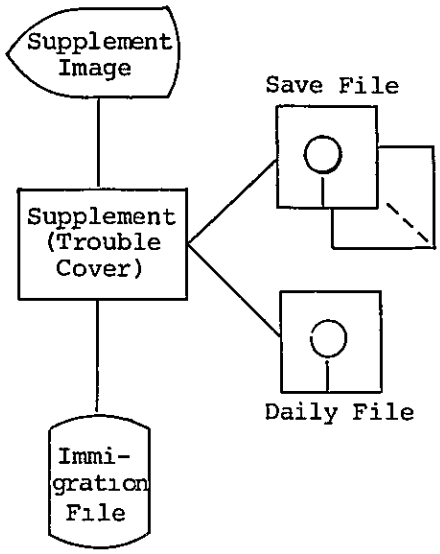
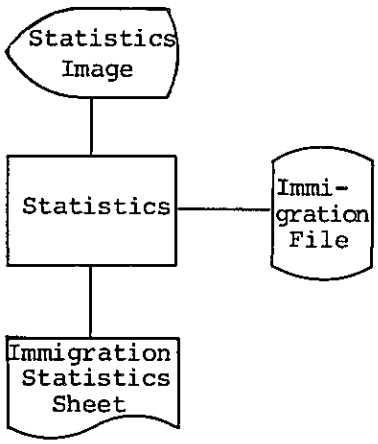
Time	Flow	Explanation
Anytime	<Unit Trouble>  	8. This process is used for data recovery of the immigration file when data destruction occurs. Data current to the previous day are first copied from the save file, and then the present day's data are input into the file from the daily file.
End of Term	<Annually>  	9. Materials for annual reports are printed out annually.

Fig. V-1-9 (cont'd.)

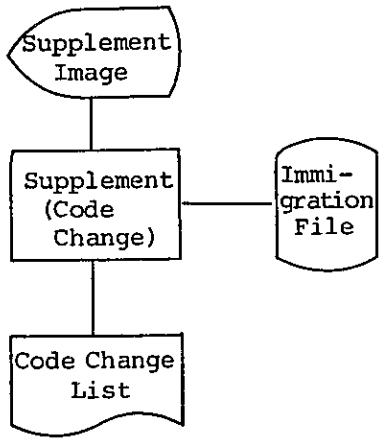
Time	Flow	Explanation
Anytime	<Occasional>  	10. This process is used for the updating of various codes, such as those for occupation and nationality. Codes registered in the immigration file are also automatically updated.

Fig. V-1-10 Process Chart of Passport Control

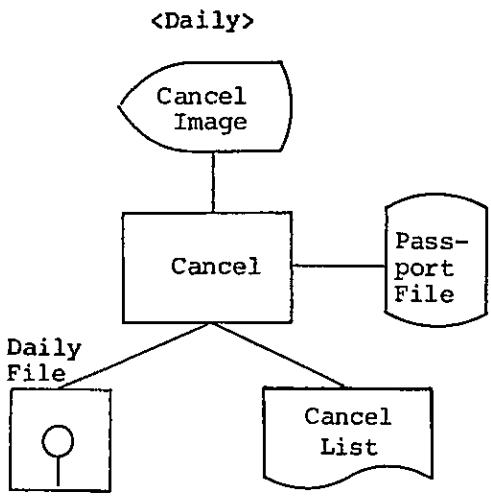
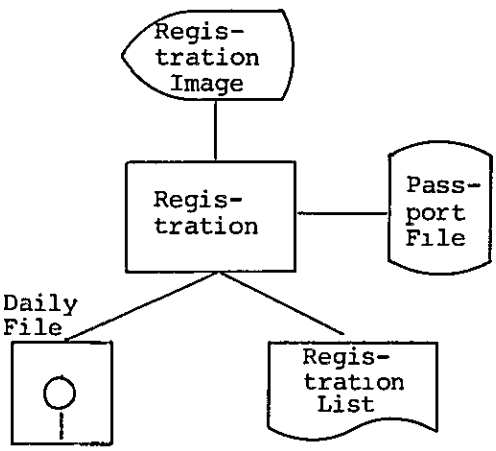
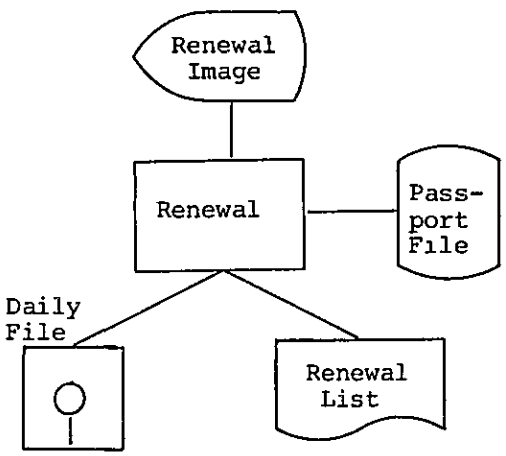
Time	Flow	Explanation
Every Morning		1. A cancel order is entered in specific records on the passport file according to data on passports which expired on the previous day. At the same time, a cancel list is printed out and the daily file is updated.
Daytime		2. Registration records are entered in the passport file according to passport applications. A registration list is printed out and the daily file is updated.
		3. The expiration date of a passport is automatically extended for passport holders who took the proper steps for passport renewal. A renewal list is printed out and the daily file is updated. Data other than the expiration date can be revised by this program.

Fig. V-1-10 (cont'd.)

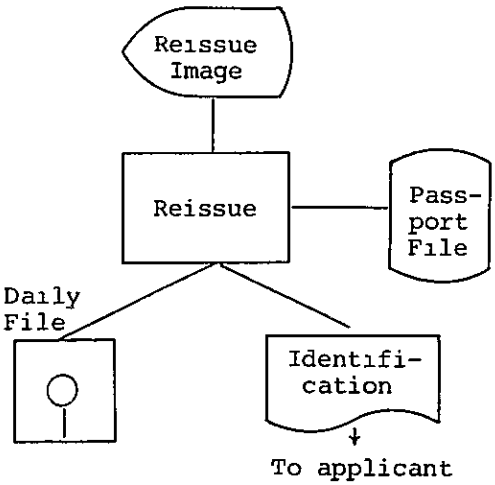
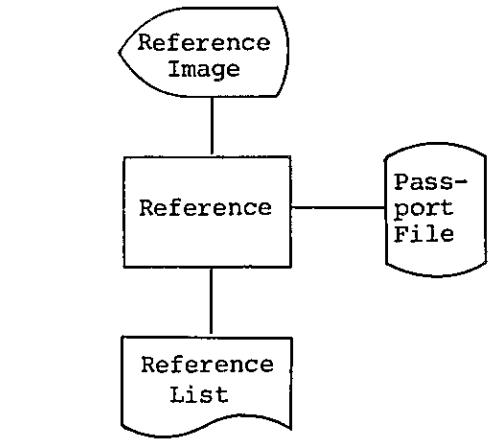
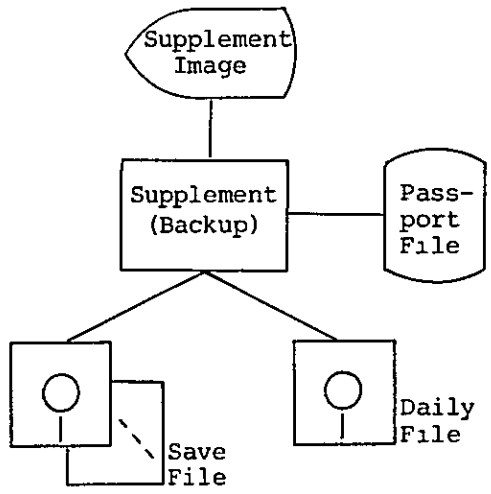
Time	Flow	Explanation
Evening		4. This process is used for reissuing a passport upon report of loss. Reference is made first to the passport file, and if the passport data has been registered in the file, identification cards will be output from the computer and issued. The same data are also recorded in the daily file.
		5. Inquiry can be made to the passport holder file. Data are output on the CRT diaplay or the printer.
		6. Using the backup function of the support program, the passport file is copied into a save file. At the same time, the daily file is cleared.

Fig. V-1-10 (cont'd.)

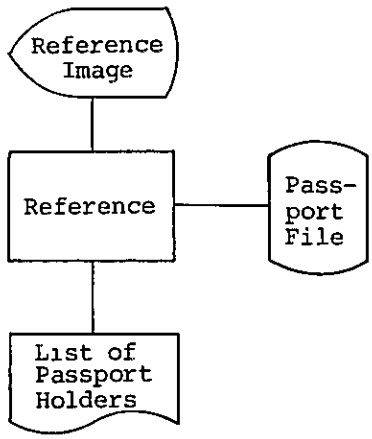
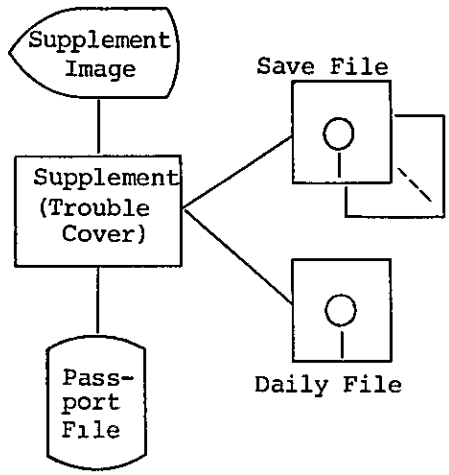
Time	Flow	Explanation
End of Month	<Monthly> 	7. A list of passport holders as of the end of month is printed out.
Anytime	<Unit Trouble> 	8. The passport file can be recovered when unit troubles and data destruction occur. First, all data are copied from the save file. Then the passport file is updated according to the day's data in the daily file.

Fig. V-1-10 (cont'd.)

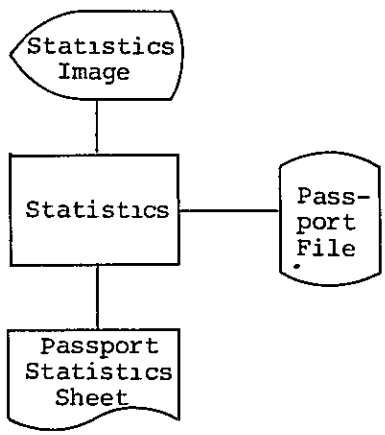
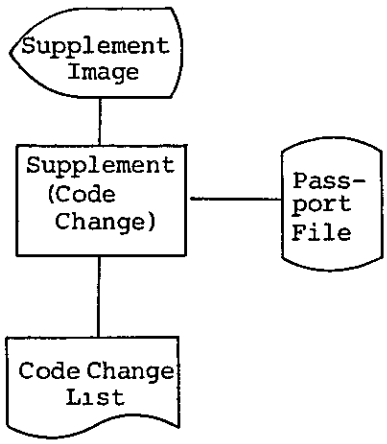
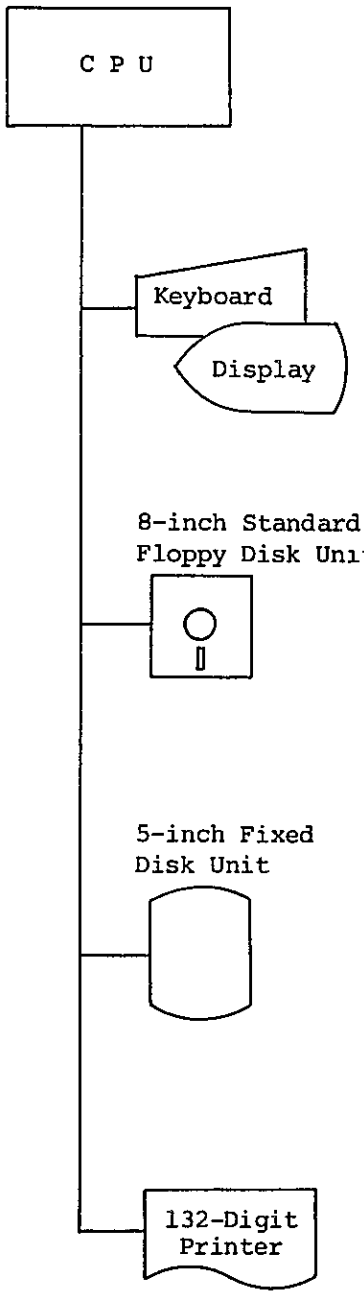
Time	Flow	Explanation
End of Term	<Annually>  <Occasional>	9. Materials for annual reports are printed out.
Anytime	 	10. This process is used for updating various codes. Codes registered in the pass-port file are also automatically updated.

Fig. V-1-11 Hardware Configuration



- The CPU is expected to be of 16-bit architecture and the memory should be expanded up to approximately 0.5MB.
- Keyboard: The board is based on ASCII arrangement.
- Display : 14-inch Color Display
- 1 MB x 2 Drive
- 10 MB x 2 set

(2) Location

All three sets should be located in the Immigration Department. However, in the future, one set will be installed in the airport and connected to the units in the Department by telephone line, using an acoustic coupler. This will make possible a rapid improvement in the efficiency of the system; checks can be made instantly at the airport.

It is unnecessary to prepare a special room for the computers; they can be located in an ordinary office room. However, a room subject to sea breezes should be avoided.

(3) Physical Environment for Equipment

In the Kingdom of Tonga, which has unstable power resources, it is advisable to have either stand-by generators, or, batteries. These units should be located in a room with air-conditioning. However, air-conditioning which is used exclusively for the units is unnecessary. Continuous use of the computers throughout the day should be avoided; it is necessary to shut down the power supply occasionally.

(4) Auxiliary Equipment

The following three pieces of equipment should be installed in the future.

1) Special Desk and Stack File

With a special desk, the area occupied by the computer is reduced and unit troubles are also reduced in frequency due to the level surface provided. The stack file is very convenient for materials arrangement following computerization.

2) Accoustic Coupler or MODEM

One of these two pieces of equipment is necessary for online connection through telephone lines in the future.

3) Soundproofing Equipment

Because the printer is particularly noisy, this equipment should be installed according to the surrounding circumstances. If the printer is to be used in an area with many people, the installation of this equipment is strongly advised.

1-7 Software Composition

(1) Basic Software

An operating system (OS) such as CP/M-86 or MS-DOS should be adopted as basic software. The reasons for this are as follows:

a) There are many software packages which can be implemented under these operating systems.

b) The data and programs have compatibility.

c) Various tools, such as an editor and a debugger, are already prepared for system

development.

d) Other organizations, such as the Treasury Department, have already adopted a similar OS, and therefore, data exchange will be easy in the future.

(2) **Application Software**

The following three systems are applicable softwares.

a) Database Language (Example: dBASE-II)

If mainly used for the management of stored data and information verification for the Immigration Department system, Database language will be the most effective. However, care should be taken to check the maximum number of records to be stored and the possibility of rearrangement for input and output formats.

b) BASIC (Example: MS-BASIC)

This refers to BASIC (compiler or interpreter) used under the OS. If the Database language mentioned above cannot be used, a high level language should be adopted; BASIC is the most popular such language. It will receive manufacturer backup support, and furthermore, has many instructions and functions which can fully utilize the capacity of the hardware.

c) English Word Processor Software (Example: Word Star)

Needless to say, this software makes it possible to use a personal computer as a word processor, which is one of the secondary functions of the system. This software is also effective for use in the emergency backup unit.

1-8 Implementation Plan

The implementation plan of the system is shown in Fig. V-1-12. Aiming at rapid implementation in a short period of time, the program development will be started in the latter stages of the system design. The system design is to be done mainly by technical experts from foreign countries.

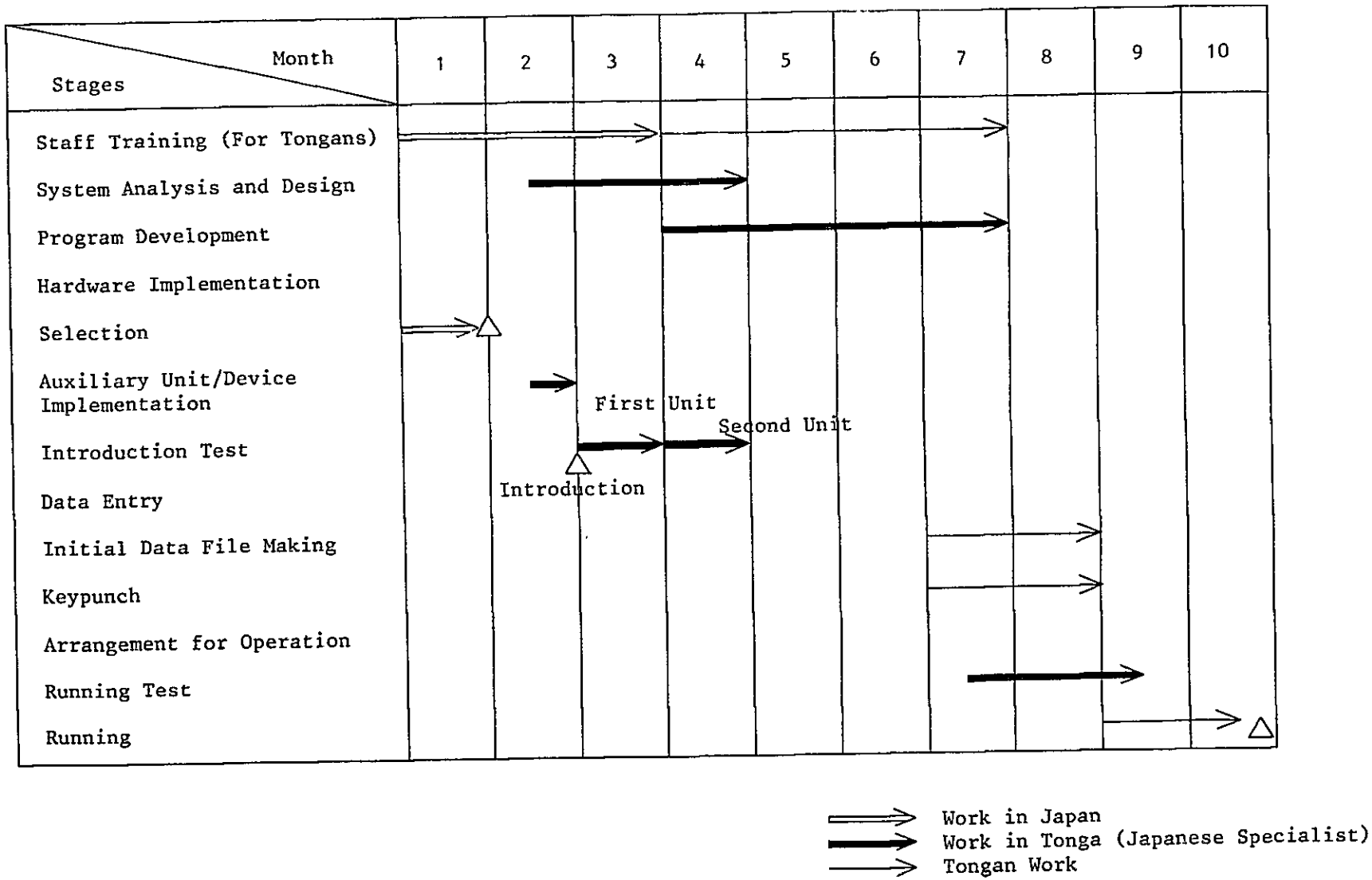
1-9 Staff Line-up and Training Plan

The staff line-up and training plan are shown below. Training is carried out only for Tongans. The figure in the "month" column shows the number of months from the start of the implementation plan.

(1) **Manager and System Analyst**

A technical expert from a foreign country will take charge of both posts.

Fig. V-1-12 Development Schedule of the Immigration Control System in the Ministry of Police



(2) Systems Engineer

The systems engineer will assist the manager and systems analyst; a Tongan should be assigned to this post. He will be trained in computers in a foreign country for the first three months and by OJT during the next four months. After regular operations begin, the person will be in charge of unit maintenance at the Immigration Department.

(3) Programmer

A technical expert of a foreign country will be assigned to this post.

(4) Keypuncher and Operator

Two or three Tongans will be assigned to these posts. Before they make input of initial data, they will take staff training and OJT for two months after the seventh month in the implementation plan. After the regular operations begin, they will undertake computer operations in the Data Processing Section.

1-10 Cost Estimation

(1) Hardware Costs

The estimates of hardware costs are shown in Table V-1-1. No auxiliary equipment shown in Fig. I-4-4 is included in this estimation. The average purchase prices in Japan are reflected.

Table V-1-1 Hardware Cost Estimates

Part Name	Quantity	Amount ¥1,000	Amount US$	Remarks
CPU	3 sets	660	2,857	Keyboard included
CRT display	"	360	1,558	14-inch color
Floppy disk unit	"	1,050	4,545	8-inch 1MB (interface included)
Fixed disk unit	"	2,700	11,688	20 MB (")
Line printer	3	900	3,896	132 column
Switching unit	2	400	1,732	1 backup
Delivery & insurance		300	1,299	
Total		6,370	27,576	

(2) Software Costs

The estimates of software costs are shown in Table V-1-2. The softwares herein are limited to those introduced from outside, and exclude independently developed systems.

Table V-1-2 Software Cost Estimated

Software Name	Amount		Remarks
	¥1,000	US$	
Operating system	25	108	CP/M-86 or MS-DOS
Data base language	240	1,039	dBASE-II
BASIC	140	606	
English word processing software	125	541	Word Star
Total	530	2,294	

(3) Costs for Training and Software Development

In these costs are included those for three months training of a Tongan in a foreign country and for on-site software development and OJT by a specialist from a foreign country. Traveling expenses and hotel bills are not included, but all expenses for training are included, at the rate of ¥1,500,000 monthly (the costs and miscellaneous expenses for training are included in the monthly amount). The total costs for training amount to ¥4,500,000. The dispatching cost for the specialist is estimated to be ¥2,500,000 (including hotel bills) monthly.

(4) Miscellaneous Costs

The costs for subprogram development and for equipment and office supplies needed for preparing an initial data file are shown in Table V-1-3. These outlays are required for operation after the regular operations commence. Since, in Tonga, it seems to be difficult to order equipment and office supplies, it is necessary to store as large a volume as possible to reduce reorder frequency.

Table V-1-3 Miscellaneous Cost Estimates

Equipment & Supply Name	Unit Price (¥)	Quantity	Amount	
			¥1,000	US$
Coding sheet	200	40 volumes	8	35
Form sheet	4,000	1 box	4	17
Floppy disk	15,000	10 boxes	150	649
Document file	1,000	5 sets	5	22
Floppy disk cabinet	42,000	1 set	42	182
Document cabinet	70,000	1 set	70	303
Ink ribbon	3,000	30 reels	90	390
Total			369	1,598

(5) Summary

Costs are summarized as follows:

Item	¥1,000	US$1,000
Hardware cost	6,370	27.6
Software cost	530	2.3
Costs for Training and software development	25,750	111.5
Others	369	1.6
Total	33,019	143.0

1-11 Recommendations for Implementation

(1) Labor-Saving in Large-Volume Registration Procedures

When a large ship arrives for a short stay, it is thought to be unnecessary to register detailed information for all persons on board. If there are more than a thousand people on board, the workload will be overwhelming. In such a case, a simple processing system is required. This means that only the captain and other important persons are to be registered; for others, a note reading "plus an additional 'X' persons arrived" is enough. This will have a great effect on reducing data volume.

(2) Opinions on Data Length

In the case study, all data lengths are set at 256 byte but can be made much longer. However, length should be determined in consideration of input load and actual limitations of the computer file. If the length of the data is desired be restricted, a method to delete unnecessary items or to increase the number of code items should be found.

(3) Reduction of Workload

Though only the immigration cards are preserved in the current immigration control system, the data input load of the cards will increase in the future. As the volume of the work is expected to become considerably large, a system to reduce the volume is desired. The best way to accomplish this is thought to be the adoption of a markcard reader. Recently, personal computers have come to be connectable to markcard readers. If most of the data are input with the markcard reader and only the parts which cannot be read by computer are revised manually, the volume of work will be greatly reduced. In considering this, attention should be paid to the following points:

1) Approximately three markcards are required to input one individual's data.
2) As the reader is a special device, confirmation should be made as to the possibility for hardware maintenance support.

The initial cost for the markcard reader is estimated to be about US$ one million (two sets).

(4) Storage of Data

Though this problem has not been taken up in the work flow, the capacity of the immigration and passport files will be depleted in time. Therefore, these files should be cleared yearly; this should be done after statistics materials have been made. When clearing, the data should be, of course, stored on floppy disks and printed out on ledgers or vouchers. Data stored this way may also be retrieved.

(5) Retrieval of Detailed Information

In passport control, detailed information is entered on passport applications and photographs of the applicants are attached. Information can be retrieved from the computer file by passport number; this means that a document file can be referred to at any time.

2. Tonga Development Bank – Loan Management

2-1 Policy for Basic System Design

For the basic design of the loan management system in the Tonga Development Bank, emphasis is being put especially on the following points.

1) **Smooth Transition from the Present Work System**

Although desk-top calculators are in use, most loan business is still performed by hand; thus, rapid computerization will possibly cause confusion among the bank clerks. For this reason, computerization in the Bank should be done gradually to give the staff sufficient time to be trained, and furthermore, be made with an eye to easier operation.

2) **Improvement of Accuracy**

The system functions are enhanced for reference tasks in order to discover, as efficiently as possible, various mistakes such as input errors. For this purpose, measures should be taken to make arrangement for conversational input check and error messages.

3) **Maintenance of Data**

Data losses should be minimized in the case of unforeseen events such as power failure For important files, two copies should be made and provided with appropriate audit trails.

4) **Size of the System**

In view of step-by-step computerization, the capacity of the main memory and on-line files and the number of connectable work stations should be larger than initial requirements.

2-2 Process Design and Process Chart

In this section, working processes designed for the computerization in the Bank, their descriptions, and their data flow, are outlined.

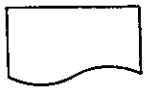
Loan management in the Bank consists of the following three main subsystems.

- Loan Application and Registration Subsystem
- Loan Accounting Subsystem
- Loan Statistics Subsystem (Management Information)

In the applications subsystem are included loan applications, refusals, approvals. In the accounting subsystem are included new or renewal account registrations, interest calculations, preparation of daily journals, ledger writing, arrears accounting, loan disbursement, loan repayment, refunding, preparation of monthly journals, and account closings. The statistics subsystem is centered on discerning loan situations.

The relations between the three subsystems in the total system is shown in Fig IV-2-1.

Explanatory notes:



= I/O List or Voucher

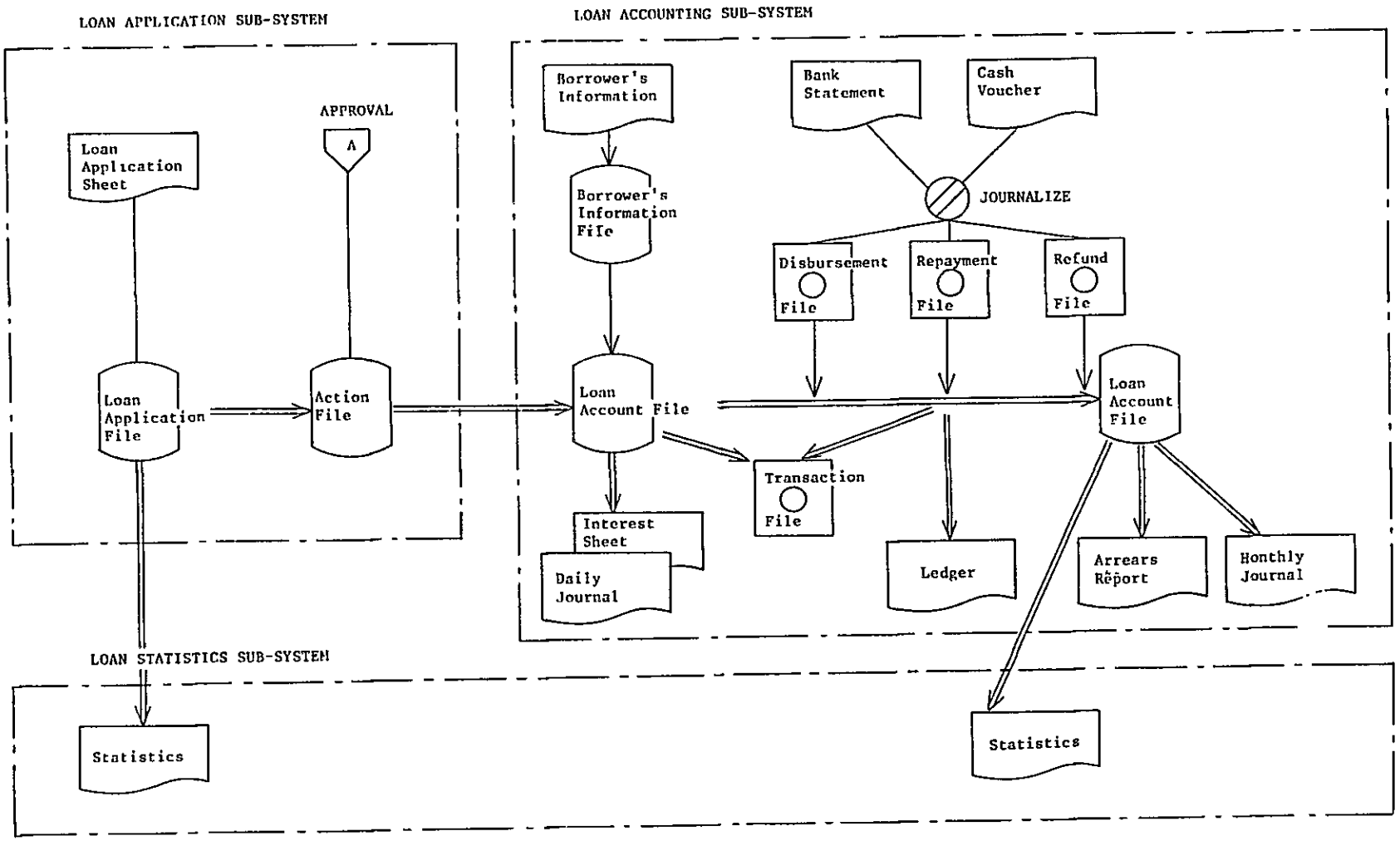
= Instruction

= Fixed Disk File

= Journalization

= Floppy Disk

. Fig. V-2-1 Scope of The Loan Management System in The Tonga Development Bank



A description of work items which are suitable either for real-time processing or for batch processing is given as follows:

(1) **Real-Time Processing**

Real-time processing is a method in which data are processed instantly; therefore, it is suitable for processing many types of data. Moreover, because conversational processing can be adopted, it has the merit of making possible the reduction of the term-around time of an error. The following work items are suitable for real-time processing.

- All Loan Application Work among Loan Accounting
- Borrower's Information Reference
- Interest Calculation
- New Account Registration
- Loan Disbursement and Refunding

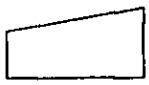
The following work items are essentially suitable for batch processing, but can be processed in real-time because of the availability of conversational processing.

- Loan Disbursement, Refunding, and Deletion of Repaid Accounts
- Balance List Output
- Checking and Processing of Arrears

Explanatory notes:


= List or Voucher


= Ledger Writing


= Data Input from Keyboard


= Data Output on CRT Display

Fig. V-2-2 Loan Application (On Request)

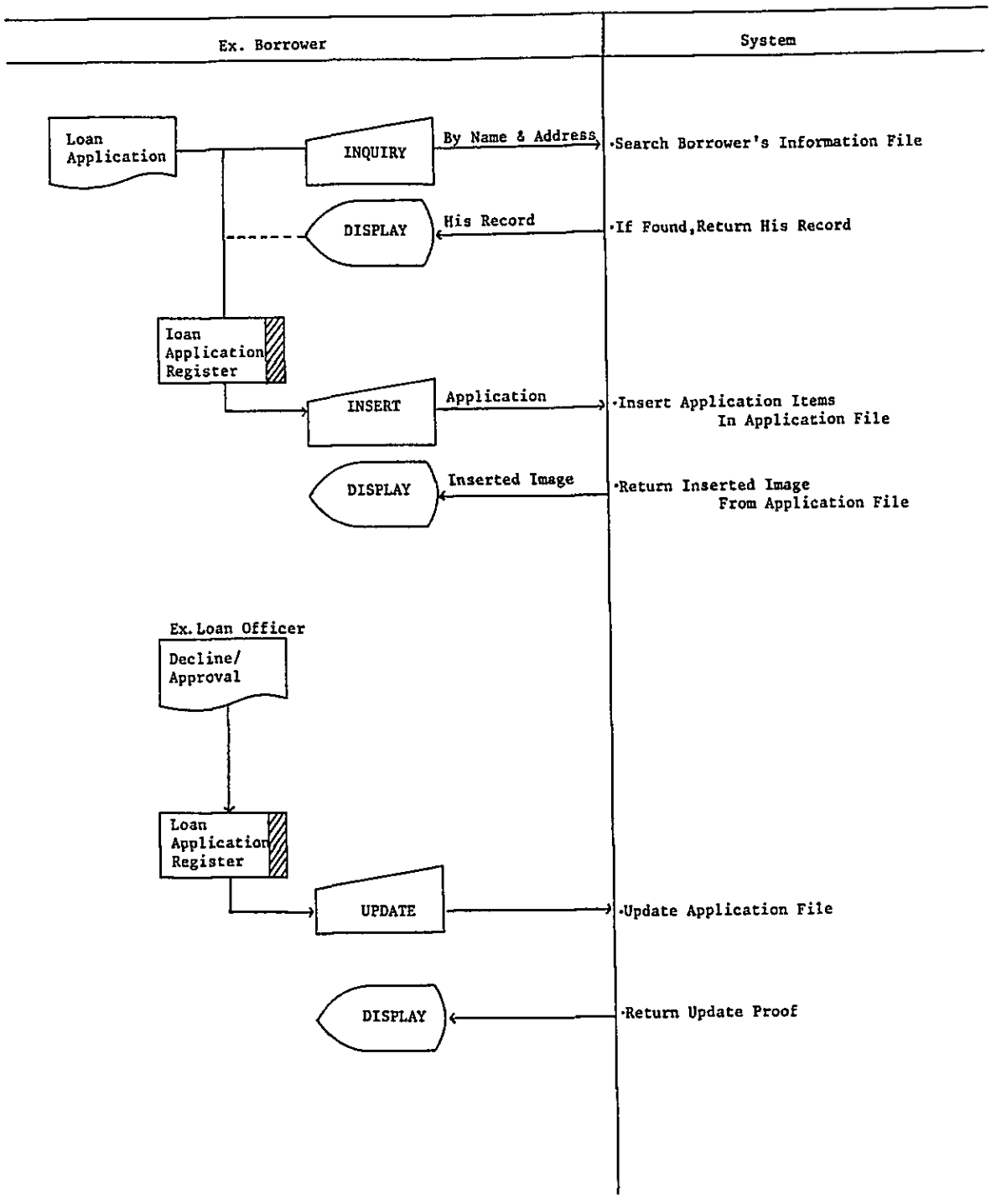


Fig. V-2-3 Loan Action (On Request)

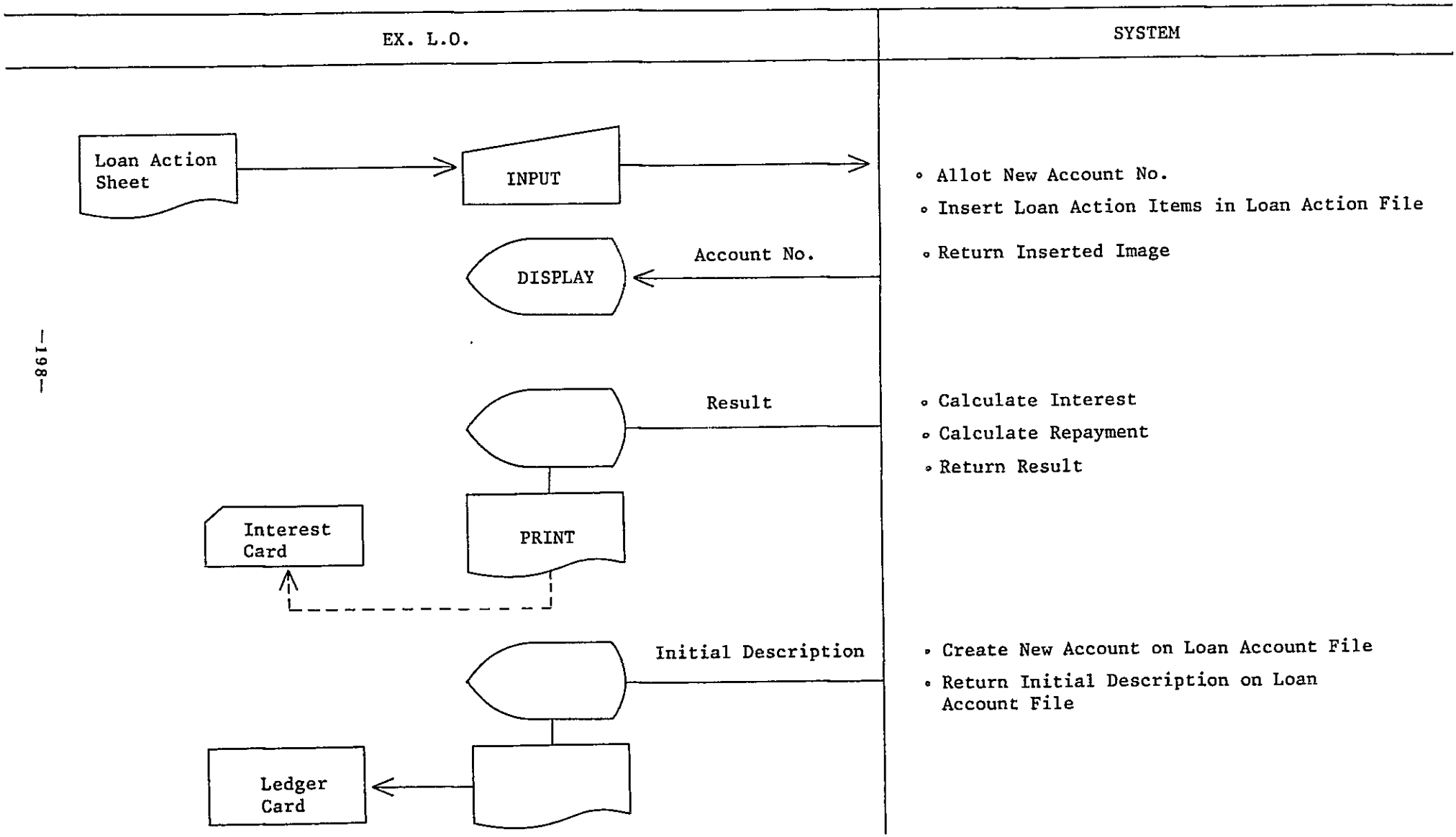


Fig. V-2-4 Process of Bank Statement (Weekly)

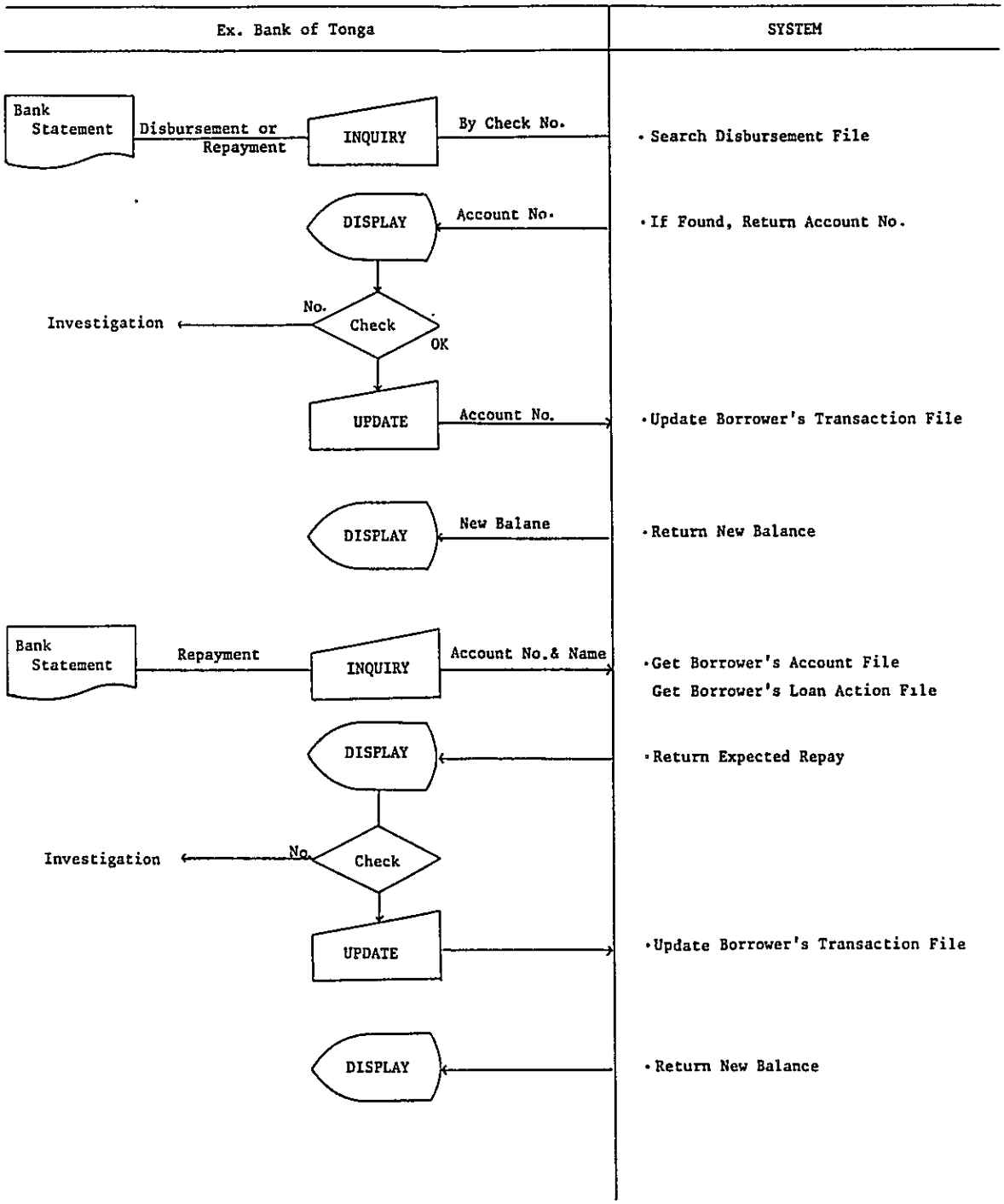
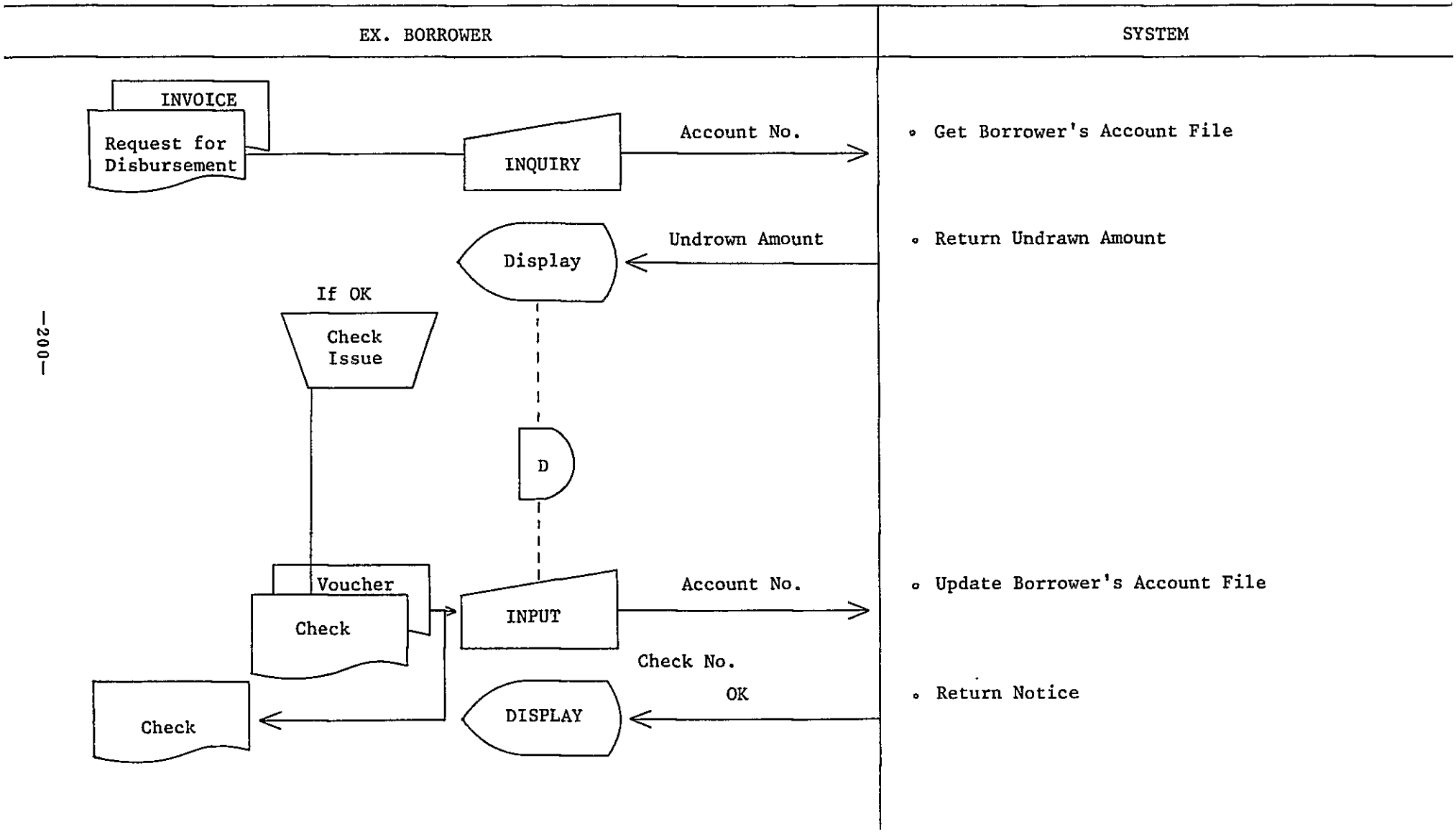


Fig. V-2-5 Loan Disbnrsement & Check Issue



(2) **Batch Processing**

In batch processing, data are not processed instantly whenever generated, but stored during a certain period before being processed as stored data. The following work items in the Bank are said to be suitable for such processing.

- o Loan Disbursement
- o Loan Repayment
- o Refund

These are items mentioned in bank statements from the Bank of Tonga. Since bank statements are issued once a week, it is efficient to perform processing during the interval. Work to be performed regularly should naturally be processed by the batch system. The list of such work is as follows:

Daily Processing

Daily Journal Output

Repayment by Cash

Monthly Processing

Arrears Report

Monthly Journal Output

* Refund of Withholding from Private Companies' Employees

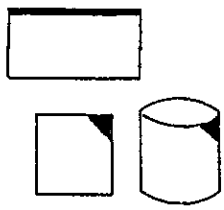
* Ledger Writing

Quarterly Processing

* Statistics

Note) Process charts of those marked * are omitted

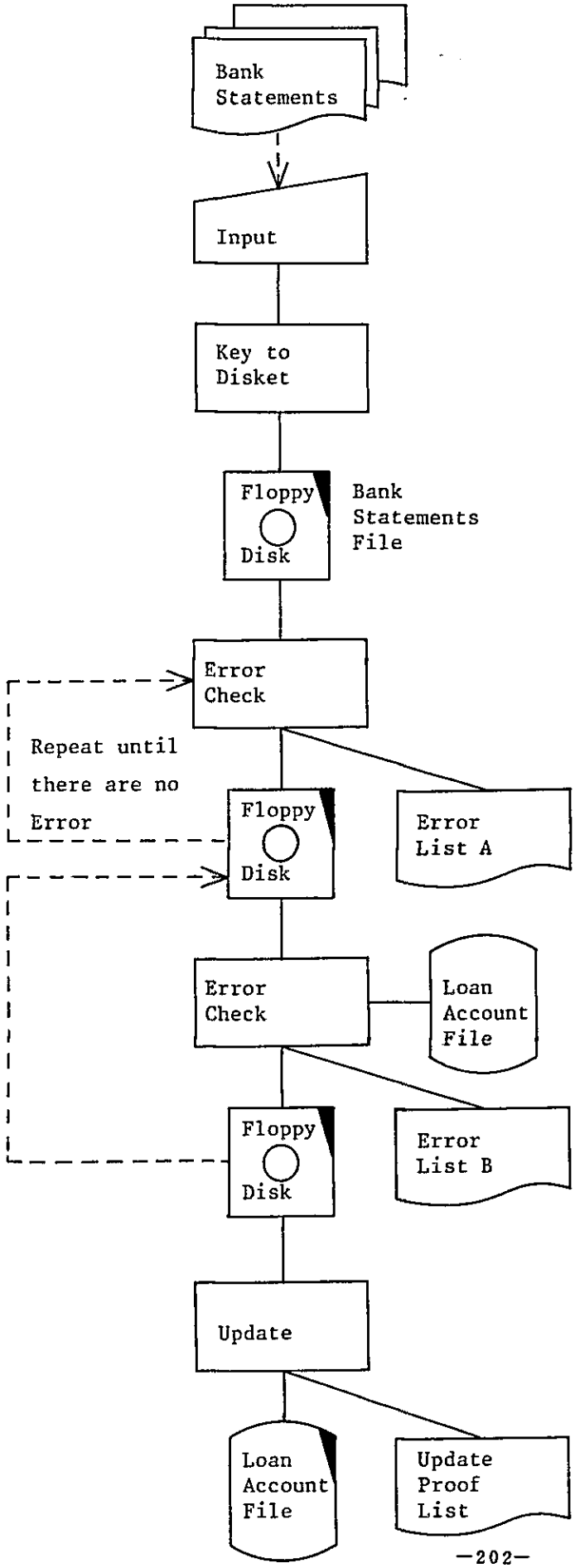
Explanatory notes:



= Batch Program

= Update File

Fig. V-2-6 Bank Statement Batch Process (Weekly)



PROCESS 1

- Input Bank Statement from Key Board of work station

PROCESS 2

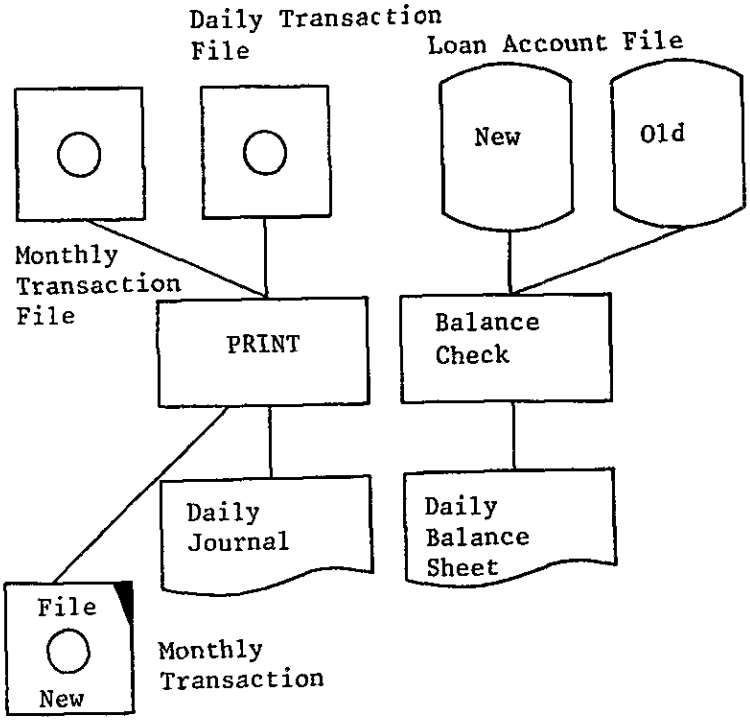
- Error Check of Input data

PROCESS 3

- Error Check of Input data

Fig. V-2-7 Daily Batch Process

1)Daily Journal Output



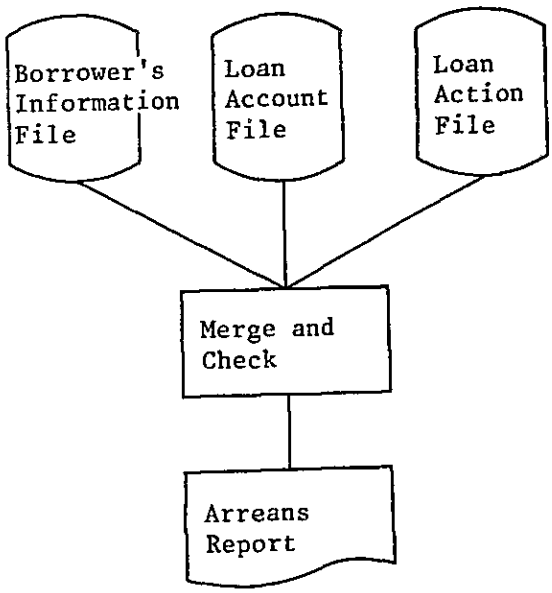
- Output Daily Summary of Transaction Data
- Balance Check between New/Old Account File and Daily Transaction File

2) Repayment by Cash

(Same as the following page)

Fig. V-2-8 (1) Monthly Batch Process

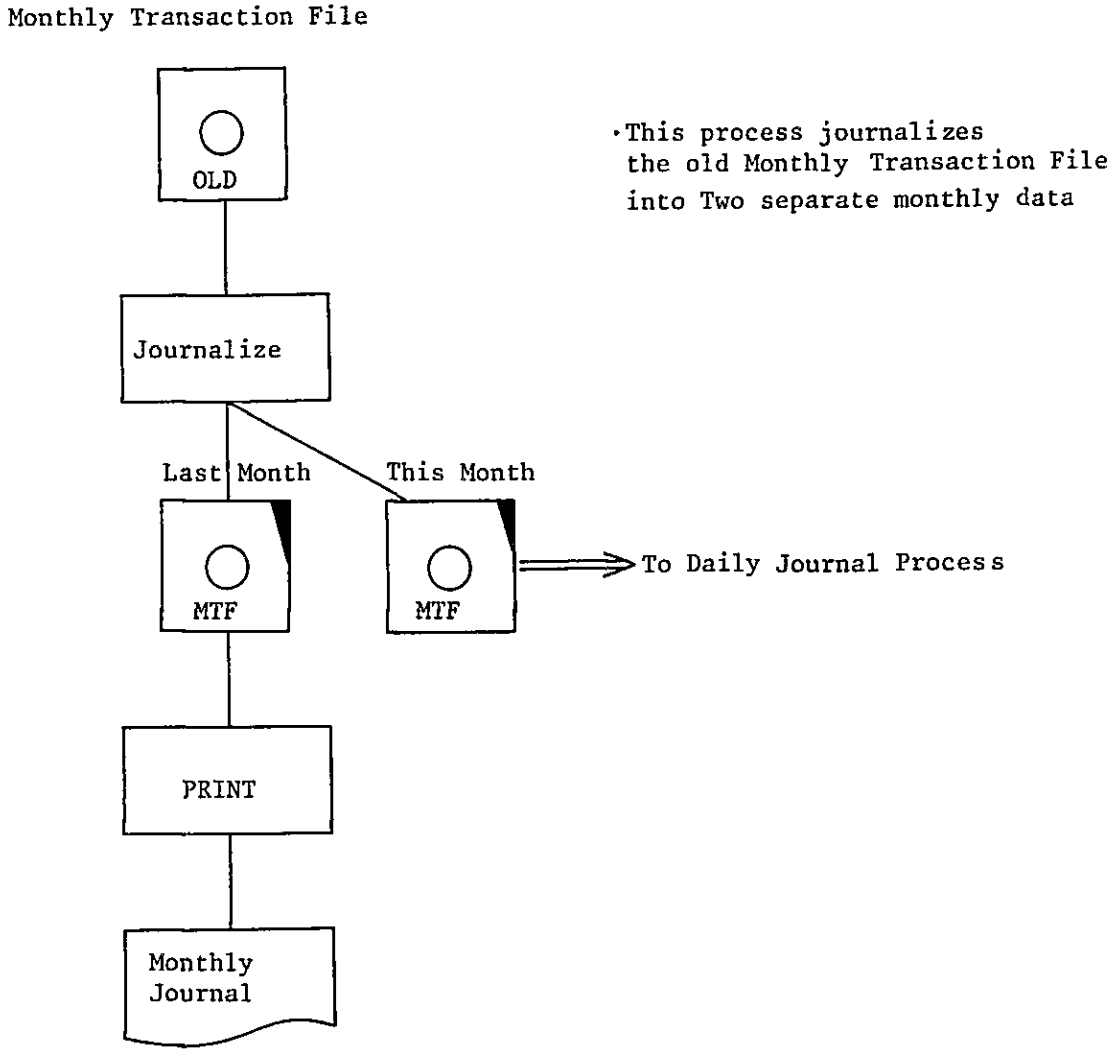
1) Arrears Report



- Check the difference between would-be repayment amount and actual repayment during the month

Fig. V-2-8 (2) Monthly Batch Process

2) Monthy Journal



2-3 File Design

In file design, care has been taken not to alter the format, as much as possible, from the existing forms of the ledger, list, and voucher. Therefore, the following computer files will become necessary.

(1) Loan Application Process
   1) Loan Application Register

(2) Borrower's Information Process
   1) Borrower's Information File

(3) Loan Action Process
   1) Loan Action File (Loan Implementation File)

(4) Loan Accounting Process
   1) Loan Account File (Monthly Master File)
   2) Monthly Transaction File
   3) Daily Transaction File
   4) Disbursement File
   5) Repayment File
   6) Refund File

2-4 I/O Design

Input is primarily made from the keyboard in direct transactions, and is not made through media such as cards and tapes. Accordingly, it is necessary to devise a method for accurate detection of errors at input. Data input from the keybaord undergoes volume check and numeric check and are finally output after once more being checked by the operator. Data input are stored this way in the transaction file for a while, and update processing is done at the same time. The file is also used as an audit trail file for recovery purposes.

2-5 Hardware Configuration

The hardware configuration in the Tonga Development Bank is shown below.

(1) CPU

16 bit Micro Processor	2 sets
Main Memory (over 512 KB)	2 sets

(2) Auxiliary Equipment

Fixed Disk Drive 10 MB	4 sets
Floppy Disk Drive 1 MB	4 sets
Line Printer 136 digits 300 – 600 lines/min.	1 set
Console Display 24 lines x 80 columns	1 set

Table V-2-1 File (Loan Application Register)

#	Item Name	Item Size	Comment
1	Date of Application	6	
2	Borrower's Name	30	
3	Borrower's Address	60	
4	Requested Amount	10	
5	Purpose	5	Codificated
6	Former Accourt No.	4	
7	Former Approval	3	
8	Approved/Declined	1	
9	Date Approved/Decline	6	
10	Amount Approved	10	
11	Reason why Declined	20	
12	New Account No.	4	
13	Unused	97	

Codification of Purpose (Example)

Code				
1	0	0	0	0	Agriculture
1	0	1	0	0	Beverages & Spices
1	0	1	0	1	Capsicum
1	0	1	0	2	Kava
1	0	1	0	3	Tobacco
1	0	2	0	0	Fruits
1	0	2	0	1	Banana

Record Identification Item : Borrower's Name & Address

Record Size : 256 Bytes

Estimated Number of Record Pen Year : 3,000 Records

File Size : 360 KB

Record Creation Timing : On Regnest

Table V-2-2 Loan Action File

#	Item Name	Item Size	Comment
1	Account No.	6	
2	Control Office	2	
3	Refinancing Agency	2	
4	Agent	3	
5	Borrower's Code	5	
6	Name	30	
7	Purpose	5	
8	Amount in $	10	
9	Additional Amount in $	10	
10	Related Account No. (1)	6	
11	Related Account No. (2)	6	
12	Related Account No. (3)	6	
13	Place of Development	20	
14	Mortgage	2	
15	Loan Agreement (1)	2	
16	Loan Agreement (2)	2	
17	Loan Agreement (3)	2	
18	Loan Agreement (4)	2	
19	Loan Agreement (5)	2	
20	Insurance	2	
21	Insurance Amount	10	
22	Interest RB	5	
23	Interest FR	5	
24	Repayment Start	6	
25	Repayment End	6	
26	Further Condition	40	
27	Term	2	
28			
29			
30			

Table V-2-3 Borrower's Information File

#	Item Name	Item Size	Comment
1	Borrower's Code	5	
2	Borrower's Name	30	
3	Borrower's Address	60	
4	Current Account No.	6	
5	Total Amount	10	
6	Total Number of Repeated Loan	2	

Table V-2-4 Loan Account File

#	Item Name	Item Size	Comment
1	Date of Action	6	
2	Subject	3	Codificated
3	Application	20	
4	Debit	10	
5	Credit	10	
6	Balance	10	

Codification of Subject (Example)

Code	
1 0 0	Loan
2 0 0	Disbursement
3 0 0	Interest
4 0 0	Repayment
5 0 0	Refund
6 0 0	Correction

Fig. V-2-9 Loan Application & Registration Sub-System

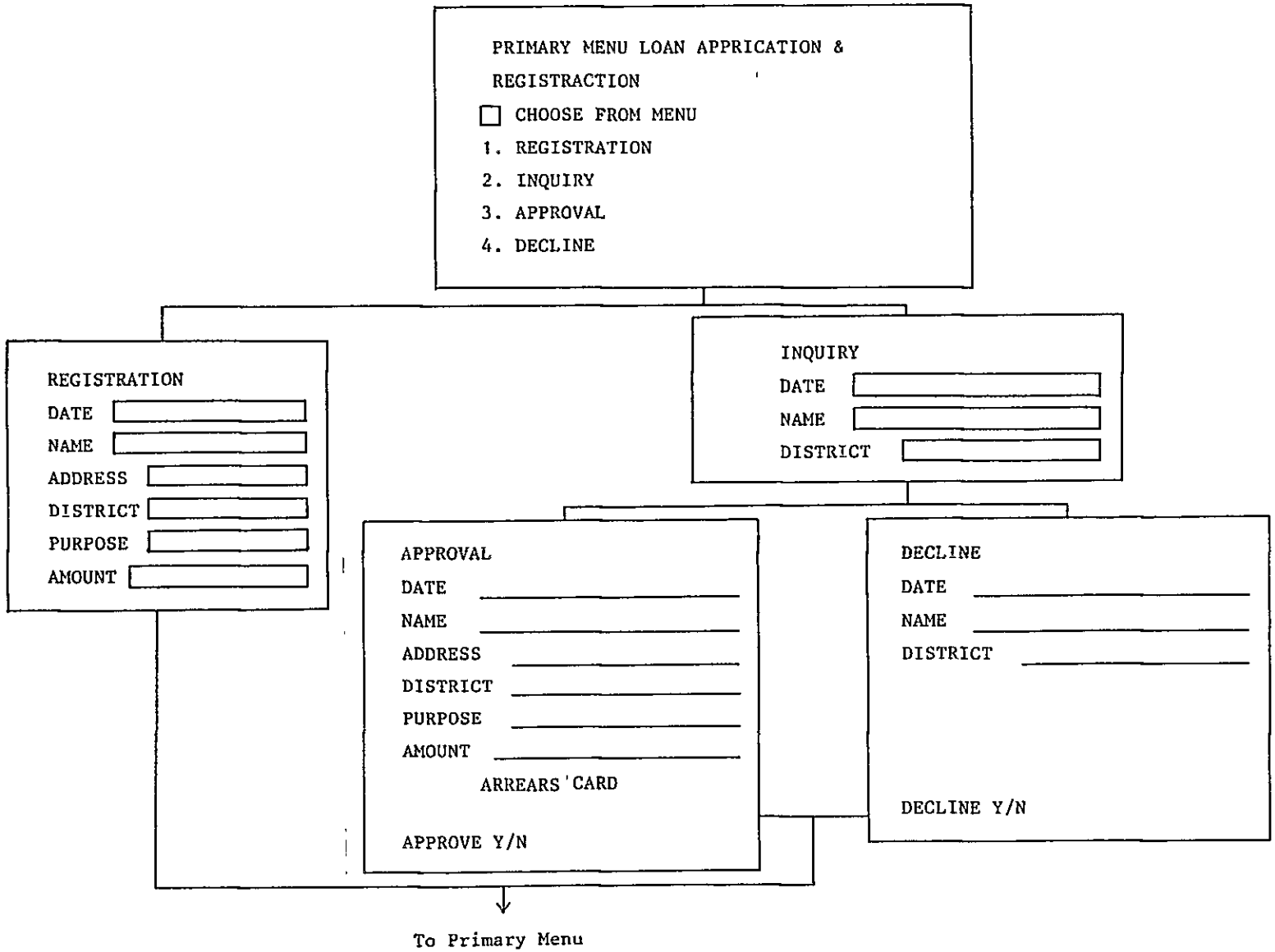


Fig. V-2-10 Loan Accounting Sub-System

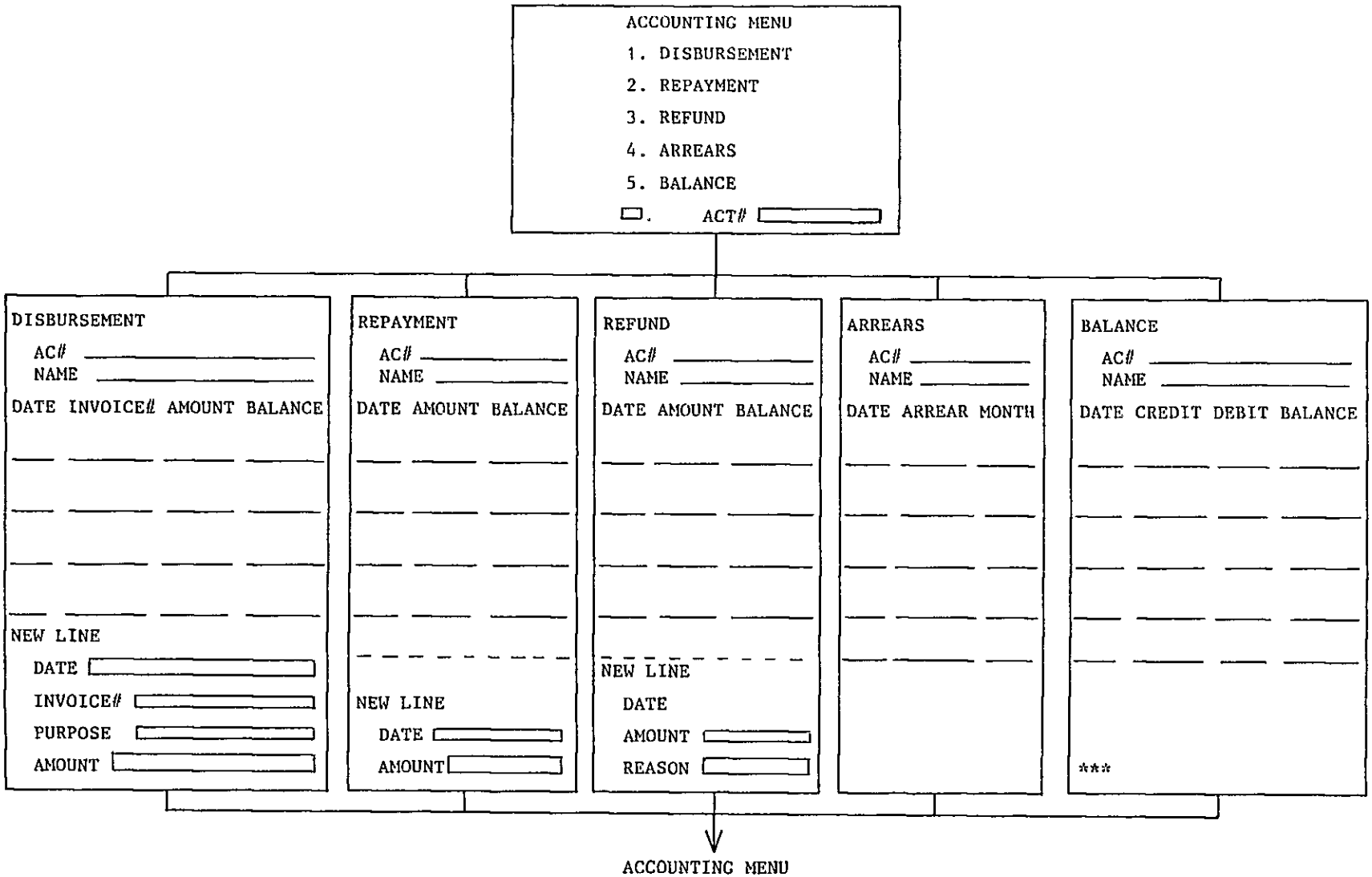
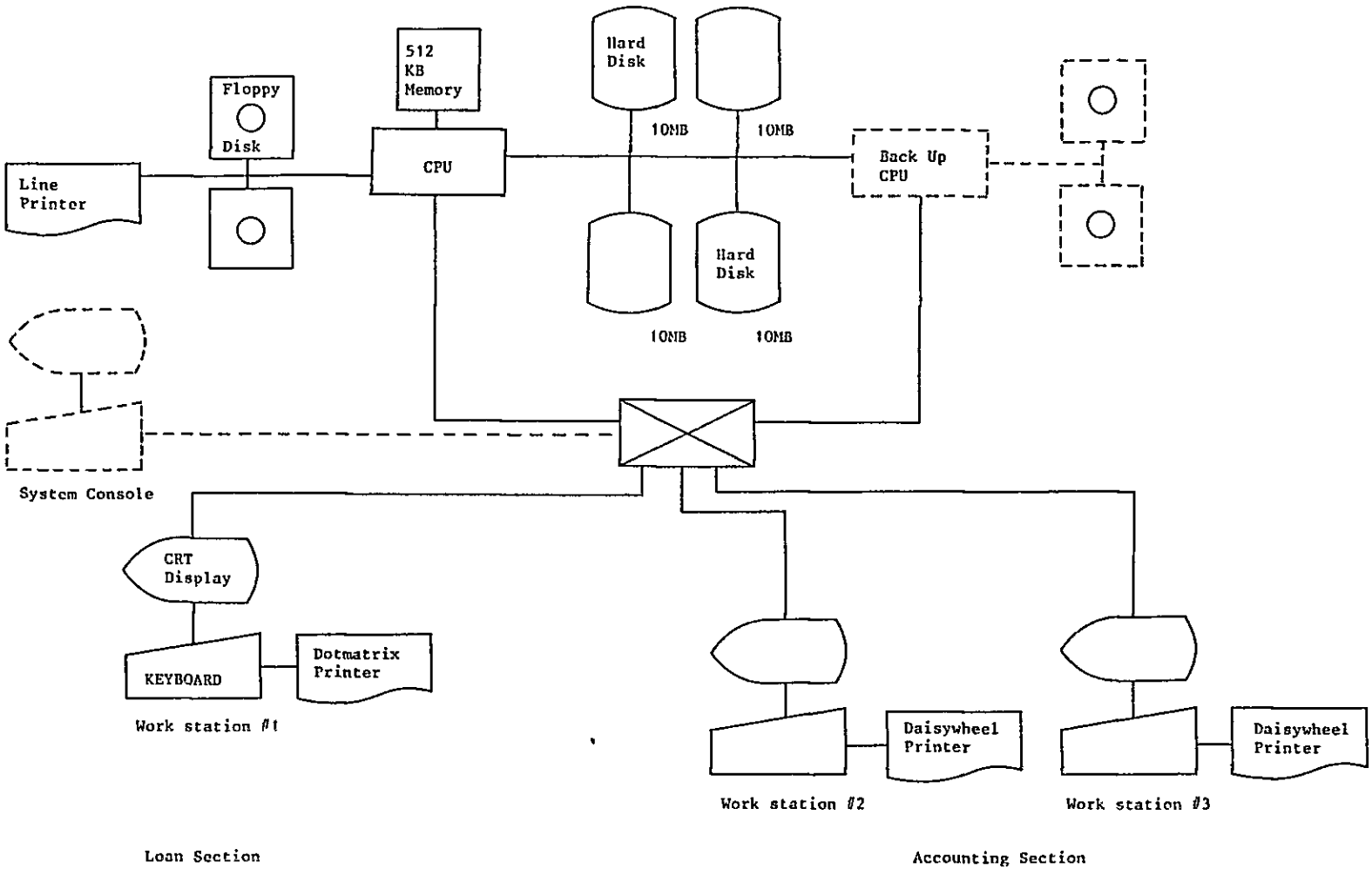


Table V-2-5 Computer Output List (Proposed)

#		List Name	Output Interval	Lines / Record	Number Ofrecords	Total Output Lines
1		Borrower's List	O/R	5		
2		Loan Application List	O/R	1		
3		Loan Decline List	O/R	1	400	400
4		Loan Approval List	O/R	1		
5		Loan Action List	O/R	10		
6		Interest Sheet	Mo	-		
7		Arrears Report	Mo	1		
8		Ledger List (by Account No.)	Mo	1		
9		Balance Report	Mo	1		
10		Bank Statement List	We	1		
11		Daily Summary List	Da	1		
12		Weekly Summary List	We	1		
13		Monthly Summary List	Mo	1		
14		Quarlerly Summary List	Qu	1		
15		Annual Summary List	An	1		

Fig. V-2-11 Hardware Configuration



(3) Work Station

1) Loan Application

CRT Display (Monochrome)	1 set
Keyboard (Ten-Key)	1 set
Dot Matrix Printer 150 CH/sec.	1 set

2) Loan Accounting

CRT Display (Monochrome)	2 sets
Keyboard (with Ten-Key)	2 sets
Daisy Wheel Printer 40 CH/sec.	2 sets

2-6 Software Composition

The required functions of software to be introduced into the Tonga Development Bank are as follows:

(1) OS (Operating System)

The basic requirement for the OS is that it has multiuser-multitask functions. The work of the Bank is divided broadly into the two categories of loan application and loan accounting. The former has comparatively large amounts of input data, into which there tend to be many inquiries. On the other hand, the latter has only a small amount of input data, into which there are few inquiries. If the two are processed in the same work station, unnecessary interruptions and delays will be generated. For this reason, it is thought best to give each of the two separate work stations. Considering the balance between the input and output and backup for equipment breakdowns, the loan accounting work should have two work stations. Consequently, an OS is required which meets the above-mentioned requirements and controls at least four work stations.

There are many OS which meet such requirements, but the two systems mentioned below are generally widespread.

1) UNIX
2) MP/M

The AED System of the Treasury Department is using MP/M, even though its low capabilities in concurrent processing, which has induced the Bank to adopt the same system. However, the OSs of small computers are undergoing rapid improvements at present, reportedly aiming at using UNIX. Therefore, taking future situations into account, UNIX or a compatible OS is suitable for the Bank. Adaptation of small business computers is also suitable with use of COBOL.

(2) DBMS (Data Base Management System)

Present processes in the loan management of the Tonga Development Bank are so specialized that the possibilities of finding suitable software packages for the Bank are not

very great. Consequently, systems development through the introduction of DBMS is thought to be the most realistic.

2-7 Development and Introduction Plan

The schedule for computer introduction greatly differs according to whether the application software is independently developed by the user or an existing software is used. When an existing software package is used, time for program development is saved, but on the other hand, time to select a suitable package is required. Furthermore, the package may not be so well matched to the processing system and is liable to cause many errors and subsequent corrections.

The Tonga Development Bank is dealing exclusively with loans and the work is confined to a comparatively narrow scope of operations. Since there are special interest calculations, which are not a very common type of work, the number of software packages available is not very high. Therefore, a choice should be made for a popular operating system which, as far as possible, allows for a wide selection of softwares. The Tongan socio-political system resembles that of the United Kingdom and English is the language used in formal situations. Due to this, the application software package should be a product of an English speaking country. English-language loan control programs available in Japan are limited in number, and if found, seem to require many corrections. Accordingly, an application software should be selected, in principle, from among as many products as possible.

The schedule of computer introduction into the Tonga Development Bank is described below.

(1) Hardware Selection

The hardware selection, which is to be made internally, will be made from among several items listed on the basis of objective standards.

(2) Hardware Introduction

Hardware will be ordered right after selection and transported to Tonga within two months after the order. A hardware engineer will make on-site preparation for installation of the hardware during the two weeks before its arrival. After arrival, installation and various tests will be made; if no troubles appear, work will be completed in about one and a half month after the arrival.

(3) Software Selection

The selection of software will be made through catalogs first; however, because it is necessary to get detailed explanation from a distributor, procurement from a foreign country will also be checked into. In this case, on-site checks in an English speaking

country (especially Fiji, New Zealand, and Australia) are necessary, in addition to a one month domestic trial period. Finally, the decision will be made domestically on the basis of objective standards.

(4) Software Introduction

The selected software will be ordered from the distributor right after selection. Delivery from the distributor will be made in about one month after ordering, and the software will be installed in the computer.

(5) Detailed Design

Considering the limitations of software packages, each detailed design should be made to take advantage of functions as much as possible. Design in this case will be made mainly for the preparation of an Input and Output format. This work will be undertaken in Tonga.

(6) Software Amendments

The software package obtained will be amended partly through the method mentioned above. There are few cases in which amendments are not required; generally, they take about a month and a half.

(7) Operating Test

After implementation of the necessary amendments, the system will be tested with an input resembling actual data.

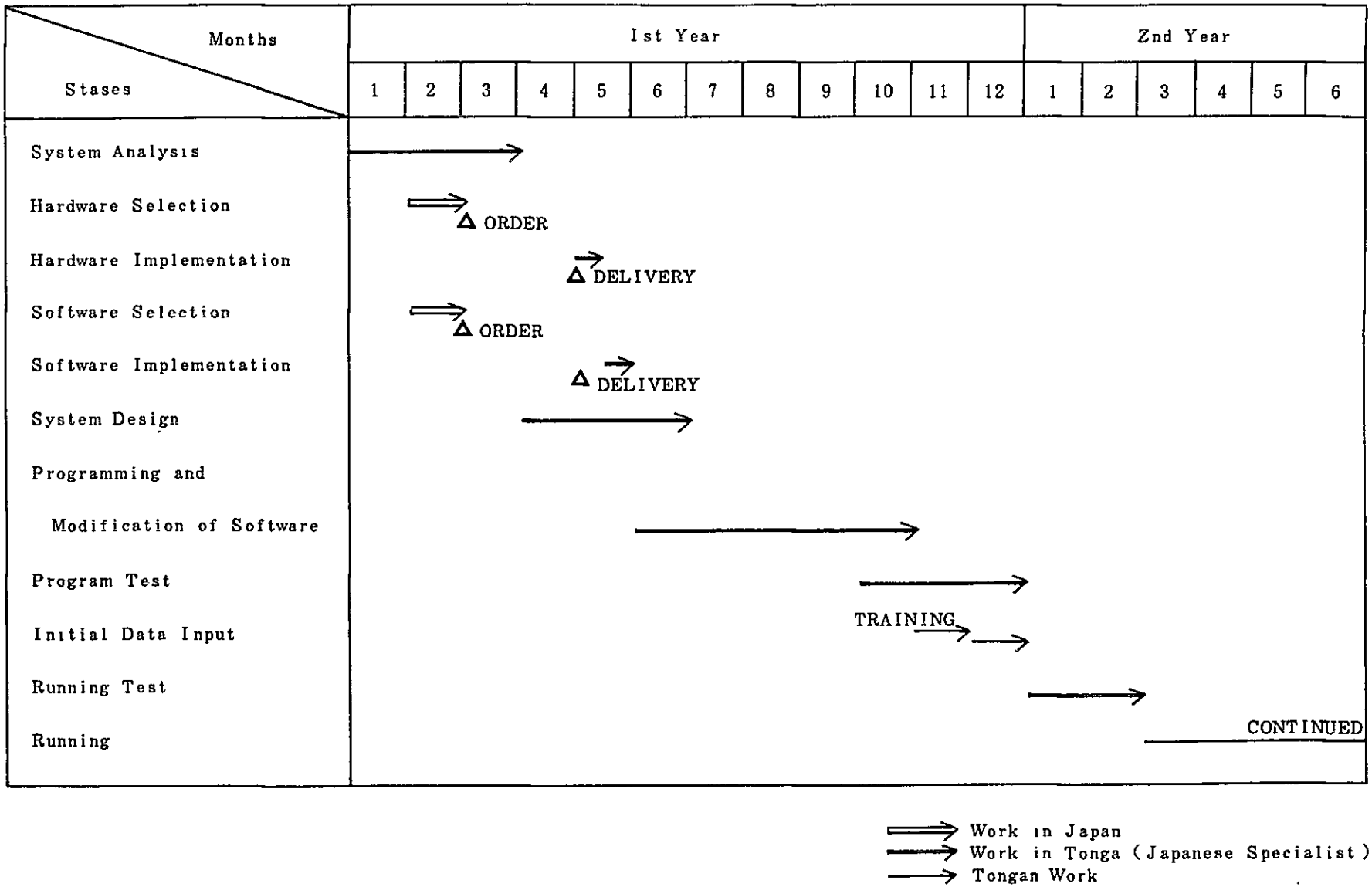
(8) Parallel Operation

After confirmation of defect free operation of the program, systems operation will begin. However, at this time, mainly conventional manual work will be done and the computer system will be used as an auxiliary system. At a certain time in this step, the roles of the two systems will be reversed and the computer system will assume the main role; manual work will become auxiliary.

(9) Operation

If parallel operation produces a good result, manual work will be terminated and the computer system alone will be used. Even in this case, however, the manual work system should be ready to be implemented in case of computer breakdown.

The schedule for computer introduction into the Tonga Development Bank is in Fig. V-2-12 (next page).



図V－2－12　Implementation Schedule in the Tonga Development Bank

2-8 Staff Training Plan

Staff training should be made basically at a central training center. However, in view of the fact that such a center has not been established yet, in-house training is required to be made in the Bank. The training plan should not be uniform; it should be designed according to each staff member's role. Practical examples are shown as follows:

(1) Workstation Operator

Training should be made centering on an input method for various vouchers. Accordingly, actual work stations are used. For this purpose, it is necessary that most of the system be completed by the time training starts, and that an operation manual be ready for use.

(2) Console Operator

Because the console operator plays an important role in the upgrading of the system, it is required that he or she is skillful in a series of hardware operations. When a fixed operation process has been set up, it is also desirable to make an operation manual for the Bank's own use.

(3) EDP Manager

It is better for the manager to be present at all training initially, because he or she is required to have a certain extent of knowledge about all systems introduced.

(4) Training Instructor

A foreigner will be assigned to this post for the time being.

2-9 Cost Estimation

The following expenditures are required for computer introduction to the Tonga Development Bank.

Table V-2-6 Total Cost for Development of Loan Management System

Item	Yen	US$
1 Hardware Cost	11,347,500	49,123
2 Software Cost	2,320,000	10,043
3 Equipment	1,439,000	6,229
4 Consuming Goods	1,330,000	5,758
5 Training Cost	5,300,000	22,944
6 Implementation Cost	28,900,000	125,108
Grand Total	50,636,500	219,205

1) Cost Estimation (Hardware)

	Part Name	Unit Price	Q	Amount	
				Yen	US$
1	CPU + 512 KB Memory	700,000	2	1,400,000	6,061
2	5Inch Hard Disk Drive 10MB	500,000	4	2,000,000	8,658
3	Hard Disk Interface	100,000	2	200,000	866
4	Floppy Disk Drive (2drives)	500,000	2	1,000,000	4,329
5	Line Printer 300 ~ 600 Lines/min	2,500,000	1	2,500,000	10,823
6	Switching Unit	400,000	1	400,000	1,732
7	CRT Display (24 x 80)(Green)	100,000	4	400,000	1,732
8	Work Station	500,000	4	2,000,000	8,658
9	Dot Matrix Printer	200,000	1	200,000	866
10	Daisy wheel Printer	500,000	2	1,000,000	4,329
11	Delivery & Insurance			247,500	1,071
	Hardware Total			11,347,500	49,125

Note: No maintenance parts costs are included.

2) Cost Estimation (Software)

	Software Name	Unit Price	Q	Amount	
				Yen	US$
1	MP/M-86	100,000	1	100,000	433
2	COBOL	160,000	1	160,000	693
3	Word Processing Soft	200,000	1	200,000	866
4	DBMS	160,000	1	160,000	693
5	Utilities	200,000	1	200,000	866
6	Loan Management Software	1,500,000	1	1,500,000	6,494
	Software Total			2,320,000	10,045

Note: No development costs are included.

3) Cost Estimation (Equipment)

No.	Equipment Name	Unit Price	Q	Amount	
				Yen	US$
1	Power Supply Generator	450,000	2	900,000	3,896
2	Cabinet for Floppy Cabinet	42,000	2	84,000	364
3	Desk for Work Station	70,000	4	280,000	1,212
4	Delivery & Insurance			175,000	758
	Equipments Total			1,439,000	6,230

4) Cost Estimation (Supply)

No.	Supply Name	Unit Price	Q	Amount	
				Yen	US$
1	Standard Form Sheet (136)	4,000	50	200,000	866
2	Floppy Disk	15,000	50	750,000	3,247
3	Standard Form Sheet (80)	2,000	50	100,000	433
4	Delivery & Insurance			280,000	1,212
	Supply Total			1,330,000	5,758

5) Training Cost

No.	Particular	Unit Price	Q (M/M)	Amount	
				Yen	US$
1	Trainer	*2,500,000	2	5,000,000	21,645
2	Other Expense	100,000	2	300,000	1,299
	Total			5,300,000	22,944

Note: Including hotel bills in Tonga.

6) Implementation Cost

No.	Particular	Unit Price	Q (M/M)	Amount	
				Yen	US$
1	Hardware Selection	1,000,000	0.5	500,000	2,165
2	Hardware Implementation	*2,500,000	2	5,000,000	21,645
3	Software Selection (Japan)	1,000,000	1.5	1,500,000	6,494
4	Software Selection (Foreign)	*3,500,000	0.5	1,750,000	7,576
5	Software Implementation	*2,500,000	0.5	1,250,000	5,411
6	Detailed Design	*2,500,000	1.5	3,750,000	16,234
7	Modification of Software	*2,500,000	3	7,500,000	32,468
8	Running Test	*2,500,000	1.5	3,750,000	16,234
9	Parallel Running	*2,500,000	1	2,500,000	10,823
10	Other Expense	200,000	7	1,400,000	6,061
	Total			28,900,000	125,111

Note: Including hotel bills in Tonga.