REPORT OF THE STUDY
FOR
THE DEVELOPMENT OF DATA PROCESSING SYSTEM
IN
THE KINGDOM OF TONGA

SEPTEMBER 1984

JAPAN INTERNATIONAL COOPERATION AGENCY

PREFACE

In response to the request of the Government of The Kingdom of Tonga, the Government of Japan decided to conduct a survey on the Project for Development of Data Processing System in that country and entrusted the survey to the Japan International Cooperation Agency (JICA). The JICA sent to Tonga a survey team headed by Mr. Akira Maruyama from November 26th to December 24th, 1983.

The team exchanged views with the officials concerned of the Government of Tonga and conducted a field survey in that country. After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve for the development of the data processing system in Tonga and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of The Kingdom of Tonga for their close cooperation extended to the team.

Tokyo, August 1984

Keisuke Arita

Keisuke Arita
President
Japan International Cooperation Agency

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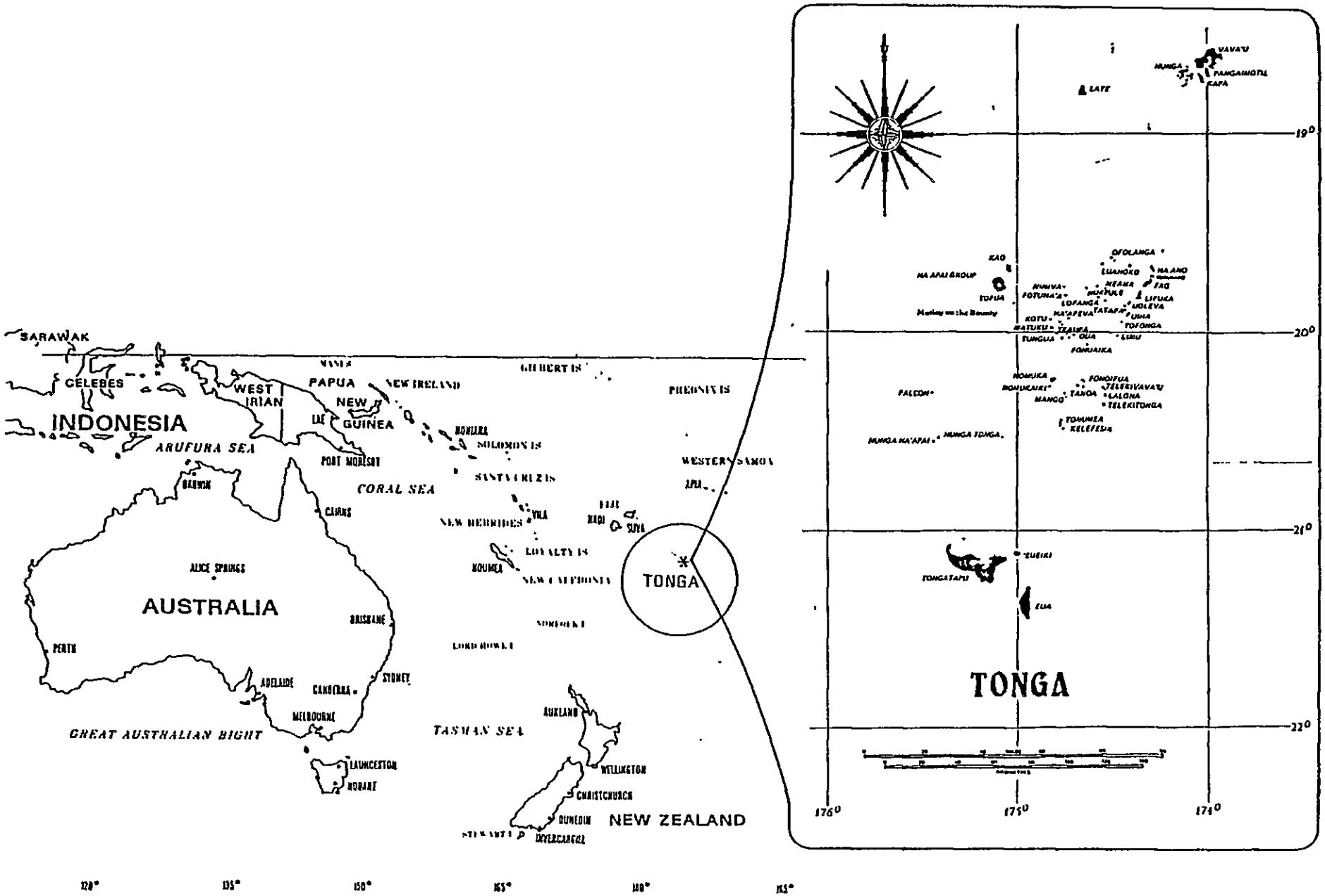
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CANBERRA
SYDNEY
MELBOURNE
GREAT AUSTRALIAN BIGHT
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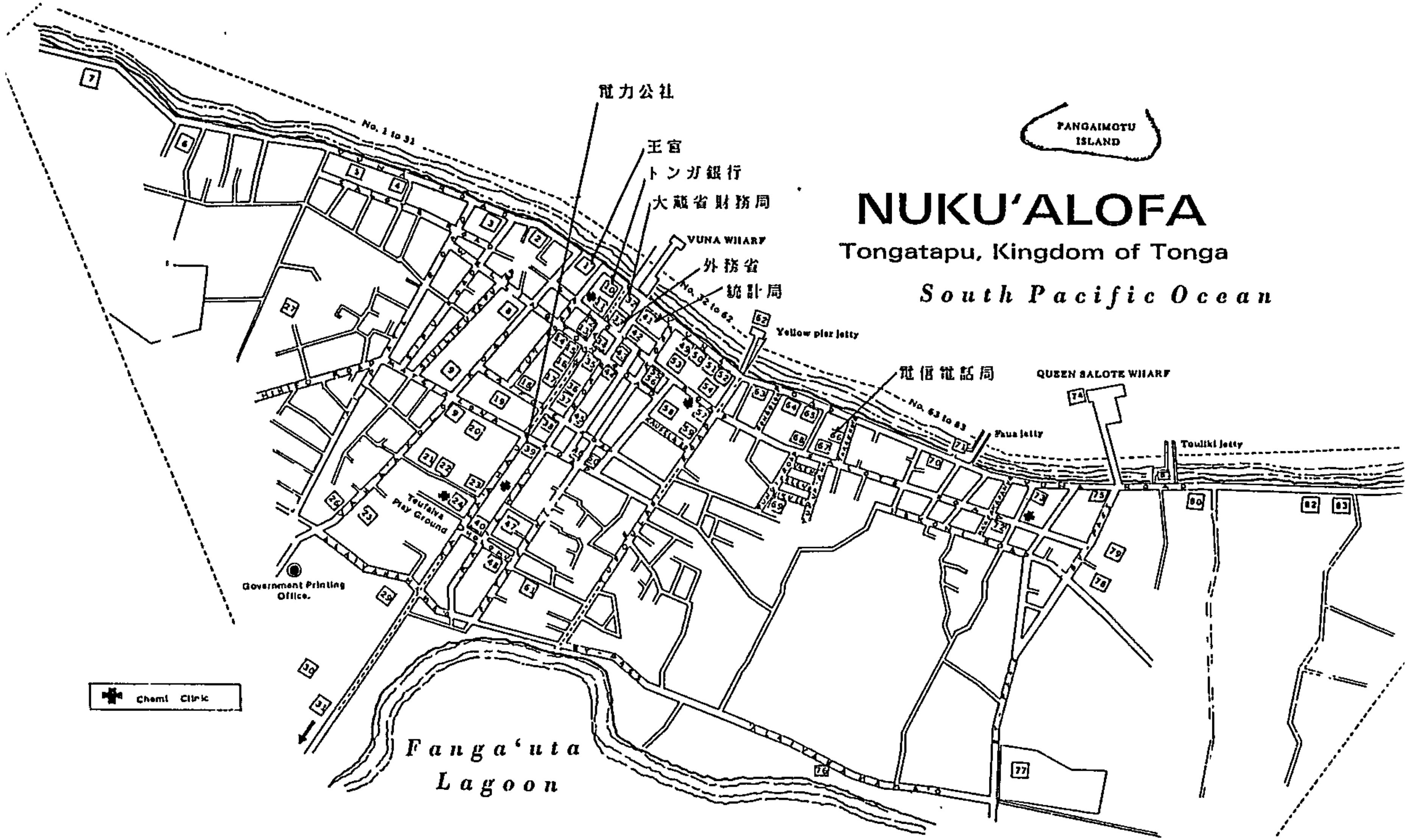


NUKU'ALOFA
Tongatapu, Kingdom of Tonga
South Pacific Ocean
Fanga'uta Lagoon
PANGAIMOTU ISLAND
電力公社
王宮
トンガ銀行
大蔵省財務局
外務省
統計局
電信電話局
VUNA WHARF
QUEEN SALOTE WHARF
Yellow pier jetty
Faua jetty
Touliki jetty
No. 1 to 31
No. 32 to 62
No. 63 to 83
Teufaiva Play Ground
Government Printing Office.
Chemi Clinic

ABBREVIATION

1. Organizations

JICA ; Japan International Cooperation Agency
MOF ; Ministry of Finance
TDB ; Tonga Development Bank
TEPB ; Tonga Electric Power Board
TCF ; Tonga Cooperative Federation
BOT ; Bank of Tonga
USP ; University of South Pacific
ESCAP ; Economic and Social Commission for Asia and the Pacific, United Nations
UNDP ; United Nations Development Program

2. Technical Terms on Computer System

EDPS ; Electronic Data Processing System
CPU ; Central Processing Unit
OS ; Operating System
DOS ; Disk Operating System
AS ; Application Software
DBMS ; Data Base Management System
FDD ; Floppy Disk Drive
HDD ; Hard Disk Drive
CRT ; Cathode Ray Tube
I/O ; Input/Output
COM ; Computer Output Microfilm
POS ; Point of Sales
LSI ; Large Scale Integration
KB ; Kilo Byte (10^3 Byte)
MB ; Mega Byte (10^6 Byte)
GB ; Giga Byte (10^9 Byte)
MTBF ; Mean Time between Failures
MTTR ; Mean Time to Repairs
CVCF ; Constant Voltage Constant Frequency
UPS ; Uninterruptible Power System
SA ; Systems Analyst
SE ; Systems Engineer
CE ; Customer Engineer
OJT ; On the Job Training
O/M ; Operation/Maintenance

3. Others

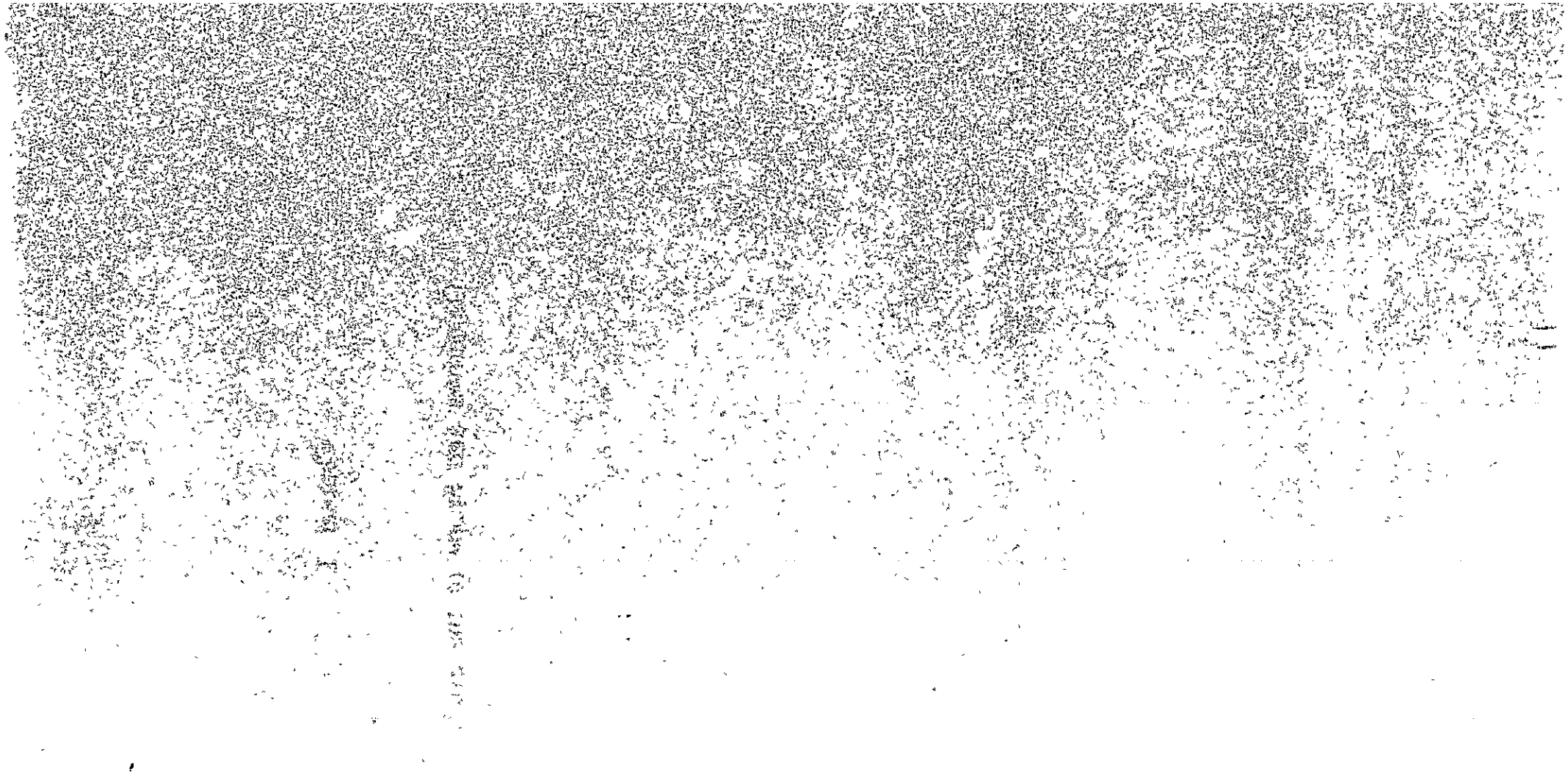
S/W ; Scope of Works
F/S ; Feasibility Study
D/D ; Detailed Design
GNP ; Gross National Products
GDP ; Gross Domestic Products

EXCHANGE RATE

US$ 1.00 = T$(Pa'anga) 1.05 = Yen 231.0

Chapter I

Objectives and Scope of the Study



Chapter I Objectives and Scope of the Study

1. Background and Objectives

The Kingdom of Tonga has since 1981 been actively pushing ahead with its fourth 5-Year Economic Development Program aimed at modernizing the state administration while ensuring balanced development of the national economy.

The Tongan Government requested the Government of Japan to cooperate in examining its present state of data processing, and in assessing the feasibility of the introduction of a new system, in order to increase the efficiency of policy administration.

In response to this request, the Japanese Government instructed the Japan International Cooperation Agency (JICA) to take the necessary steps to initiate such an investigation. Accordingly, JICA dispatched to the Kingdom of Tonga a Preparatory Survey Mission in November 1981. The Mission opened discussions with Tongan Government officials to verify and clarify the particulars of the request, and conducted a preparatory survey of the current state of data processing in the offices of the Tongan Government itself and of related organizations. Later, in August 1983, JICA dispatched a Preliminary Study Mission, which concluded an agreement with the Tongan authorities on the Scope of Work (S/W) for a full-fledged study.

1-1 Objectives

Data processing in nine government-related organizations (including the Government itself) were studied in the following manner.

(1) The data processing jobs at present performed in each office were analyzed, and on the basis of the results, future plans for a data processing system were drawn up. (Phase I)

(2) Two jobs, out of all those studied, were selected for case studies with a view to the introduction of electronic data processing. (Phase II)

1-2 Ministries and Other Government-related Organizations to be Studied

(1) Statistics Department, Ministry of Finance – National Statistics

(2) Treasury Department, Ministry of Finance – Budget Control

(3) Tonga Development Bank – Loan Management

(4) Government Store – Stock Control

(5) Commodities Board – Sales Information*1

(6) Tonga Electric Power Board – Stock Control*2

(7) Ministry of Police – Automobile Registration and Immigration Control*3

(8) Tonga Cooperative Federation – Stock Control

(9) The Bank of Tonga – Accounting

Notes: *1 For the Commodities Board, the subject to be studied was stated, in the S/W, to be accounting. However, an on-the-spot investigation revealed that what required study was not in fact accounting, but information management of the sales made by growers of coconuts, the main product handled by the Board, and stock control of construction materials. The study was conducted accordingly.

*2 Although the S/W indicated that accounting was to be examined, the Electric Power Board indicated at a meeting held at its offices that it would prefer a study of stock control. The study was therefore conducted to meet this request.

*3 The S/W specified a study only of immigration control, but emigration control (passport control) was added at the request of the Ministry of Police.

1-3 Aspects to be Studied

Phase I Analysis of the Present Data Processing Work and Proposals for Future Plans

(1) A study of general conditions in Tonga for the purpose of assessing the feasibility of the introduction of computers.

(2) Analysis of current data processing work performed in ministries and other government-related organizations (listed above).

(3) Proposals for a future data processing system.

Phase II Case Studies for the Introduction of Computers

(1) The scope of the introduction of EDP into the two types of work that were selected for the case studies.

(2) Conceptual design

(3) Hardware configuration

(4) Basic and application software

(5) Implementation schedule

(6) Staff training program

(7) Estimation of costs

(8) Conclusions and recommendations

2. Schedule of the Study

On the basis of the above S/W, the JICA organized and dispatched a six-member study team. From November 26th through December 24th of 1983, the study team conducted on-site research and analysis of current jobs, and investigated the feasibility of the introduction of computers and the drawing up of computerized systems suitable to the current Tongan situation. In addition, the study team narrowed the subjects included in both studies down to a few candidates, taking on-the-spot research results and opinions of the organizations concerned into consideration. The study team submitted to the Government of the Kingdom of Tonga a progress report that described the results obtained

through research and investigation.

The study team, after the completion of the on-site study, came back to Japan and completed a final report by analyzing the data obtained during the three month period.

3. Status of the Study

A complete schedule for an EDP program – processes for introducing and developing computerized systems – is usually advanced in such a way as shwon in Fig. I-1-1.

Fig. I-1-1 Processes for Introducing and Developing Computerized Systems

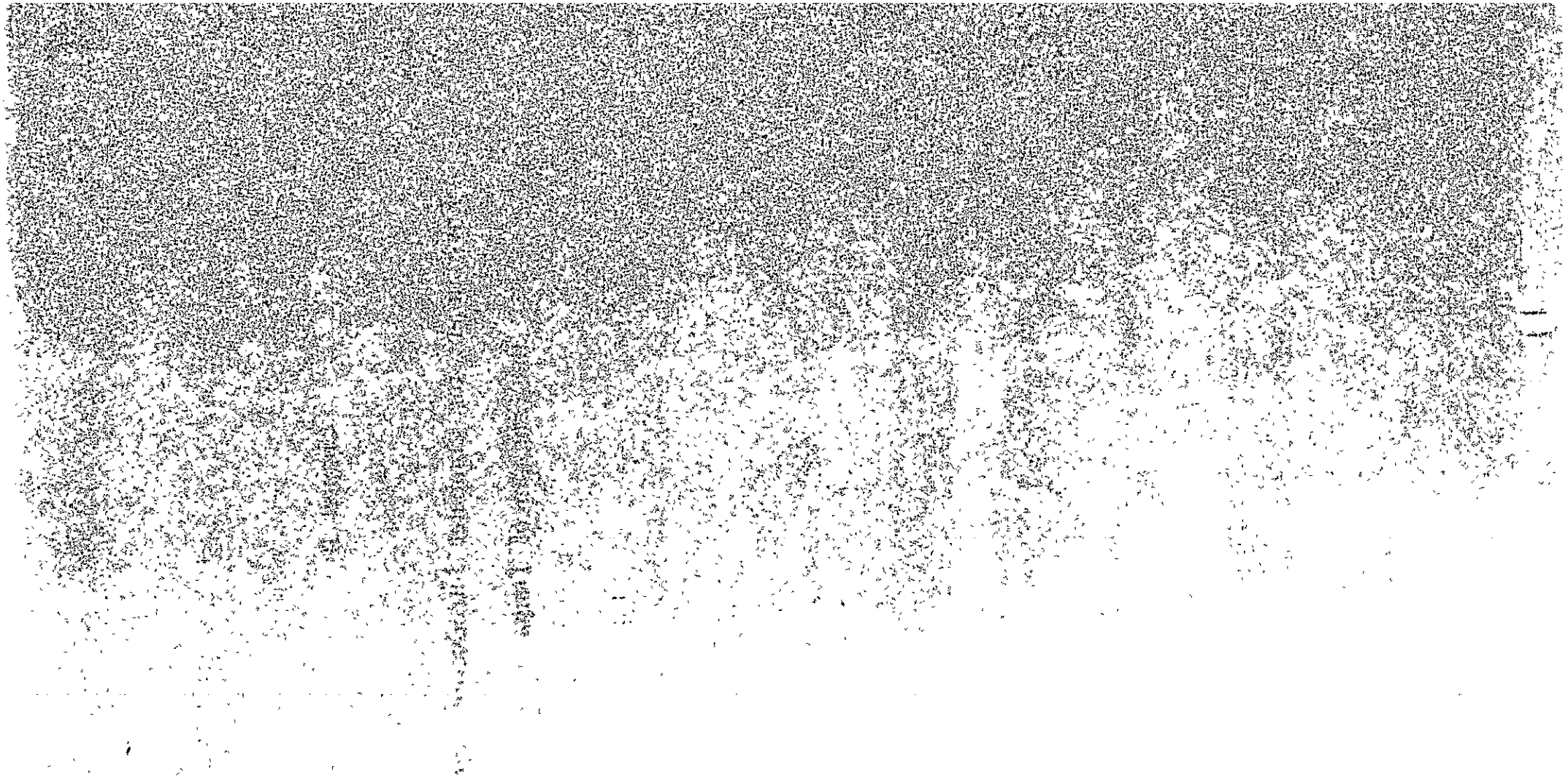
I	Master Plan Study	System Analysis	Analyzation of the present state of data processing and mapping out of improved plans in order to establish basic ideas for a new system.
II	Feasibility Study	Basic Design	Preparation of basic design of a new system for specified jobs to provide a developing and running program, including introduction of hardware, development of software, and planning of staff training for the system. Study on costs and effects of introducing the new system.
III	Design	System Design	Selection of a suitable computer system and its introduction. Concurrently, setting up of detailed requirements (codes, inputs, outputs, and files) for jobs that the computer will conduct, and definition of fundamental process flow.
		Program Design (In case of Development)	Division of the process into appropriate modules, and design of detailed processing procedures for all modules.
		Parameter Design (In case of Adoption of Software Packages)	Definition of parameter in order to adjust the software packages to be adopted to the system.

IV	Development	Programming (In case of Development)	Programming for all modules and testing of programs by module in order to examine their validity.
		Parameter Set (In case of Adoption of software Packages)	Set each parameters and test by module.
		Test	Testing of all programs in order to confirm their adequacy. Testing of the entire system in order to verify individual validity of each system.
		Installation	Conversion of current system into the new system.
V	Operation and Maintenance	Operation	Operation of the system.
		Evaluation, Maintenance	Evaluation of the system and improvement of the hardware and software in coordination with functional additions and updates.

Generally, following feasibility studies, an approval process is necessary, after which decisions, from the selection of computers to full-scale system designs related to the computerized system, will be made.

Chapter II

Environment for Computer Introduction into the Kingdom of Tonga



Chapter II. Environment for Computer Introduction into the Kingdom of Tonga

1. Economy and Society of the Kingdom of Tonga

1-1 Present State of Tongan Society

(1) Natural Conditions (Topography, Population, Climate)

The Kingdom of Tonga is an island state which consists of one hundred and sixty-nine islands in the South Pacific Ocean. They are located between fifteen and twenty-three degrees thirty minutes south latitude, and one hundred and seventy-three and one hundred and seventy-seven degrees west longitude, and are about eight thousand kilometers south-east of Japan, about two thousand kilometers north-east of New Zealand, and about eight hundred kilometers south-east of Fiji. The country is made up of three main island groups —the north group of Vava'u, the central group of Ha'apai, and the south group of Tongatapu—together with Niuatoputapu and Niuafo'ou Islands which lie north of Vava'u. The total area is about six hundred and ninety-seven square kilometers, and Tongatapu island amounts to about forty percent of this. The estimated population is 92 thousand (1979), of which about sixty-six percent is accounted for Tongatapu island.

Temperatures vary because of the long north-south axis of the islands. The capital Nuku'alofa has a subtropical and oceanic climate with periodic winds in the south-east direction. Temperatures average about twenty-six degree centigrade, and vary from a maximum of 31.9°C to a minimum of 10.6°C. Hurricanes occur from January to April, occasionally causing significant damage.

(2) Social Conditions (Government, People, Language, Religion, Transport, and Communications)

The Kingdom of Tonga won its independence from a protectorate of Great Britain in 1970. It is a constitutional monarchy and a member of the Commonwealth of Nations. The monarchy is supported by a social class system which is stratified into royalty, the nobility, and commoners. This system maintains stability on the basis of tradition. The government is composed of the King, the Privy Council, the Cabinet, the Legislative Assembly and the Judiciary, and the King has a wide influence on the people.

Racially the Tongans are Polynesians, and have their own nationality. They speak Tongan usually, and also use English as a official language owing to the spread of English education. For example, official documents such as the estimates are frequently written in both Tongan and English. Both are written in the Roman alphabet, which will facilitate the mechanization of office work. As for religion, almost all people believe in Christianity, and there are various churches in the country which contribute significantly to various

aspects of social development, including education.

The main means of land transportation is motor vehicles, and roads are being improved Air and sea services are available for internal and overseas transportation. Regular shipping services are operated between the islands, and the harbours at Nuku'alofa in Tongatapu, at Neiafu in Vava'u, and at Pangai in Ha'apai display lively activity when ships arrive. Domestic services are provided by South Pacific Islands Airways and private companies using light planes Air Pacific, Polynesian Airlines, Air Nauru, and Air New Zealand operate overseas flights between Fiji, Western Samoa, and New Zealand. It takes about one hour and a quarter to fly to Fiji and about three hours to New Zealand. The international airport of Fua'amotu is utilized for overseas flights.

Domestic telegraph and telephone services are managed by Telegraphs and Telephones, a government enterprise. However, it has been decided that this organization will become a quasi-government enterprise like other boards in July 1984. There are automatic telephone lines in Tongatapu Island, and radio-telephone is used to communicate between domestic islands. Since an earth station has been established by Cable and Wireless Ltd., international direct communications can be carried by satellite circuits, which make it easy to communicate with Japan.

(3) Economic Conditions

The GDP (Gross Domestic Product) of the Kingdom Tonga in fiscal 1982 amounted to about 56,570 thousand Tongan dollars on a nominal basis, and has continued to show annual growth of about ten percent on nominal basis for several years. GDP per capita has grown doubled over the past ten years, reaching about five hundred and eighty Tongan dollars in 1982. With regard to the percentage distribution of GDP by kind of economic activity in the past ten years, the ratio of primary industries has declined while that of tertiary industries, especially commerce, transport, and communications, has increased. This shows that the Kingdom of Tonga has become less self-sufficient with regard to agriculture, because of the bankruptcy of the Tongan land tenure system, referred to as the "Api System". It also implies a major social need for modernization.

In 1982, imports amounted to about 41,205 thousand Tongan dollars and exports to about 3,646 thousand Tongan dollars. This substantial excess of imports over exports has been a structural factor for several years Export commodities are relatively few while import requirements range from consumer goods to machinery. The visible trade deficit is covered by invisibles, namely remittances from overseas (about 11 million Tongan dollars in 1981/82), and donations, contributions and gifts (about 13 million Tongan dollars in 1981/82). These amounts do not include money transfers arising from foreign aid in kind, capital loans and capital grants.

As for the National budget, recurrent expenditure amounted to about 16,010 thousand Tongan dollars and development expenditure to about 4,970 thousand Tongan

dollars in fiscal 1982. This means that an amount approximately equivalent development expenditure is derived from various overseas funds.

(4) International Relations

The Kingdom of Tonga has maintained close diplomatic relations with neighboring nations namely Australia, New Zealand and the other South Pacific countries, since it won its independence from a protectorate of Great Britain. It has not joined the United Nations, but is a member of the Commonwealth of Nations, ESCAP and WHO.

Tonga's relations with Japan have been friendly since independence, and political and economic interchange have been encouraged. The Japanese Embassy at Fiji was established in 1980, and is the focus of Japan's diplomatic relations with the Kingdom of Tonga. Tonga's trade with Japan continues to show an excess of imports over exports. While Tonga's import from Japan amounted to 1,880 thousand Tongan dollars, its exports to Japan amounted to only one hundred and eighty Tongan dollars in 1981. Economic co-operation has grown steadily, however. Experts are dispatched every year to provide technical assistance, and financial co-operation has been provided since 1977.

Achievements to date are as follows.

1) Grants

* Fisheries Promotion Project (concluded in 1977)
* Nutrition Improvement Project (concluded in 1978)
* Construction of Primary School (concluded in 1980)
* Fisheries Development Project (concluded in 1981)
* Materials for Cultural Properties Protection (concluded in 1981)
* Small Fisheries Promotion Project (concluded in 1982)

2) Technical Co-operation

In addition to the reception of trainees and the dispatch of experts on fisheries, administration, and so on, the following projects have been carried out or planned.

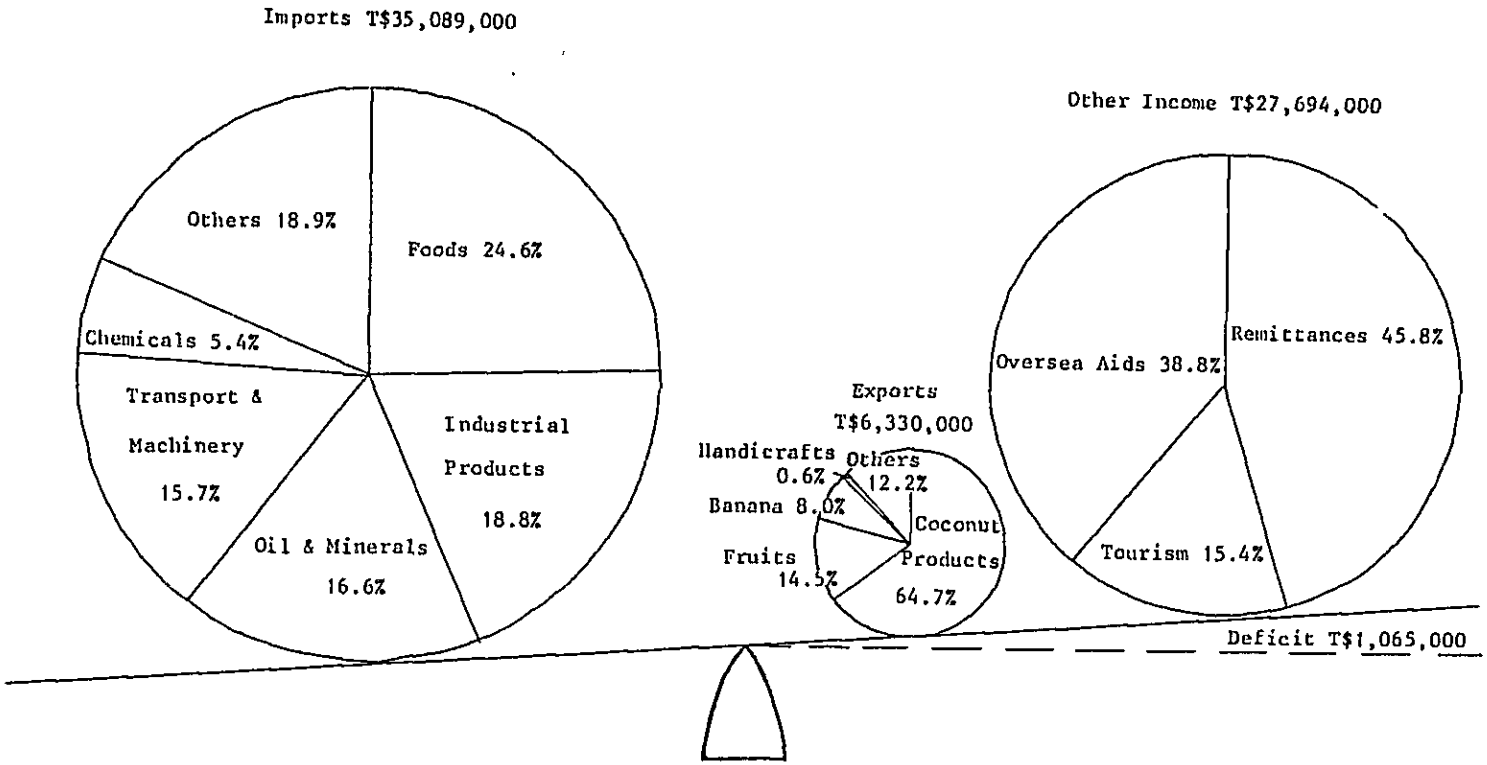
* Health and Sanitation Inspection Station (1981 ~ 86)
* Materials for Fishery Training (1981)
* Preliminary Study for EDP System Introduction Project (1981)

Table II－1－1　Economic Indices of the Kingdom of Tonga

	1978	1979	1980	1981	1982	
Gross Domestic Product	34,710	40,583	46,278	51,244	56,570	fiscal year T$1000
GDP per capita	378.6	436.2	490.0	534.6	581.4	fiscal year T$
Export	4,570	6,268	6,910	6,330	3,646	calendar year T$1000
Import	22,318	26,210	30,135	35,089	41,205	
Revenue	8,722	10,597	12,571	15,723	16,338	fiscal year . T$1000
Expenditure	8,932	10,538	11,758	16,266	16,005	

Source : Statistics Department

Fig. Ⅱ－1－1　Tonga's Economy (1981)



1-2 Economic Òrganization of the Institutions Covered in the Study

This EDP study of covers nine organizations in the government, quasi-government and private sectors These organizations are, in some senses, characterized by their public roles, as the following chart shows.

The Treasury and Statistics Departments of Ministry of Finance and the Ministry of Police are classed as general government proper. The Treasury Department controls the budget, that is, the accounting of revenue and expenditure or the salary accounting. As a result, the Treasury has close relations with other government institutions in the area of data processing. In addition to these activities, it also issues notes and coins and sells stamps. The Statistics Department compiles internal and external statistical information, and publishes periodical trade statistics, balance of payments, price statistics, and national accounts. It is primarilly concerned with national information through surveys of establishments and households or reports on taxes and customs. The Ministry of Police administers the maintenance of public peace and order, regulation of traffic and emigration and immigration control. These tasks require various forms of registration or recording operations. Emigration and immigration control is particularly important because of problems associated with the growing number of foreign tourists visiting Tonga each year. Emigration has also become a social problem in the Kingdom Tonga.

Among these organizations, the Government Store of the Ministry of Works belongs in the government enterprise category. The main role of the Government Store is the procurement of goods for government organizations. Because government activities account for a higher percentage distribution of GDP, and the Government Store supplies these government organizations with almost all goods procured, this organization has an extremely high position of economic significance in the national accounts.

Another public sector category consists of quasi-government public corporations. Among the organizations surveyed, the Tonga Commodities Board and the Tonga Electric Power Board are classed as Public Corporations, of which Tonga Commodities Board is the largest, employing about eight hundred and sixty workers. It consists of the Construction Division, Field Construction, Workshops, Processing and Research Division, and Primary Produce Division, each of which has its own historical background. In addition to handling the main agriculture exports commodities (copra, bananas, vanilla, etc.) The Board also operates a soap factory and is in charge of housing construction and sales of construction materials.

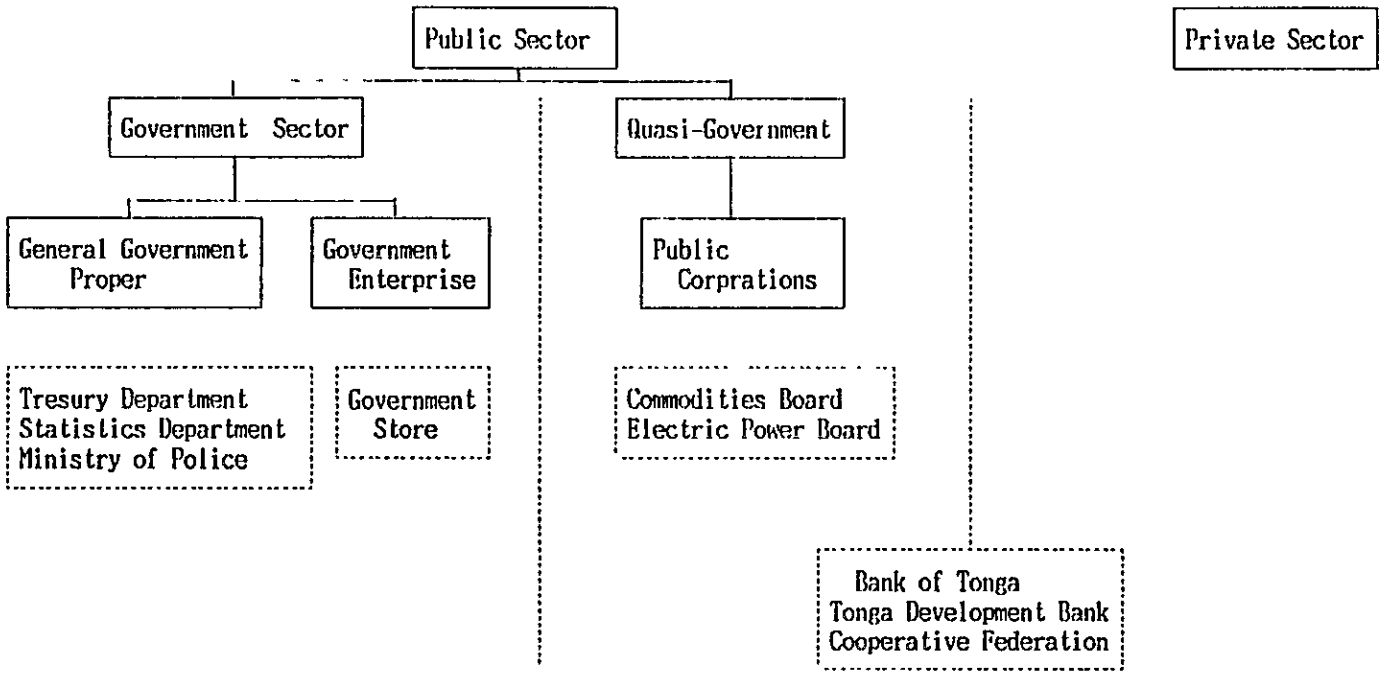
Tonga Electric Power Board operates a electrical goods store as well as supplying power The production of electric power relies on diesel generators, since the islands of Tonga have no rivers.

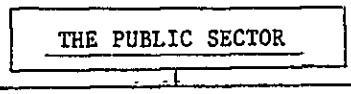
Some organizations are primarily in the private sector, but receive loan aid from the Government because or their public roles These are the Cooperative Federation, the Bank of Tonga and the Tonga Development Bank. The Cooperative Federation operates whole-

saling, and distributes import commodities to domestic small retailers (members or non-members). In addition it handles the sale of crafts and also fisheries. The Bank of Tonga was established as a private corporation in 1974, but the Government is the biggest investor. It deals with such public activities as foreign reserve control, loan regulation and receipt of revenue. Finally, the Tonga Development Bank is a credit bank which was established under the government leadership. It lends money at low interest and promotes private incentive projects.

Government organizations are thus deeply involved in the industrial economy in the Kingdom of Tonga. The country would therefore benefit socially and economically from the introduction of data processing procedures and support systems in these organizations, given aid were extended to lighten the initial cost and appropriate technical advice.

Fig. II - 1 - 2 Classification of Organizations





GOVERNMENT SECTOR

PUBLIC CORPORATIONS (STATUTORY BOARDS)

- Tonga Commodities Board
- Tonga Electric Power Board
- Tonga Broadcasting Board
- Tonga Water Board
- International Dateline Hotel

PRODUCERS OF GOVERNMENT SERVICES (General Government Proper)

GOVERNMENT ENTERPRISES

GOVERNMENT MONOPOLY

QUASI-CORPORATE ENTERPRISES

DEPARTMENTAL ENTERPRISES

- Philatelic Bureau

- Civil Aviation
- Harbours & Wharves
- Post Office
- Telephone and Telegraph
- Government Fisheries
- Government Sawmills

SMALL-SCALE ENTERPRISES

ANCILLARY ENTERPRISES

- Newspaper Office
- Visual Aids Centre
- Government Hostel
- Marketing Services
- Agricultural Mechanical Pool
- Rent of Buildings
- Niuafo'ou Copra Production
- Carpenter Shop (MOW)
- Machine Shop (MOW)
- Hire of Plant and Equipment (MOW)
- Sale of Coins

- Printing Office
- Government Store

◦ Public Administration and Defence

1.General Public Services:
- H.M. The King
- Legislative Assembly
- Prime Minister's Office
- Governor Vava'u
- Governor Ha'apai
- Statistics Department
- Justice
- Police
- Crown Law
- Ministry of Finance
- Inland Revenue
- Customs
- Audit
- Civil Pensions and Gratuities
- Prisons
- Central Planning Dept.

2.Defence

3.General Administration, Economic Policies and Services including community development programme:
- Ministry of Labour, Commerce and Industries
- Ministry of Agriculture (Admin.Only)
- Ministry of Lands and Survey (Admin.Only)

◦ Educational Services: Ministry of Education

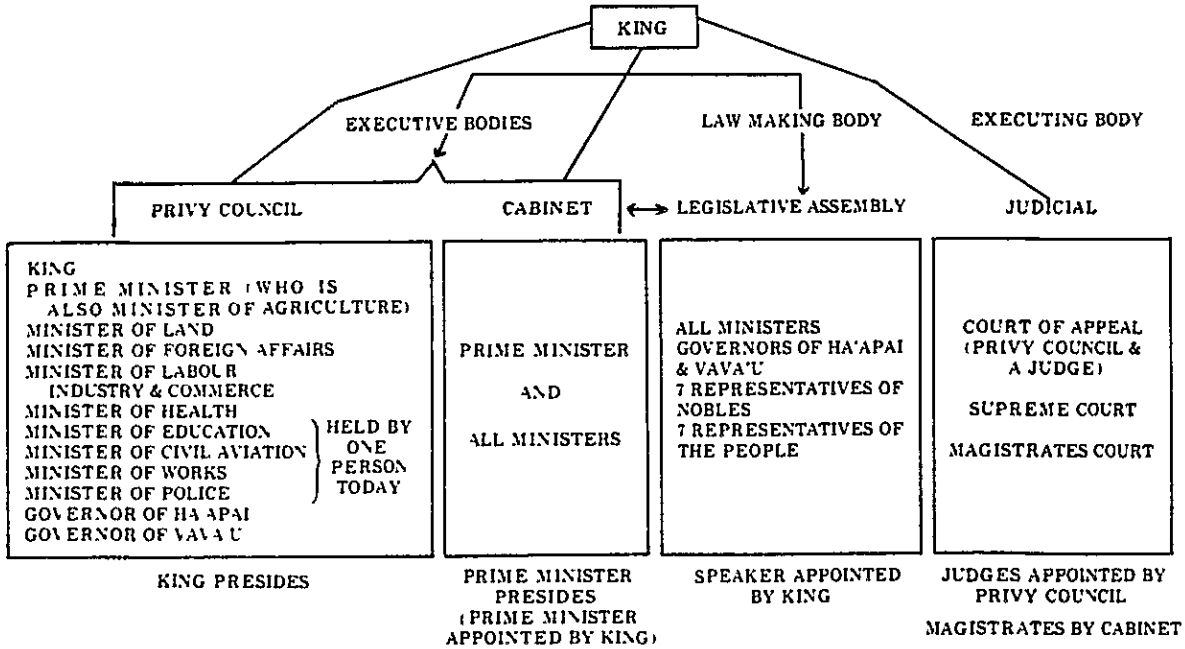
◦ Health Services: Ministry of Health

◦ Agricultural Services: Ministry of Agriculture (Excl.Admin.)

◦ Community Development and Other Services: Ministry of Lands and Survey (Excl.Admin.), Tourist Office

SOURCE : Statistic Dept.

Fig. II-1-4 The Structure of The Government of Tonga



2. National Policy on Data Processing

Among data processing jobs conducted in Tongan ministries and government-related organizations, one of the most important works is that performed at the Treasury Department of the Ministry of Finance, which administers the national budget. The jobs of the Treasury, as have been explained in Section 1 of this chapter, play vital roles in backing up economic growth of the Kingdom by maintaining the annual revenue and expenditure of the state in good balance.

Effective utilization of the national budget is particularly essential.

With respect to this key point, the Tongan administration is striving to cut wasteful expenditures in the national budget in line with the statement that "government budgetary practices are to be reviewed in order to reduce inefficient and ineffective expenditures" (the Fourth 5-Year Economic Development Program). To achieve the goal that "the accounting system will be reviewed to produce more timely reports and give earlier warnings of likely over-expenditure," the government is stressing the importance of increasing the efficiency of administrative jobs in quickly and correctly grasping the exact facts of annual revenue and expenditure. In order to accomplish this, the introduction of computerized systems is at the focus of great expectations for enhancing the efficiency of these administrative jobs.

At the same time, in the Statistics Department, some delays have been found in the preparation of reports ("Statistics on Imports and Exports"). These reports include important data for management of the national economy and thus require submittance on an earlier basis; this can be obtained by introduction of computerized systems.

Thus, this study underlines the fact that improvement of the efficiency of data processing, by introduction of computerized systems, is a vital process for the execution of governmental policies. It is suggested, however, that measures for the prevention of unemployment due to the introduction of an EDP system must be taken, as stated that "automation of the accounts will also be considered, but care will be taken to ensure a balance between efficiency and maximum possible employment."

These administrative policies seem quite reasonable, and the introduction of an EDPS seems to be indispensable for modernizing economic management, due to the fact that many administrative jobs such as the rapid preparation of statistics and reports, which cannot be improved by staff augmentation, must be carried out within a reasonable period of time in order to be put into practice. Finally, however, there are several requirements of expanded administrative services which will be beyond the capacities of the new system, such as insuring that enhancement of administrative efficiency can be furthered with little fear of unemployment.

3. Environment for the Introduction of Computers

3-1 Current Use of Computers in the Kingdom

3-1-1 Computers Presently in Use

The following description concerns computers which have been brought into the Kingdom. For the first three systems the team observed the units and received on-site explanations of the systems. For the remainder of the units, information including numbers, types of machines, and applications was obtained by interviewing relevant persons.

(1) The Treasury Department (Ministry of Finance)

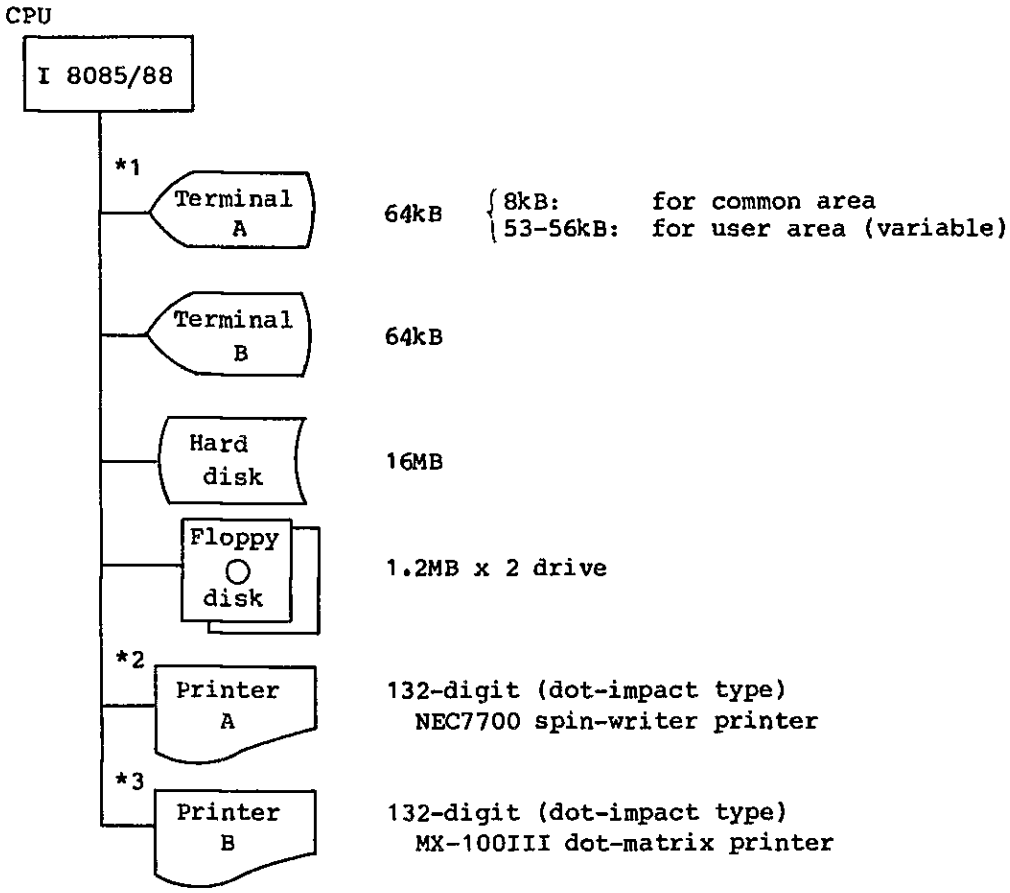
The Treasury Department has, with aid from the Australian Government, introduced two AED*1 S-100 systems. The hardware configuration of each system, including air-conditioners and standby batteries, is shown in Fig. II-3-1. Two systems are installed separately in the computer room and the Economic Research Section. The computer can be connected with 16 terminals at maximum Manuals completed for the system software are as follows:

(a)	MULTI/OS*2	(Info Soft Co.)
(b)	COBOL-80	(Micro Soft Co.)
(c)	PASCAL/MT+	(Digital Research Co.)
(d)	dBASE II*3	(Aston Tate Co.)
(e)	Word Star*4	(Micro Pro Co.)
(f)	Super SORT*5	(Micro Pro Co.)
(g)	Accounting System	(IMS Co.)

Notes: *1 AED stands for products of the Acoustic Electronic Development Co. of Australia.
*2 Multiuser operating system compatible with CP/M.
*3 Relational data base management system.
*4 English language word processor.
*5 Utility that conducts SORT and MERGE processes.

Among the list, only dBASE II and Word Star have been put into practical use. Although Word Star is being used for preparation of reports, programs for salary calculation are still under development. Details of the Department are described in Section 2, Chapter 3.

Fig. II-3-1 Hardware Configuration of AED S-100



Notes: *1 Each terminal is a set consisting of a display and a keyboard. Both are manufactured by AED. The display is an 80x24 green monitor.

*2 Both printers are of OEM make, and are somewhat noisy and slow.

*3 Although there are 20 mountable slots, only 11 are currently in use.

(2) **Telegraph and Telephone Department**

The Department has two Apple-II systems that are the same as those being used in Western Samoa with the assistance of ITU. The systems are employed in calculating and charging phone bills using application programs developed by ITU. Each consists of a main unit equipped with a display, two 5-inch floppy diskdrives, and a printer. Memory size has been increased to 64KB, and the keyboard has been provided with an additional ten keys to speed up input of figures. The computer room itself is dust proof and has an air-conditioner. The software includes Apple's BASIC and CP/M, an operating system. The operators are Tongan women who are well-trained and follow instructions carefully. There are now an estimated 2,000 subscribers using 3,500 lines.

(3) **Tonga Technical Development Holdings, Ltd.**

The company employes an Olivetti M-20 system, which conducts a portion of the accounting using Multiplan, a spread sheet type software.

(4) **The Ministry of Land Survey**

The Ministry has the same AED S-100 system as the Treasury Department. The system has just been installed so it is not yet in practical operation.

(5) **The Ministry of Foreign Affairs**

It has been reported that the Ministry maintains an Olivetti micro-computer; however, details are unclear.

(6) **The Ministry of Welfare**

A Canon micro-computer is expected to be introduced and to be used for the preparation of health-related statistics.

(7) **Seventh-Day Adventist Society**

The society has introduced an Apple-II unit equipped with a floppy diskdrive, 10MB hard disks, and a printer. The system is used in translation between Tongan and English, blood-type testing, and word-processing, etc..

(8) **Mormon Church**

The church utilizes a Honeywell machine for translation and accounting.

(9) **Polynesian Printing Ltd.**

The company maintains a KAYPRO II (United States) for accounting, database management, and word-processing.

(10) Others

It is reported that some individuals are privately utilizing Osborne and Apple-II machines, and Cable & Wireless Co., Ltd., is expected to bring in an IBM micro-computer.

3-1-2 Comments

As detailed above, in the Kingdom of Tonga a variety of small computers are being put into practical use; this would be a source of future troubles because of the following factors:

(a) Each type of computer requires individual stocks of its own particular spare parts.
(b) Experience with one type of these computers is not always applicable to the others.
(c) Programs and data are in most cases not compatible.

Data processing systems in the Kingdom fall roughly into two groups. The first is related to commodities, vouchers, and cash in various agencies such as the Treasury, the Government Store, the Bank of Tonga, and a network subgovernmental organizations. The other group includes completely independent systems such as those of the Ministry of Police and a part of those the Statistics Department keeps.

Changing the former groups into an EDP network will probably require a central computer of fairly large capacity (a mini-computer at least). In anticipation of such an EDP network, it is desired that small computers in prospective subsystems be of the same make or of similar type. The current situation in the Kingdom of Tonga is that diverse types of computers, as depicted in Section 3-1-1 of this chapter, have already been introduced, and therefore, if a data communication system is to be planned for the future, it is necessary to provide early countermeasures in order to offset this. This will call for powerful leadership by the Tongan Government.

In the beginning, introduction of EDP into data processing in the latter group, where systems are local and independent, should be promoted. Meanwhile creation of the proper environment, by the improvement of electric power sources and the training of personnel, should be implemented for an EDP network in the future.

3-2 Infrastructure for Computer Introduction

3-2-1 Staff

(1) Computerization and Staff

The most critical aspect of the introduction of EDP systems into the Kingdom will be human factor.

In general, the development and operation of an EDP system requires systems analysts, system designers, programmers, operators, terminal operators and backup support by customer engineers of the hardware manufacturer Fig. II-3-2 shows a comparison of introduction processes of the required hardware and staff, with development processes for computerized systems, as shown in Fig. I-1-1. The roles of the staff members are as follows.

(a) EDP Manager is the responsible person for the system development and its operation.

An appropriate knowledge and good experience in the systems related field should be requested.

(b) The systems analyst prepares a basic outline for the introduction of computer systems by analyzing details and processes of the jobs which are to be computerized, and by selecting potentially computerizable processes from among them and determining the necessary conditions for introduction (Master Plan). In addition, he provides the basic and conceptual design for necessary codes, input/output documents, and details of files, conforming to these, he prepares the entire schedule for the development of the computer programs and the staff training program, as well as estimating the cost of such. Lastly, he calculates profit against cost by determining various effects and impacts caused by introduction of computers (the Preparation of the System Development Plan).

(c) The systems designer designs the specific codes, inputs, outputs, and files for the selected jobs, and provides a process design indicating a series of processing procedures from data input to output (Systems Design). He or she also breaks the process down into modules, and designs detailed processing procedures for each module (Program Design).

He may work with the systems analyst at the beginning of planning, or may execute the planning for the systems analyst in case of his absence.

With a general knowledge of programming and computer operation, he must manage all processes related to development and operation of computerized system (from introduction of computer systems to program development and tests).

As such, the systems designer is the most important member of the staff in the

development of a computerized system.

(d) The programmer, in accordance with the specifications of the system design provided by the systems designer, writes programs in a specific programming language. Such work is called programming or coding, and it gives commands for the computer to process data in specifically laid-out procedures. Although some programming languages differ depending on the type of computer used, languages that are used commonly throughout the world include COBOL, FORTRAN, PL/1, and BASIC, etc.

(e) The operator runs the written programs (or the software) through the computer daily, weekly, or monthly depending on the requirements of the particular job. Thus, the operator should be conversant with the operating system (OS) in order to handle the computer software.

(f) The terminal operator inputs data into the computer system periodically or when necessary. This work can be performed by a typist.

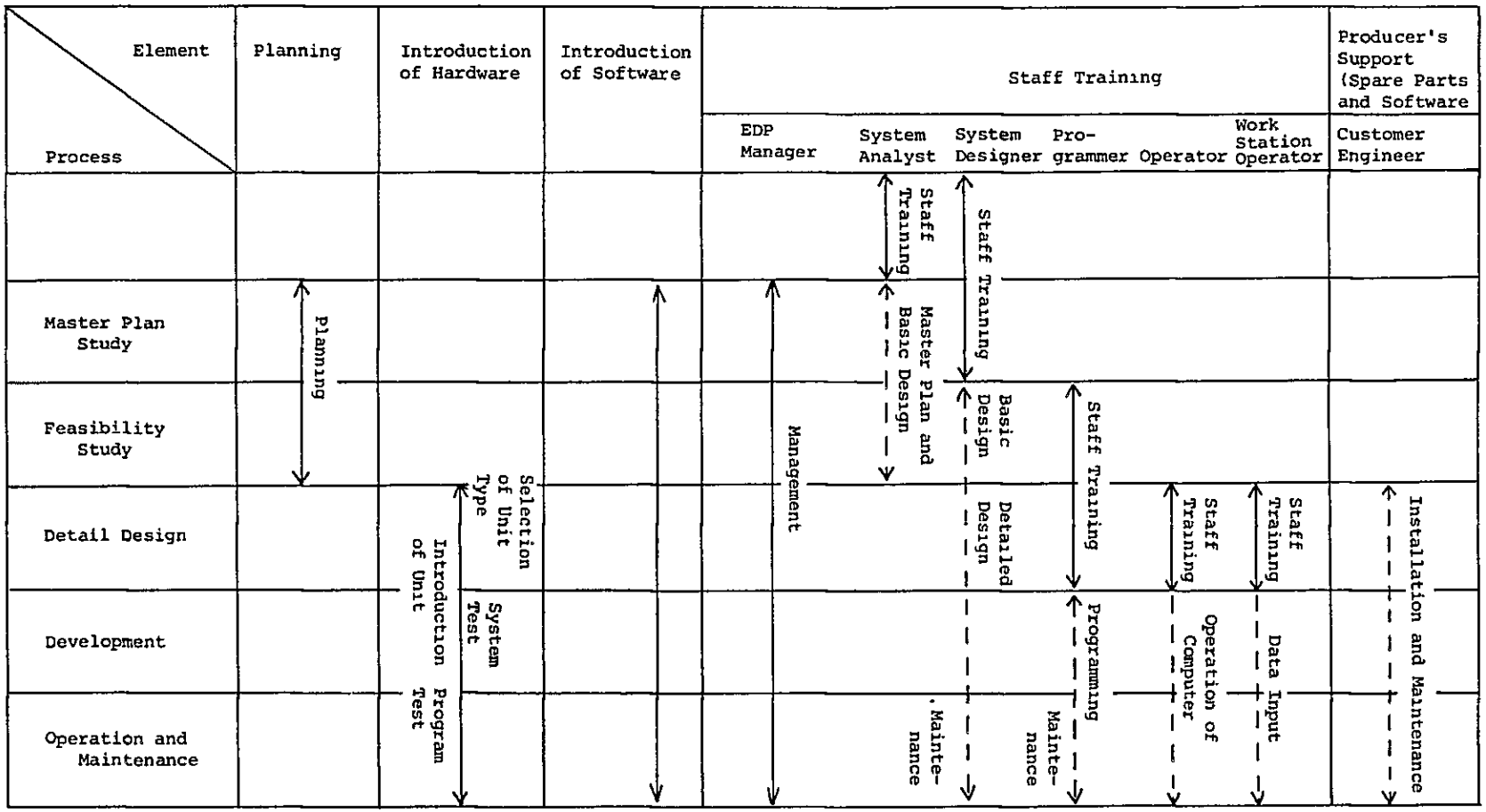
(g) The customer engineer, a non-staff member, provides support by solving problems related to the hardware and the operating system of the computer Whether such immediate support is available or not is one of the important factors to consider at the time of introduction of a computer system.

The above staff configuration is typical for introduction of a medium-size or large-size computer, but some of these jobs can be combined for a micro-computer.

A micro-computer system can be developed and operated with a system analyst/designer, a programmer, and a terminal operator as the minimum staff requirements, because, (i) non-specialists can operate the machine, (ii) the reliability of the hardware is fairly high, and (iii) softwares, for simple tabulation functions and so on, which enable the user to develop a system easily, are provided as application packages. Moreover, since a typist can usually be easily trained as a terminal operator, the unaided development of a micro-computer system requires training of only a systems analyst/designer first, and then a programmer.

The problem with hardware is that the backup of a customer engineer is needed, as are spare parts for repair. Thus, in countries such as the kingdom of Tonga, where it is not easy to obtain the ready back-up support of a customer engineer, if the system internal staff is able to repair the hardware to some extent stability of computer utilization will be increased.

Fig. II-3-2 Introducing and Developing Processes for Computertized Systems and Necessary Elements (Medium and Large Units)

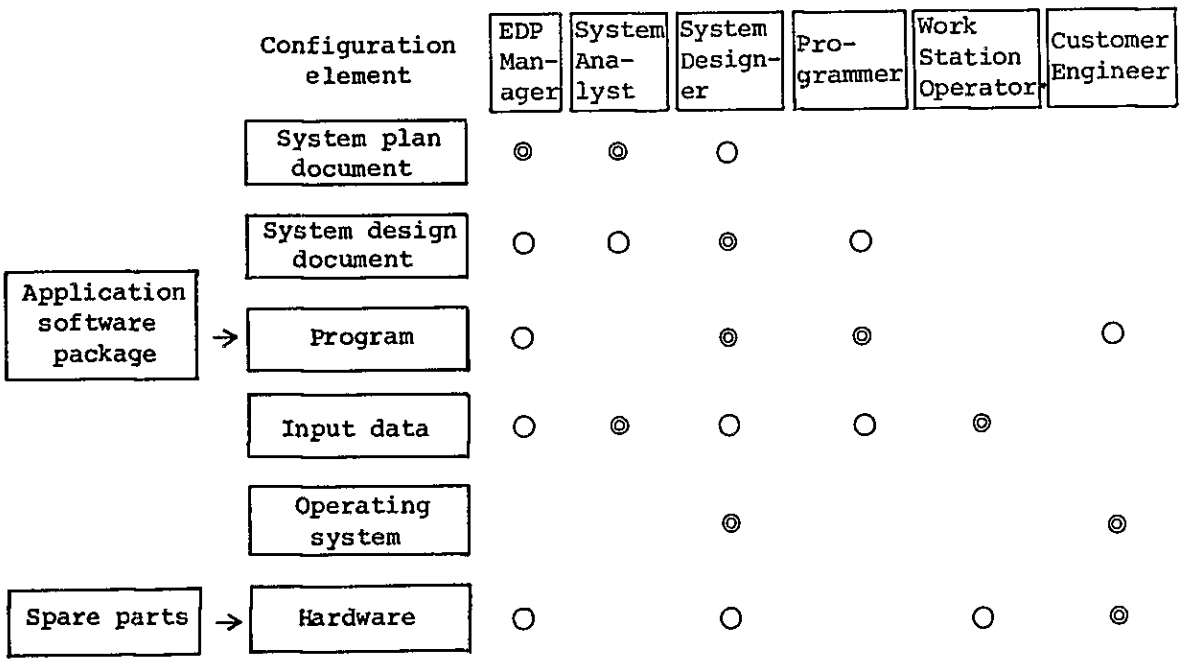


One countermeasure against computer breakdown is to have two machines of the same type. Normally, the two computers carry out their respective jobs adequately, but when there are problems with one unit, its job can be transferred to the other machine until repair has been completed. Therefore, it is desirable for the internal staff to be able to repair minor problems.

The staff training scheme should begin with lessons on the operation and programming of the computer, as a longer period will be necessary to train a system analyst/designer who is expected to become the key person in the system development. Therefore, it is more realistic to invite a systems engineering expert from abroad to conduct system development in parallel with on-the-job staff training (OJT).

It also is desirable to use as many programs as possible of the existing application software package. The development of new programs requires much more time and money, while existing programs require much less effort on the part of the programmer to master their operations, thereby shortening greatly the period necessary for training.

Fig. II-3-3 Development Elements and Roles of Staff Members for the Computer System (Micro-computer)



(2) Current Situation Regarding Personnel in the Kingdom

Because the current situation regarding personnel in the organizations surveyed is described in Chapter III, only a general outline is included here.

(a) Government-Related Organizations

Among govenment-related organizations, an Apple-II (micro-computer), installed in the Telegraph and Telephone Department, is the only machine now in operation. In this department, a foreign expert, holding the position of technical manager, is conducting back-up support for the hardware and systems development, while a Tongan woman is actually operating the unit. Some Tongans are now being trained as systems analysts/designers.

The Treasury Department is now developing a computerized system. Tongan women carry out data input and operation, while a foreigner writes the programs. In the Statistics Department there is as of yet no computer unit, but among the staff there is a foreign expert on statistics. Moreover, some of the staff have been educated in EDP and statistics, so the department is well-prepared, in terms of human resources, for introduction of a computer system.

As mentioned above, foreign experts in government-related organizations are now actively involved in the computerization of jobs and are able to handle these jobs in a systematic manner. Unfortunately, however, most Tongans who are working under these foreign experts are not able to help them in designing the computerized systems.

It is expected that people such as the staff of the Statistics Department who specialize in collecting data, and other workers who are in charge of accounting in various organizations and are interested in computers, may become system analysts.

Allowing Tongan clerks to operate computes by themselves, even though it may be in a trial and error way, will be an important factor in deepening understanding of computers and enhancing the clerks' abilities.

(b) Enterprises (Government and Private)

Governmental or private enterprises that employ electronics engineers (foreigners and Tongans) who have the ability to support hardware and software are:

Tonga Broadcasting Commission
Cable & Wiereless Co., Ltd.
Tonga Technical Development Holdings Ltd.
Moor's Electronics
Mr. Joese's VT Shops
Mr. M. Schuster's Electronics Shop

The Telegraph and Telephone Department and the Tonga Electric Power Board have grasped the importance of infrastructures such as the fundamental environmental and supporting systems necessary for installation and maintenance of computers; thus it can be said that they have already prepared for the introduction of computers.

(c) Educational Institutions

The branch of the University of the South Pacific in the Kingdom has no lecture course in electronics at present; the University once planned to provide one but failed to invite an instructor.

The Rural Development Center related to the Rural Development course, one of the present lecture courses, has both a radio and ham club in which a Tongan electronic engieer who has returned from the United States is undertaking guidance.

The Atenisi Institute established a lecture course in electronics three years ago, and now has seven Tongan students under the guidance of a German and an American instructor.

Tonga High School is reportedly interested in education in electronics.

As stated above, almost all computer engineers in the Kingdom at present are foreigners, and Tongans are working only as operators of micro-computers that have been introduced and are being managed by those foreigners. This fact, however, indicates that Tongan staff training has already been initiated through direct contact with these computers, showing the importance of OJT.

Although it is essential that Tongans who will have studied electronics remain in the Kingdom, one problem is that they may leave to work in countries such as the United States, New Zealand and Australia, seeking higher incomes.

This may be inevitable considering that much or Tongan foreign revenue consists of remittances by such workers, but introduction of computers into the Kingdom will require some compensatory measures which impel them to remain in the Kingdom.

3-2-2 Electric Power

Electric power available in the Kingdom is rated at 240 V and 50 Hz with regulatory fluctuations of ±20 V and ±1 Hz. Private owners of a shop selling electrical business equipment in Nuku'alofa confirmed that the fluctuation of the voltage sometimes exceed these figures. The Board's view is that such fluctuations are also caused by user's illegal use of electric devices.

It has been reported that although there are few power outages for long periods, short period outages ranging from several to ten or so minutes frequently occur.

Because the Tonga Electric Power Board does not publish accurate data on power quality, statistical materials cannot be obtained. However, the facts that the AEDs-100

computer installed at the Ministry of Finance has had added a constant voltage power supplier with batteries, (suggest a fairly poor quality of electric power supply.)

Thus, even a personal computer, intended for use on a daily basis, will require the addition of a CVCF (Constant Voltage and Constant Frequency) device to its power source, and also, the addition of a UPS (Uninterruptible Power System) unit to the computer for important jobs.

3-2-3 Hardware/Software Maintenance

In computer operations, proper maintenance includes the following three particulars:

(1) Computer Supplies
(2) Hardware Maintenance
(3) Software Maintenance

That is, in computer operations, the most important points are whether or not various necessities and parts can be supplied in time, and whether troubles which occur in the hardware or software can soon be recovered from. In the latter case, depending upon availability of the required staff, such as engineers, problems may or may not be ascertained correctly and taken care of speedily. If it is too difficult a problem for the computer user to take care of, outside (domestic or overseas) support will have to be obtained.

(1) Computer Supplies

This refers to physical supplies related to the computer such as paper, cards, disks, and tape. Governmental organizations and firms now dealing in typewriters, desk calculators, and general office supplies are expected to be able to supply them.

(2) Hardware Maintenance

This refers to parts supply and repair of computers themselves, and input – output equipment.

Parts will be supplied partly by electronics companies and firms in Tonga previously mentioned. For problems which the users cannot clear up themselves, the following solutions are being considered.

(a) Support services could be entrusted to hardware distributors in Fiji, New Zealand, or Australia.
(b) If possible, the previously mentioned electronics companies should take charge of maintenance services independently or as local agents in cooperation with Fiji, New Zealand, Australia, the U.S., or Japan.

(3) Software Maintenance

Software maintenance consists of the maintenance of the Operating System (OS)

and the Application Software.

(a) As for the OS, since the present hardware supplied by the hardware distributor is operating well, simply receiving upgraded version from the manufacturer will suffice. For microcomputers, many types of units with common OS such as CPM86 and MS/DOS have begun to be installed and have had stability improved.

(b) If the Tongan Government undertakes the development of the application software themselves, programmers should be trained in governmental organizations. During the training period, backup services for software maintenance will be entrusted to engineers of the domestic or foreign hardware distributors and maintenance companies described in section (1).

3-2-4 Environmental Conditions for Computer Installation

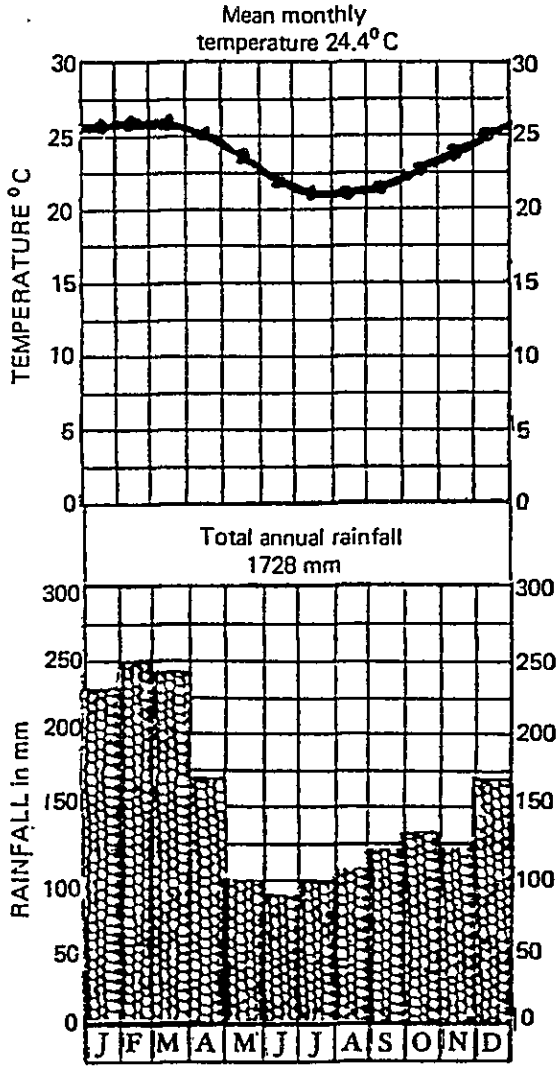
In general, for the introduction of computers conditions for installation which must be taken into consideration are atmospheric temperature, humidity, salt-air, and dust, as well as the electric power situation.

Yearly changes in atmospheric temperature and rainfall are shown in Fig. II-3-4. The annual average temperature is approximately 24.4°C and total yearly rainfall is approximately 1,728 mm; in the rainy season which extends from December to April, the temperature is 25° to 26°C on average (with a high of 31 9°C), monthly rainfall is 250 mm, and the average humidity is 75%.

On the other hand, recent advances in hardware have greatly improved the capability of small size computers to adapt to environmental conditions, which eliminates the necessity of providing very strict environmental control. However, consideration of the imperfect maintenance and support systems of the hardware in the Kingdom has resulted in a suggestion that the room should be as clean as possible to protect units from salt-air and dust, that the room should be provided with an air-conditioner (a standard unit is sufficient), and that entrance and exit of persons concerned should be fairly limited in order to maintain the aforesaid environment and, additionally, preserve secrecy.

For installation of a mini-computer or larger unit, a special room for exclusive use of the computer, and equipped with an airconditioner, should be provided.

Fig. II-3-4 Climograph : Nuku'alofa Average Climate : 1945-1970



3-3 Computerization in Fiji, a neighboring country

The study team, in investigating the feasibility of computer introduction into the Kingdom of Tonga, surveyed the actual situation in Fiji in order to get information on experiences in the introduction of computers and their current state, and on the availability of support services from the nieghborhood.

3-3-1 Computerization in Fiji

(1) In Fiji, IBM opened a user bureau to offer computation services before 1970. IBM's 1401 machines were rented to the Government and small computers were introduced into other organizations separatley. In 1970, when Fiji became independent, IBM withdrew, so the Fijian Government established a full-fledged computer center and introduced British-made ICL computers; private companies also started their computerization. Computers introduced up to now are roughly as follows.

(a) Mini-computers

Fiji Government Computer Center, EDP Services ICL
Bank of New Zealand ICL
Westpac Banking Co. ..... NCR
Private computer sales companies . NCR
Other private companies ..... WANG, PRIME and others

(b) Micro-computers: Around 150 units (with an additional 150 terminals)
ICL, NCR, Olivetti, Apple-II, WANG, RPIME, COMMODORE, TRS 80, MICRODATA, ATARI, and others, including 12 Japanese-made CANONs and 3 Japanese-made SORDs.

The Fiji Compute Society was organized in September 1983, and has now some 70 members including 30 or more companies that install computers or distribute hardware. The number of members is expected to exceed 200 in 1984.

(2) **Main computerized jobs are:**

Accounting concerning debtors, creditors, and general ledgers.
Payrolls
Stock control
Merchandise information and financial planning
Word processing
Statistical processing in governmental agencies

(3) Fiji maintains diesel and hydraulic power plants; thus, power quality is said to be much better than that in the Kingdom of Tonga. Since December 1981 the Westpac Banking Co. has maintained an on-line network that links the Center at Suva with the branch offices on Viti Levu and Vanua Levu Islands through the Fiji Posts and Tele-

graphs Department's microwave link and land-laid lines.

3-3-2 Fiji Government Computer Center, EDP Services

(1) Establishment

After the establishment of IBM's service center, the Government immediately began to receive computation services from the Center, and later rented an IBM 1401 machine. In 1970, at the time when Fiji became independent from the British Commonwealth of Nations and IBM withdrew from Fiji, the Government itself established a computer center by introducing an ICL 1902A machine. With the establishment of the center, while there was no aid from foreign countries, there was an offer of skilled staff from the British Government. Since then, the Government has made efforts to expand the staff number and its services. The units are replaced approximately every five years.

(2) Units in Use at Present

Hardware:	ICL ME 29, Model 45 (640 kB)		2 sets
	Each set:	60 kB Mt Drive	2
		PBS Line Printer	1
		MDS Disc Drive	3
		Multipurpose Work Station	9
Software:	OS:	TME Operating System	
		FIND2, TME RAPID, QUERY MASTER, PDS, DDS, QPG	
Languages:	COBOL, FORTRAN		
Packages:	COCENTS, RGSP, SI General Ledger Package X, and others		

(3) Maintenance and Backup Support

Five customer engineers sent from ICL are providing sufficient maintenance.

The backup unit is the ICL unit installed in the Bank of New Zealand, and it is mutually performing backup functions with the unit of the Center.

The electric power supply is said to be better than that in the Kingdom of Tonga, and no installation of auxiliary equipment (standby generators, etc.) is reported.

(4) Staff

All staff members except three are Fijians, and many of them are working on the development of programs.

(5) Jobs

Government-related jobs account for 90% of the workload of the Center. Applications of the computer include approximately 90 jobs including Payroll, Statistics, Immigration Control, Billing, Registration, Education, Building Design, and Project Management, with about 800 programs running at present.

Examples other than common payroll, accounting, and statistical systems are:

- The Bureau of Statistics:
  Population censuses, population projections, and statistics on imports and exports
- The Education Department:
  Summation and classification of examination results
- The Public Service Commission:
  Information on an estimated 17,000 temporary employees
- The Department of Meteorology:
  Analyses of data on rainfall, river levels, and climate
- Registrar-General's Office: Analyses of population movement
- The Lands Department: Mapping
- The Telephone Department: Telephone charge billing

A new software package for Government accounting is supposed to be introduced in 1984.

Sometimes the Center is also requested to perform mainly statistical processes for surrounding countries; for example, summaries or census and population projections from Western Samoa, and foreign trade statistics from the Cook Islands. In addition, the Center carried out statistical processing of the population census of the Kingdom of Tonga in 1981.

In 1986, a population census is scheduled for the Kingdom of Tonga and the country of Burma, but the Center says it has not yet received a formal request for a census data processing from the Tongan Government. The input format of population censuses differ from country to country, resulting in the absence of a unified census system.

The unit at the Center is only used in batch operation at present, but on-line processing of special interest to the Ministry of Police is expected in the near future. Additionally, a distributed processing system will be examined in the coming two years.

The Fiji Government Computer Center is one of the major official organizations for computer staff training in Fiji, as well as the site of the University of the South Pacific lecture course in computers.

3-3-3 Private Computer Sales Companies

The study team was informed about actual computer services in Fiji from two private

computer sales companies that deal with Japanese-made computers.

TECAIR Co. conducts electronics technology services and sells Japanese-made SORD models PACIFIC MERCANTILE Co. is a sales company dealing with CANON and SORD-brand computers, and also electric appliances made by SEIKO and SONY.

(1) Service

Both companies are engaged only in the sales and maintenance of hardware, and in the sales of software packages; they do not develop software themselves. All software packages they deal with are existing ones from allied makers and software selling companies. It is said that this is expedient from the viewpoints of selling cost and the difficulty of training talented staff to develop software. Thus, they say that they have built up a position in which they are able to offer responsible maintenance and support for hardware by themselves, sometimes in conjunction with affiliated manufacturers.

(2) Affiliated Companies

There is no need to mention the fact that the hardware is made in Japan, but Japanese-made software packages are not well suited for use because of differences in accounting systems and problems in English output; thus, they are selling softwares made in New Zealand or Australia.

Allied companies are:

- Interactive Application Ltd.
- International Data Ltd.
- Padmade Co.
- Kerridy Odeon Data Products
- Canon Data Products (a CANON distributor)

One of the two companies (Tecair Co. and Pacific Mercantile Co.) says that when the company is not able to itself solve hard or software support problems, it receivess daily support services, in the form of spare parts and software packages stored in disks, by air cargo from New Zealand and other countries.

(3) Staff and Training

The staff of one company consists of 18 Fijians in the following capacities:

Training	2
Technical staff	14
Others	2

The technical staff is able to do programming but their ability is insufficient. The technical level of hardware is, however, high enough that they have set up terminals

for an airline's on-line services

The other company has approximately 10 Fijian staff members as follows:

Marketing	2
SE, programming	1
Hardware engineering	2
Technicians	4
Others	

Although some of the staff members of the two companies graduated from technical schools in Fiji, the primary engineers have been trained in Australia, New Zealand, and Japan (including the University of Auckland and the South Australian Institute of Technology). They have training experience mainly in hardware and its operations, but very few members have training in programming.

(4) Software

Major software systems in use in Fiji are for.

- Wholesale and retail accounting –
  stock control, accounting, debtors, general ledgers, and word-processing
- Manufacturing – job-costs and payrolls
- Construction – architecture and word-processing

Tables of allied companies include the following software packages:

- Order entry/Invoicing
- Inventory control/Purchasing
- Debtors ledger/Sales analysis
- Creditors ledger
- General ledger
- Payroll
- Bills of materials

It appears that all packages are applicable on a CP/M base (SP 80 or UNISES) of an M23. One company uses both a mini-computer and a micro-computer for its own business as follows:

- Mini-computer (NCR's BM series):
  stock control (about ten thousand items), general ledgers, debtors, history reports, sales analysis, operating statements, etc.
- Micro-computer (SORD M243):
  Sales analysis, cash flow, etc.

(5) **Prices of Hardware and Software**

In Fiji, foreign-made computers incur customs duties of 42% for hardware and 57% for sofware, so that prices including freight rate and insurance are approximately two or three times of those in the countries of manufacture.

(a) Hardware

SORD M23	Mark III	3,800 F$
	Mark X	6,300 F$ (provided with HDD)
	Mark X	7,500 F$ (fully-equipped)
M41		5,250 F$
CANON CX-1		6,500 F$
AS-100		8,500 F$

(b) Software

One package	about	500 F$
Special Software		1,000 F$ or more

However, customs duty is 10% for a computer the C.I.F. of which is 500 F$ or less; thus, it is reported that such computers are widely used for education purposes in schools.

(6) **Computer Support in the Kingdom of Tonga**

Ideas on support preparations for computers introduced into the Kingdom are as follows:

(a) Hardware

When hardware is sold with a computer, it will be best supported by using Fiji as a backup station. It would be useless to build a service center in the Kingdom unless the number of computers increases significantly.

On the basis of experiences in Fiji, environmental conditions such as temperature and salt-air in the Kingdom may still allow the reliability of hardware to be maintained without causing problems. In Fji, computers are now operating satisfactorily in a non-air-conditioned room in a certain company, and in a common office room of a different company's building located near the seaside.

(b) Software

Software can be obtained in English, but only in packages. New software cannot be developed. Translation into Tongan requires a certain amount of labor.

(c) Training

If the number of computers of a particular manufacturer is large, it is better to ask the manufacturer to provide training for the staff. Training for CANON and

SORD-brand units is available in Fiji. For CANON units, with a large number of staff members, training is more economical in New Zealand than in Japan.

3-4 Technical Progress in Small-Size Computers

Small-size computers, especially microcomputers, have been used primarily for private or hobby purposes, but now they can also be used as data processing equipment with highly advanced functions and extended roles. The development of auxiliary equipment has also made technical progress enough to have even hard disks and line printers connected to the CPU's. Up to present, minicomputers have been considered as far superior to microcomputers. While the latter have made remarkable progress, manufacturers of minicomputers have on the other hand tried to develop and sell smaller and lower-priced units. Thus, the definition of small computers has been overlapped in recent years. In view of low price and completeness of the individual system, small computers are suitable for Tonga, which has a group of small organizations. Small business computers are categorized between mini-computers and micro-computers, and can be installed in ordinal offices without a particular air-conditioning equipment. Their business oriented character has them implemented with COBOL and RPG type language. Both their prices and functions are also between those of mini's and micro's. However, their operating systems are not compatible with each other because of their dependency on the hardware. In relation to this, recent improvements in small-size computers, microcomputers, will be discussed.

(1) Central Processing Unit (CPU)

The Central Processing Unit (CPU – the main unit) carries out control and operation of the whole computer system. Almost all components of this system are microprocessors, and these are divided into three types (8-bit units, 16-bit units, and 32-bit units).

Formerly, simple classification had been made: the 8-bit, 16-bit, and 32-bit units were typed as microcomputers, minicomputers, and large-size computers, respectively. In recent years, however, even minicomputers and microcomputers with 32-bit architecture have appeared, and classification by bit number has been impossible. As a result of these advances, they have made remarkable inroads into fields of office work which were previously unimaginable In nations advanced in computerization, distributed use of computers giving higher functions like function as independently operative units, to terminals is prevailing. This is done by batch-processing steps with large-size machines and on-line processing in which data are processed in real-time under multi-terminal control of the large-size machines. Countries developing in computarization should not necessarily be required to go through the same steps of development as outlined above. Particularly, at present, when compact machines have come to possess the same capabilities as the older large machines, the way of effective use of small machines should not be simply a reduced-scale copy of the methodology for computerization with machines but rather independently established ones.

(2) Main Memory Capacity

The main memory capacity of small-size computers has expanded rapidly due to high levels of integration and big reductions in price per bit of LSIs. Main memory capacity of 8-bit units has so far been available only up to 64 KB. With the appearance of 16-bit and 32-bit units, capacities of MB levels have become available up to MB (Mega Bytes) or GB (Giga Bytes). This means that program development without considering limits on memory size has become possible and even simplified.

(3) Hard Disk

With the appearance of a hard disk (Winchester) for the auxiliary memory unit, which has used an FDD (floppy disk drive 1 – 2 MB) until now, direct access to a great volume of files has become available. This indicates that, with appearance of the DBMS (Data Base Management System) for small-size computers, will be well-suited to general office work.

(4) Multi-Stations

The operating system (OS) for small-size computers has up to present allowed only a single task at a time. Now, however, OS support for multi-users is available. As a result, several input/output stations, consisting of keyboards and CRT displays, are now usable with small-size computers.

Most small business computers have been provided with a multi-task function.

(5) Printers

Printers were formerly used only for printing type, but small-size computer printers have progressed in function with the appearance of printers of dot matrice and thermal types. Concerning small-size printers, serial-printers, which have a comparatively low printing speed, are playing a major role. Letter-press printers have a very good type and impression quality suitable for printing materials in quantity such as slips, etc. Regardless, since serial-printers are inadequate for printing large quantities of data, a line-printer unit have to be added.

(6) Floppy Disk Unit

Floppy disk units used for micro-computers or small business computers are the same, capacity included, for general purpose large computers and mini-computers. If only the format used in various computers is compatible, data can be exchanged among systems. There are two types of floppy disks (5¼-inch and 8-inch diameter), which are recording media each of which is classified further by side number (single-sided/double-sided) and recording density (standard/double density). Floppy disk units do not always correspond in a one-to-one manner in their relation to these media. For example, a double-sized double-density type floppy disk device is available for double-sided normal density

disks, sinble-sided double density disks, single-sided normal density disks, and double-sided double density disks. Floppy disks have greatly improved in storage and usage capacity, but may be affected by troubles caused by improper handling by the users. Therefore, a back-up copy should by all means be made.

(7) Software

Microcomputers previously had few operating systems (OS), and their functions were done in computer languages such as BASIC, but operating systems for microcomputers have improved recently. The general OS consists of the following:

A. CP/M-86 system
B. MS-DOS (IBM PC-DOS) system
C. UNIX system

Additionally, OS-9 and UCSD-p systems are available.

The CP/M-86 and MS-DOS are general purpose OSs which operate in INTEL 8086 microprocessors; these two types are predominant among 16-bit microsystem OSs. The IBM PC-DOS is basically an MS-DOS system with minor changes. Many of these systems are Apple-DOS systems, produced by the Apple Computer Company; however, these OSs have a very different architectures from other systems. Both the CP/M-86 and MS-DOS systems are Single-User/Single-Task OSs and can execute only one task at a time. On the other hand, the UNIX is a Multi-User/Multi-Task general purpose OS which is used for various purposes in minicomputers. The OS-9 is a general purpose OS for MC68000s and supports Multi-User/Multi-Task operations. The UCSD-p system may be used for various purposes, but it is not used very widely due to its high degree of specialization.

On the other hand, operating systems for small business computers are usually dependent upon their hardware and don't possess compatibilities with each other.

This Type of computers assure their compatibilities by its language level and provide its users with COBOL or a RPG Type language.

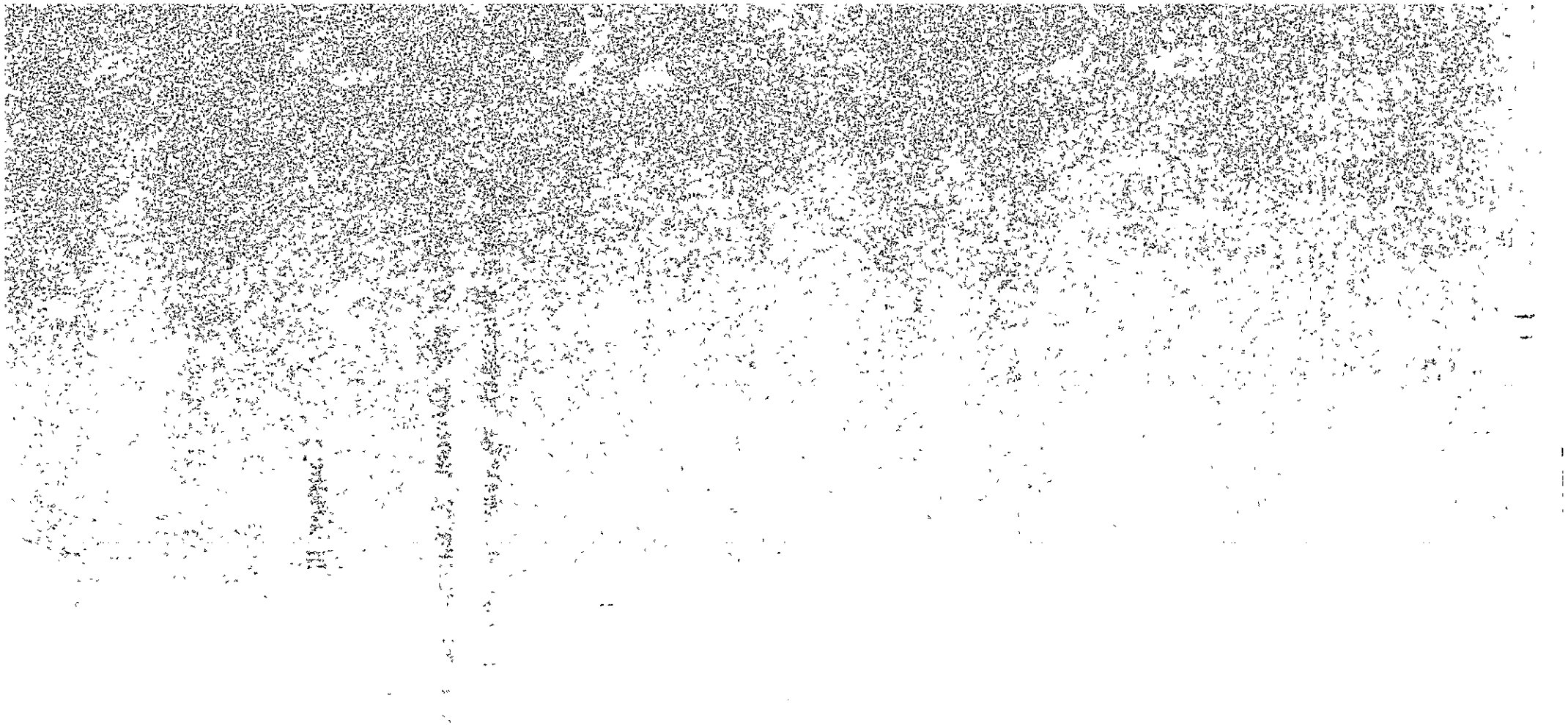
Application softwares for microcomputers have become rapidly available, and software packages (such as for payroll, accouunting, and stock control etc.) are too numerous to mention. Therefore, the introduction of existing software packages should be taken into consideration first. For package selection, it is advisable to establish selection standards; however, standards provided in existing manuals are also acceptable Lists of existing softwares have been published by DATAPRO and AUERBACHER in the U.S., etc., and many software catalogs have been issued in various countries.

In addition, apart from the above-mentioned general standards, differences in language (especially in non-English speaking countries), systems, and customs in the countries which develped the packages should be taken into account. For work which is diffi-

cult to perform with packages, the introduction should be made basically with the analysis of the current situation mentioned in Chapter I. Even computerization with micro-computers or small business computer requires the analysis and the cost proportional to the application system size.

Chapter III

Analysis of the Current Situation and Future Plan for Data Processing Systems in Nine Organizations



Chapter III. Analysis of the Current Situation and Future Plan for Data Processing Systems in Nine Organizations

1. Statistics Department

1-1 Scope of Work for the Study

The statistics issued periodically by the Department at present are as follows:

1) Trade Statistics
2) Consumer Price Index
3) Balance of Payments
4) National Accounts

Trade statistics are issued monthly, quarterly, and annually. Consumer Price Index and Balance of Payments are issued quarterly and National Accounts are annually.

Other nonperiodical surveys such as Establishments Survey, Building Construction Survey, Private Education Survey, and Household Consumption Survey have been made conducted at frequent intervals. And the Department is planning the whole sample survey on household consumption in 1984, in cooperation with New Zealand, followed in 1986 by the ten-yearly census.

National statistics produced by the Statistics Department include the following:

1) Periodical statistics of the bulletin type, such as Trade, Statistics, Balance of Payments and Price Index.
2) Annual Statistics, such as National Accounts, and the Survey on Household Consumption.
3) Large scale Statistics prepared at intervals of several years, such as Census.

There are, of course, some other social and economic surveys that may be suitable for computerization in the future.

1-2 Review of Data Processing at Present

1-2-1 Trade Statistics

Trade Statistics are aggregated on the basis of the data sent by the Customs Department, compiled in table, and published monthly, quarterly, and annually.

The data sent by the Customs Department consist of export entries and import entries. The latter has the sections dealing with the consignee and method of transportation, including port name, date, importer's name, wharf, vessel's name, nationality of vessel, port or place of origin, masters name, and country of consignment, as well as for information relating to the goods, including description, quantity, country of origin, value, rate of duty, and duty. The export entry is printed in the same form as the import entry except that the name of importing rather than exporting country is entered. As to the amount of the data sent by the Customs Department, the Department receives about

one thousand import entries per month and about two hundred export entries per month. (Refer to Fig. III-1-1, III-1-2)

These data are aggregated manually by the Department. The valuation of imports is on a CIF basis and exports are valued on a FOB basis. Quantity data such as weight, volume, and size are recorded in metric units where possible. The classifications of commodities for exports and imports, and code numbers, are based on the Standard International Trade Classification Revised (SITC-Revised), which is published by the United Nations.

The order of the aggregation process is as follows. First, those entries that are forwarded to the Department once a month are sorted by country and classification of commodities, and then totaled. Second, they are conversely sorted by classification of commodities, and country and then totaled. Finally the totals from the first and second steps are checked, completing the process. The Department processes both import entries and export entries. Quarterly and Annual Reports, involve the additional processes of aggregation, revision, and compilation.

The resulting tables are as follows:

1) **Monthly Reports**

(a) Summary of Imports, Exports, Re-exports and Visible Balance of Trade (b) Principal Imports under SITC(R) and Monthly Average (c) Principal Exports and Monthly Average (d) Principal Imports and Their Percentage Shares (e) Principal Exports and Their Percentage Shares (f) Imports by SITC-Section (g) Domestic Exports by SITC-Section and Their Percentage Shares (h) Imports by Country of Origin and Their Percentage Shares (i) Domestic Exports by Country of Destination and Their Percentage Shares (j) Imports by Institutional Sectors (k) Domestic Exports by Institutional Sectors (l) Imports by Flag of Vessel and Their Percentage Shares (m) Domestic Exports by Flag of Vessels and Their Percentage Shares (n) Imports and Exports by Ports and Their shares

2) **Quarterly Annual Report**

The kinds of tables in Quarterly Reports are almost the same as those in Annual Reports except for the terms.

(a) Imports, Exports, Re-exports and Visible Balance of Trade (b) Imports, Exports, Re-exports and Balance of Trade by Institutional Sector (c) Imports by Section of SITC-Revised and Institutional Sector (d) Exports by Section of SITC-Revised and Institutional Sector (e) Re-exports by Section of SITC-Revised and Institutional Sector (f) Imports, Exports and Re-exports by Flag of Vessel (g) Imports, Exports and Re-exports by Ports (h) Imports by Country of Origin: Exports and Re-exports by Country of Destination and Balance of Trade by Country (i) Imports and Duty Realized by Section of SITC-Revised (j) Exports and Duty Realized by Section of SITC-Revised (k) Re-exports and Duty Realized by Section of SITC-Revised (l)

Imports by Country of Origin and Section of SITC-Revised (m) Exports by Country of Destination and Section of SITC-Revised (n) Re-exports by Country of Destination and Section of SITC-Revised (o) Imports by Section of SITC-Revised, Item, Country of Origin and Institutional Sector (p) Export Commodity by Country of Destination and Sections of SITC-Revised (q) Re-exports by Section of SITC-Revised, Item, Country of Destination and Institutional Sector (r) Imports by Country of Origin and by Country of Consignment (s) Imports, Exports and Re-exports by Broad Economic Categories (t) Imports by End Use (u) Statement of Navigation, Showing Nationality, Number and Gross Tonnage of Foreign Going Vessels Entered and Cleared at the Port of Nuku'alofa in the Kingkom of Tonga (The compilation of the Annual Report is on a Calendar Year basis)

In these tables, the broad classification of commodity groups by section of SITC-Revised is as follows. (a) Food and Live Animals (b) Beverages and Tobacco (c) Crude Materials, Inedible (d) Fuels and Lubricants (e) Oils and Fats (f) Chemicals (g) Manufactured Goods by Materials (h) Machinery and Transport Equipment (i) Misc. Manufactured Articles (j) Commodities not classified elsewhere. And the classification by Institutional Sector is based on the distinction between Private Sector, Quasi-Government Sector, and Government Sector.

The most fundamental and important statistics in the Trade Statistics are the Import and Export statistics by Country and Section of SITC-Revised [(l), (m), (n)], and the Import and Export statistics by Section of SITC-Revised and Country [(o), (p)]. In the Trade Statistics of the Kingdom of Tonga, as mentioned above, Commodity Groups are classified on a SITC-Revised basis, resulting in ten broad items classification. And there are three hundred and ninety-one items of Import Commodity, fifty-six items of Export Commodities, and thirty-one items of Re-Export Commodities in the narrow classification of the Kingdom of Tonga. In the classification by Country the Kingdom of Tonga has forty-nine Import partners, twenty-one Export partners, and thirteen Re-Export partners. In all Trade partners amount to fifty-three countries. (The actual record in calendar 1981)

1-2-2 Consumer Price Index

Consumer Price Indices are aggregated and compiled in the Department on the basis of the data surveyed periodically, and are published for every commodity. The Department surveys prices of commodities every three months and publishes the statistics after about two months.

The compilation process for the statistics consists of the following three general steps. First, the Department makes an interview survey of retailers on prices. Second, it calculates the average price of all retailers. Finally, the Consumer Price Indices are calculated for every commodity group and all consumer goods. (Refer to Table III-1-3, 4, 5, 6)

The price survey is based on five retailers and the market. The "Pricing Sheet" has the columns for village name, retailer's name, collector's name, quarter ended, and date. It includes the price per unit that corresponds to every commodity and every commodity code. There are two hundred and twenty-nine items in the Pricing Sheet, and these are classified into seven categories as follows:

1) Food, 2) Housing, 3) Household Goods, 4) Apparel, 5) Transportation,

6) Tobacco, Alcohol, Kava, 7) others.

There are seventy-six items in 1), ten items in 2), fifty-four items in 3), thirty-six items in 4), thirteen items in 5), six items in 6), and thirty-four items in 7).

For the second step, the Department calculates the average retail and market prices of every item. The "Work Sheet" is used in the calculation process. For the third step, the Price Indices of commodity groups and all commodities are calculated using the "Calculation Sheet". The result is weighted averages with 1976 as the base year (Laspeyres index).

The statistics are then reported, in the following three tables.

1) Consumer Price Index by Commodity Group; Ratio of Change (1976 = 100)
2) Contribution by Commodity Group to Index Change
3) Comparison of Consumer Price Index Change in Local and Imported Goods

The process of compiling Consumer Price Index seems complex because it is not based on business statistics. The calculation and aggregation process is comparatively simple, however, and it is relatively easy to arrange the format.

1-2-3 Balance of Payments

The Balance of Payments consists of Current Accounts the including Invisible Trade Account and Transfer Account, and the Capital Account including Long-Term Capital and Short-Term Capital, in addition to the Trade Statistics mentioned above. These statistics are aggregated quarterly like Price Statistics, and published after about six months. The department does not need to make a survey of Government Institutions, Private Establishments, and Banks directry, but instead aggregates and compiles financial reports and other data of such organizations. For example, "Remittances from abroad" are estimated on the basis of telegraphic transfers sent to the Bank of Tonga, and "Tourism earnings" are estimated on the basis of foreign currency and travelers checkes. In these statistics, therefore, the data processing procedure consists mainly of aggregation.

In the tables of the Balance of Payments, the following items are printed.

1) **Current Account Items**
   - (a) Exports and Imports
   - (b) Services (Shipment, Passenger Services, Other Transportation, Travel)
   - (c) Investment Income (Direct Investment Income, Other Investment Income)
   - (d) Other Goods and Services and Income (Tonga Government, Foreign Govern-

ment, Labour Income, Property Income, Other Goods and Services)

(e) Unrequited Private Transfers (Migrants' Transfers, Workers Remittances, Religions Contributions, Other Private Transfers)

(f) Official (Tonga Government, Foreign Governments)

2) **Capital Account Items**

(a) Capital Excluding Reserves (Direct Investment Abroad, Equity Capital, Re-Investment of Earnings, Other Long-Term Capital)

(b) Port-Folio Investment (Public Sector Bonds, Other Bonds, Corporate Equities)

(c) **Other Capital (Long Term, Short Term)**

(d) Capital Account Balance

There is little need for surveys in connection with these statistics, therefore, and the number of tables produced is not large. If the Department can use data which are previously standardized, the aggregation process is comparatively easy. At present, however, some processes require estimation, and for computerization, it would be recessary to arrange data formats in greater detail. (Refer to Table II-1-2)

1-2-4 National Accounts

The National Accounts are the most comprehensive economic statistics, covering such categories National Product, National Expenditure, and so on, on the basis of various business statistics and social surveys. These statistics are issued once a year, and the fiscal 1980's National Accounts for fiscal 1980, which are published in June 1983, are the most recent. These accounts are aggregated on the basis of the fiscal year that starts in July.

The starting point of the data processing procedure is the preparation of Production Account and the Income and Outlay Account of every economic organization in the Kingdom of Tonga. In the process the Department estimates these data using financial reports and the tax returns. Household production, which is not covered in these data, is determined through household consumption surveys, etc.

The economic organizations covered are as follows:

Public Sector,
1) General Government Proper
2) Government Enterprises
3) Public Corporation

Private Sector,
4) Incorporated Enterprises
5) **Unincorporated Enterprises and households**
6) Non-profit Institutions

The Department aggregates the Gross Domestic Product at current factor cost on the basis of the Production Accounts reported by these organizations, which represents value added. The number of tables resulting from this process was forty-two in the June 1983 report, but the main items are as follows:

1) GDP and GDE

2) Disposable Income and Its Appropriation

3) Gross Capital Formation on Current Account

4) External Transaction on Current Account

In addition, detailed tables are compiled and attached to the main table. These are as follows:

5) GDP by Kind of Economic Activity (at Current Prices and Constant Prices)

6) GDP by Institutional Sectors of Origin and Kind of Economic

7) Gross Fixed Capital Formation by type of Asset

8) Gross Fixed Capital Formation by Kind of Economic Activity

and so on.

National Accounts, then, are the most complex in terms of procedures, and the most comprehensive of all the statistics, except for the census, in the Kingdom of Tonga, because they include troublesome data that need to be surveyed and estimated, and a wide variety of data. (Refer to Table II-1-4, II-1-5)

1-3 Problems and Future Plans

(1) Problems

The problems that remain to be analyzed include organization, functions, and personnel requirements. Generally there are two systems for the operation of statistical organizations. One is centralization, and the other is decentralization. The Department aiming for centralization, and has designed a plan for the extension of statistics covered, which includes the extension and modification of organizations. This will create a need for more specialized experts, the training of these people will probably take a considerable period of time. As a result, the Department plans to switch from its present manual system to the use of more efficient electronic data processing.

The problems that is now facing the Department are roughly as follows:

1) Extension and Diversification of the Operation of the Department

2) Scarcity of experts

3) Need to concentrate staff in the Survey Section

First of all, the Department is planning to diversify the fields of statistics covered, which include such Agricultural Statistics, Industrial Statistics, and Labor Force Statistics. Agricultural Statistics have been compiled and surveyed with the Household Consumption Survey on a nonperiodical basis so far. With regard to Industrial, and Labor Force Statistics, the Quarterly Survey of Manufacturing was introduced at the end of 1983. Input-Output analysis is also planned in the area of Industrial Statistics. The various surveys (Consumption, Establishment, Manufacturing, etc.) have varied in the past, however, and in designing future periodical surveys, the Department will probably need to set unified standards for each item as units of quantity or price.

Next, the Department intends to increase its staff with the extension of its organization, but is faced with a scarcity of specialized experts. As mentioned above, it is planned to establish an EDP section in the near future to make the present system of manual data processing more efficient. There are more staff with specialized EDP training in the Department than in other organizations in the Kingdom of Tonga, and it seems to have the potential for future computerization. So far the staff of the Department have had educational opportunities for EDP training as follows: "Household Survey Capability Programme" held by ESCAP, "Sampling and Household Survey Methodology" by UNDP, and the training course for Statistics held by the South Pacific Commission, all of which are short-term courses, and long-term courses such as Information Sciences Course of the Canberra College and the University of Sydney. The number of the staffs enrolled in these overseas courses amounts to eleven out of the permanent staff of twenty-six.

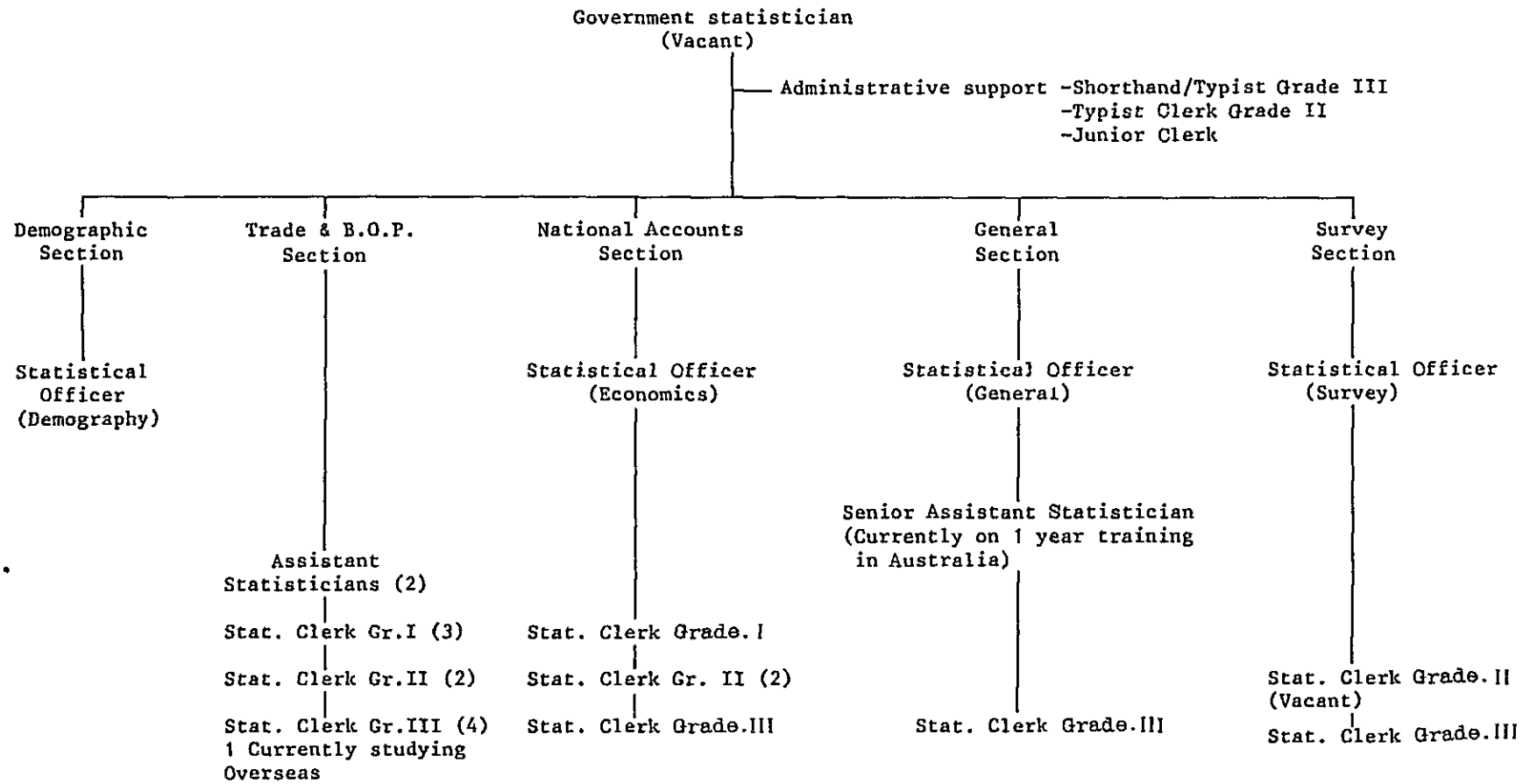
Finally the extension of the survey work of the Department will make the problem of shortage staff more serious. In 1984, the Department is planning to make a whole-sample household survey, and a census survey in 1986. Surveying is a labor-intensive activity requirings considerable amounts of manpower, and further improvements in the efficiency of statistical activities are expected from new on.

(2) Future Plan

To solve the problems described above, the Department needs to automate some aspects of its statistical procedures. The system of automation must be developed step by step. It is desirable that the first stage of automation starts with routine statistical work of such as the aggregation of Trade Statistics. The Household Survey and Census that will be made in the near future will require significant use of computers. If circumstances permit, there will be a progressive switch to computerization, enabling the Department to process not only aggregation procedures but also survey analysis as early as possible.

With regard to personnel requirements, there is little need for the staff to undergo general training in computerization, because there are comparatively more EDP experts of in the Statistics Department. Moreover, draft plans for the reorganization of the Department provide for the recruitment of specialized EDP staff. The problem which remains, therefore, is a need for special training for practical computer applications. It is desirable that instructors be assigned to the Department for a certain period to provide training on the types of equipment installed.

Fig. III-1-1 Tonga Statistics Department (As at 14 February 1983)



2. Treasury Department

2-1 Scope of Work for the Study

The EDP study for the Treasury Department deals with Budget Control. The automation of accounting systems has been already mentions in the Fourth Five-year Development Plan (1980–85), which stated that "the accounting system would be reviewed to produce more timely reports and give early warning of likely over-expenditure."

Budget Control consists of the following two processes:

1) Budget Balancing Process
2) Budget Preparation Process

The budget balancing process consists of achieving a balance in the Revenue and Expenditure Accounts of the Kingdom of Tonga. In the Budget Preparation Process, Budget Drafts submitted by all departments are collected and compiled in the Department. The need to provide timely reports and early warnings of likely over-expenditure means that the Budget Balance Process is especially important for the Department. Over-expenditure can not be prevented until accounts have been precisely analyzed.

Budget Control is based on the Estimates published in June of each year. The items of the Estimates are classified by "Vote Numbers and Sub-Vote Numbers", and "Item Numbers and Sub-Item Numbers". "Recurrent Expenditure" is printed in the Vote Numbers from one to twenty-nine, which include about 2,600 items. The Vote Numbers from forty-one to seventy-six represent "Development Expenditure", and consist of about 375 items. "Revenue" is divided into the Vote Numbers from R-one to R-seven, which contain about 125 items. Finally "Underline Account" is classified in the Vote Numbers from U-one to U-two hundred and sixty-five, which include the same number of items. The Underline Account, however, is not printed in the Estimates. Thus the account items covered in the budget control procedure amount to about 3,365.

Budget Control consists of several operations and data process procedures as follows; First, accounting operations:

1) Checking
2) Sorting
3) Recording

The Budget Preparation Process includes compilation and arrangement. The Department plays a relatively small part in the process. It merely puts together the draft of Expenditure submitted by all departments, estimates the Revenue, and submits the Draft Estimate arranged to the Privy Council. From this it is clear that budget control includes a wide range of accountings and compilation procedures, and covers an extremely large number of items. The following refers to the details in the process.

2-2 Present Data Processing Procedures

The accounting operations of the Budget Balance Process are classified in terms of data processing procedures into the checking, sorting, and recording of vouchers sent from the counter or the Bank.

2-2-1 Checking (Refer to Fig. III-2-1)

The Department has established a counter to receive taxes and social service fees and issue receipts, or pay for the expenditure of each department. At this point, two kinds of vouchers remain in the Department. There are Expenditure Vouchers and Revenue Vouchers. This means two kinds of transactions are dealt with at the counter: The issue of receipt for taxes or fees to payers, and the payment of expenditures.

The Expenditure Voucher processing procedure is divided into two parts, each dealt with by a different section, namely salary section and the Expenditure Section. The Expenditure Vouchers contain the salary vouchers, which are received at the counter of the Salary Section.

After expenditure vouchers are received at the counter and at the same time checked, the accounts are paid to the payee. At this point, the Vote Book is made out, in which the Remaining Balance of budget is entered. This shows how much each Government Organization will be able to spend. If the amount draws close to the limit, the Department issues a warning to the Organization.

In the case of the Revenue Voucher, cash or cheque is received with the Voucher in exchange for the receipt at the counter. This is entered in the Cashier's Cash Book.

The Treasury has established Sub-Treasuries in the Islands, which handle virtually the same tasks as the Treasury. Monthly aggregations by each Sub-Treasury are sent to the Treasury. In addition, the Bank of Tonga handles revenue cashier operations for the Treasury. Revenue is summed up every day and deposited into the Treasury's account.

2-2-2 Sorting (Refer to Fig. III-2-2)

With regard to sorting, expenditure and revenue vouchers presented at the counter are classified into daily totals of cash paid and checks paid, each of which is entered in the Treasury Cash Book and the Bank Cash Book every day.

In the case of expenditure vouchers, cash-paid vouchers are summed up and entered in the Treasury Cash Book, and the check-paid vouchers (including the salary vouchers) are all entered in the Bank Cash Book. In the case of the Revenue Voucher, the cash-paid vouchers are dealt with in the same way as the cash-paid expenditure vouchers. But the check-paid revenue vouchers are put together with the revenue vouchers which are received at the Bank's teller, and are entered in the Bank Cash Book, since the checks which are received at the Treasury's counter are sent together every week.

Thus all business transactions of the Bank are entered in the Bank Cash Book, which is totaled every month and registered in the Montly Reconciliation Statement. The vouchers transacted internally, referred to as Journal Voucher, are setn by other departmets of Sub-Treasuries once a month and recorded in the Journal Voucher Cash Book and put together in the Monthly Reconsiliation Statement.

2-2-3 Recording (Refer to Fig. III-2-3)

In this process, the Department makes out the Daily Abstracts, combining Expenditure Vouchers and the Revenue Vouchers, and the Monthly Abstracts, in which these vouchers are totaled with the Journal Vouchers. In addition, the Monthly Abstracts and the Ledger are used to produce the monthly Balance Sheets.

First, Expenditure Vouchers, including salary vouchers, are classified by items of Recurrent Expenditure, Development Expenditure, and Underline Account, and put together in the Daily Expenditure Summary Sheets. The Revenue Vouchers are summed up in the Daily Revenue Summary Sheets in the same way as the Expenditure Vouchers. Both sheets are integrated into the Daily Abstracts.

Second, the Department prepares monthly totals of Journal Vouchers which are used together with the Daily Summary Sheets to produce Monthly Abstracts. These Abstracts are integrated into the Yearly Totals of the Monthly Abstracts.

Finally, all vouchers are posted in the Ledger. Details of the vouchers are not recorded, but the monthly balance on all assets are calculated. The result, together with the Monthly Abstracts, are used to prepare the Balance Sheet.

2-3 Problems and Proposed Plans

(1) Problems

At present, the number of the vouchers, sent to the Department ranges from amounts to from eighty to two hundred per day in case of Expenditure Vouchers, seven to twelve per day in the case of the Revenue Vouchers, and eighty to one hundred and fifty per month in the case of Journal Vouchers. These numbers tends to increase with the extension of Government activities.

Under existing conditions, the following problems cause delays in the processing of the Budget Balance and imperfect checks on over-expenditure in the present manual system of accounting.

1) Inefficiency of manual accounting system within the Department.
2) Data processing delays outside the Department.

First, problems are the duplication of recording efforts in the manual accounting system because of the numbers postings and revisions required. Second, there are unsolved problems regarding delays in returns from other departments the Journal Vouchers from government organizations such as the Customs Department, the Inland Revenue Depart-

ment, and Government Store are sent to the Department once a month, but there are instances when Data Processing is delayed in these organizations.

At the same time, over-expenditure tends to arise because reports are not always timely enough. For example, the original budget in fiscal 1981 amounted to about 14,740 thousand Tongan dollars, but in practice about 16,270 thousand Tongan dollars were spent, resulting in over-expenditure of 1,530 Tongan dollars. To solve this problem, it may be necessary to provide warnings in the form of advice slips. Timely and precise reports of remaining balances are also essential.

(2) **Proposed Plan**

With regard to the two problems mentioned above, the latter is a institutional question in the Kingdom of Tonga. Unless transaction systems between organizations are at least reformed, it will not be solved. The former problem can be alleviated through computerization.

The Department has already introduced two sets of AEDs-100, and is developing its accounting and salary systems. The use of these systems will permit the Daily Abstracts and the Monthly Abstracts to be aggregated more rapidly, and is expected to result in a more efficient system of accounting. When these systems are complete, the next goal of computerization is an on-line system linking different departments and island. This, however, will require studies on the circumstances of other organizations and the assignment of experts.

Fig. III-2-1 Checking

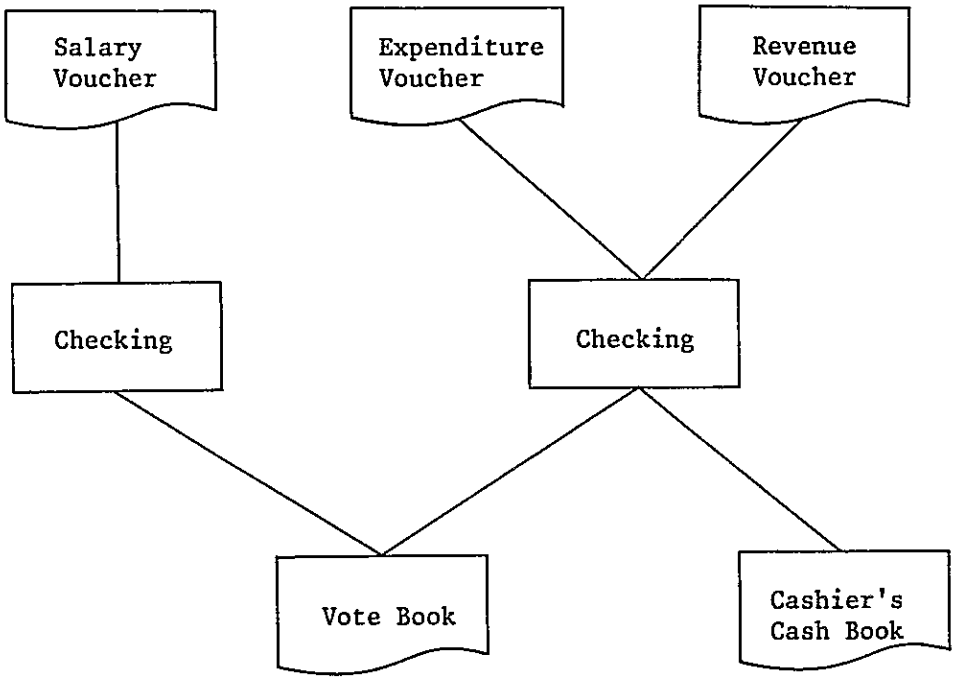


Fig. III-2-2 Sorting

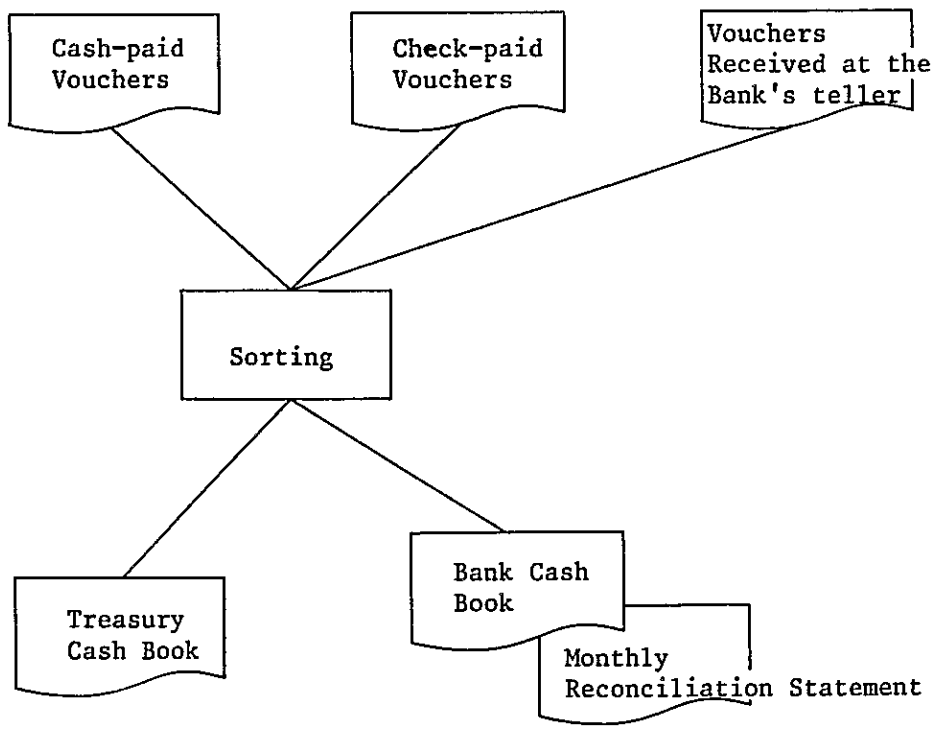


Fig. III-2-3 Recording

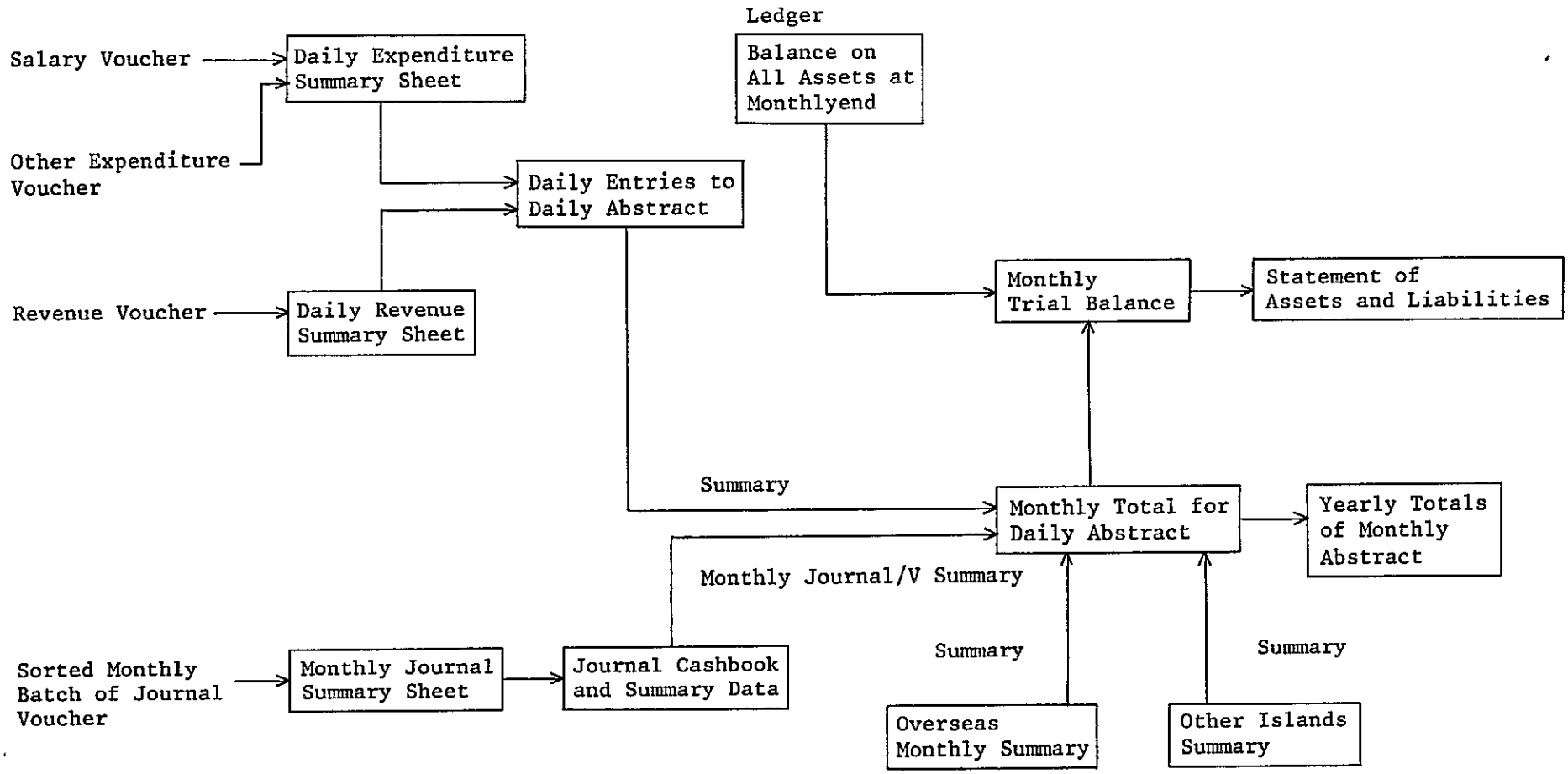
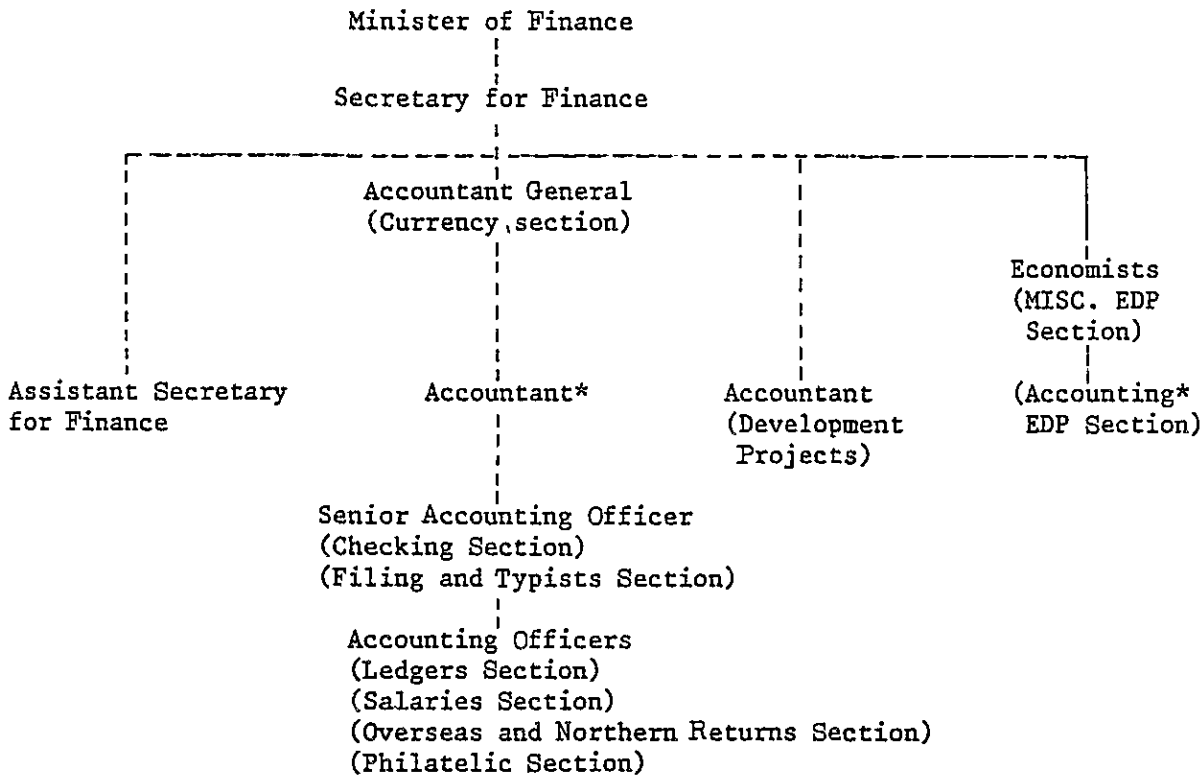


Fig. III-2-4 Organization chart of treasury department of the ministry of finance

Organisation Chart of Treasury Department of the Ministry of Finance



Notes:

- The posts are shown in descending levels of seniority.
- Where a section or sections are bracketed, the indicated post immediately preceding it is the head or supervisor of that section.
- Each section may contain any number of clerks, whose posts range from junor, second class, first class, to chief clerk.

* Accountant is currently attached to this EDP section. The supervisory capacity of the Economist in the accounting EDP section is incidental. The expertise is provided by a temporarily hired analyst.

3. Tonga Development Bank

3-1 Scope of Work for the Study

The object of the study on the Tonga Development Bank is Loan Management. Generally, Banks have two operational roles, namely, transfers and financing. Furthermore, the financial functions consist of depositing and loans. The Tonga Development Bank specialized mainly in loans. In addition to the Tonga Development Bank there is a city bank in Tonga, namely, the Bank of Tonga, which handles the transfer operations and all financial operations. The circumstances under which the Tonga Development Bank operates in the Kingdom of Tonga mean that loan management, which is the object of this study, seems to account for virtually of its activities. The Bank does not handle deposits, and is involved instead in the management of borrowings, most of which consist of basically public funds from the government or the Bank of Tonga. This means that there are relatively few lenders and its operations are comparatively simple to deal with.

Loan Management consists basically of the following processes:

(a) Loan applications processing

(b) Loan approval processing

(c) Loan disbursement processing

(d) Loan repayment and arrears processing.

Ultimately loan management consists of two steps. First, borrowers who apply for loans are examined and approved. Second, the Bank implements the disbursement of the approved loan, and is repaid by the borrowers.

The loan recording process plays an especially important role in loan management. However, the items to be recorded vary according to the purpose, and there are many kinds of recording sheets and registers. Moreover some of these sheets and registers are frequently revised, deleted and added to. Thus the recording process is the most likely aspect of loan management operations to benefit from automation.

The main recording sheets and registers are as follows:

1) Loan Application Register

2) Loan Action Sheet

3) Loan Disbursements

4) Interest Card

5) Interest Sheet

6) Journal

7) Ledger Card

3-2 Present Data Processing Procedures

As mentioned above, loan management consists of two steps, one is namely the approval of the loan on the basis of the application, which in some senses can be termed a registration operation, and the management of loan disbursement and repayment, which come under the heading of accounting operations. (Refer to Fig. III-3-1, III-3-2)

3-2-1 Loan Application Processing

This is the process whereby borrowers apply to the Bank for loans. As a data processing procedure, the Bank receives loan applications and posts them to the Loan Application Register.

The information needed is as follows.

1) Date
2) Name
3) Address
4) Purpose
5) Amount of Loan

In addition, when the loan application is approved, the date of approval and the amount of the approved loan are entered in the Loan Application Register. This process entails the following loan recording operations: first, the Loans Department receives the applications from borrowers; second, the Accounting Department enters them in the Loan Application Register. Several Loans Officers are in charge of the Loans Department, and one Accounting Officer records transactions in the Loan Application Register in the Accounting Department. This Loan Application Register is aggregated quarterly, and the applications statistics are also compiled in the Accounting Department.

3-2-2 Loan Approval Processing

This is the process whereby the Bank approves applications for loans, and it is similar to the general registration operation. In short, the Loan Action sheet is made out according to the approval, and is entered in the Loan Approval Register.

Loan Action sheets are made out individually, and include the following items:

1) Account Number
2) Name
3) Address
4) Purpose
5) Amount of Loan
6) Security
7) Insurance
8) Interest
9) Repayment
10) Other Conditions

After the loan is approved, the Loans Department writes out the Loan Action sheet. The person in charge of recording in the Accounting Department enters the contents of the sheet in the Loan Approval Register. The Register is aggregated by kind of loan, purpose, location, size and term quarterly, and the statistics for each item are compiled.

3-2-3 Loan Disbursement Processing

This is the process whereby the Bank disburses approved loans to the borrowers. These disbursements coincide with the purchase of the assets for which the loan was approved. They are paid by cheque after the checking against the Loan Disbursement sheet. Finally the amount of disbursement is entered on the debit side of the Ledger Card.

The documents recorded in this process are Loan Disbursement sheets Ledger Cards and Journals. The Loan Disbursement sheet is a document in which the remaining balance is recorded. The total amount of the loan is entered at the top of the sheet, and the balance of the total and each disbursement is registered in turn. Entries in the Loan Disbursement sheet, including the balance, are as follows:

1) Date
2) Purpose
3) Payee
4) Amount of Disbursement
5) Cheque Number
6) Undrawn

Next, the Ledger Card shows the entire account of each borrower with the Bank. Thus it also shows the repayments of each borrower, as will be mentioned later. The Ledger Card has almost the same format as a deposit passbook, and contains columns for Date, Debit, Credit and Balance.

The data processing procedure for disbursements within the Tonga Development Bank is as follows. After the Loans Department issues the payment approval, it is checked by the Disbursement Section in the Accounting Department, and finally is entered in the Ledger Card by the machinist, also in the Accounting Department. The loan disbursements are not paid in cash or by cheque at the counter of Tonga Development Bank. Instead the Bank draws a cheque covering the amount of the loan on its account at the Bank of Tonga. These disbursements are entered by group according to the account number on the debit side of the Daily Journal.

3-2-4 Loan Repayment and Arrears Processing

There are roughly three kinds of repayment procedures. The first is for the borrower to repay directly at the counter of the Bank. The second is for the borrower to transfer repayment to the Bank's account at the Bank of Tonga. The third involves repayment through deductions from the borrower's fortnightly pay.

The Accounting Department checks repayed cash and cheques against each borrower's Interest Card or Loan Arrears Card. If the Department finds overpayments by borrowers, it refunds them through the Payment Authority. If the Department finds Loan Arrears, the Accounting Department enters them in the Arrears Report, and reports the matter to the Loans Department.

The most important aspect of the repayment process, is the checking and consecutive processing of arrears. And then the calculation of interests also requires time consuming routine work. At this point, there are six kinds of documents which must be recorded at the same time. Two have been already explained in relation to the Loans Approval Process: namely the Loan Action Sheet and the Loan Approval Register. The other four documents are as follows:

1) Interest Card (or Loans Arrears Card)
2) Interest Sheet
3) Journal
4) Ledger Card

In these records, repayments due during the month, amount of interest, amount of repayment and balance of debit and credit are calculated and printed on the basis of the interest approved in the Loan Action Sheet. First, the Interest Card shows repayments due during the month and the terms for the individual borrower. Second, in the Interest Sheet, the amount of interest is aggregated by group according to the account number. Third, in the Journal all loan control items regarding the disbursement cheque and amount of interest are summed up. Fourth, the Ledger Card shows the amount of interest for each borrower with the date of approval.

3-3 Problems and Proposed Plan

(1) Problems

As stated above, loan management involves registration operations and accounting operations. Loan registration operations, involve 3,422 loan approvals per year, with a total value of 2,880 thousand Tongan dollars (actual figure for fiscal 1982). This means that the Bank approves two hundred and eighty-five loans each month. The number of the loan applications is twenty percent higher than the number of the loan approvals. The number of staff in charge of loans is eighteen out of a permanent staff of sixty-two. The Loan Department expends much time on discussions with borrowers, and its activities are highly labor intensive. The Department also handles accounting operations including interest calculation at the time of loan registration, and is in the same position as the Loans Department in this respect.

The main problems which arise with regard to the data processing procedures involved in registration operations are as follows:

1) Time consuming checking and consecutive processing of arrears

2) Duplication of efforts regarding interest calculation and interest registration

3) Frequent revisions of records

4) Storage of records

Interest registration is based on six kinds of documents in which the calculated interest is printed when the loan is approved. These documents are made out by the Loans Department and the Accounting Department, thus the existing system produces much duplication of effort in the areas of calculation and registration.

With regard to registration, there are frequent changes to the financial conditions, including the term and rates of interest, as well as revisions resulting from additional Loans. This means that all of these documents must be renewed. Because these documents must be exchanged between the Loans Department and the Accounting Department, the Bank must store records so as to provide easy access for each department and at the same time prevent losses.

The Accounting Department section dealing with loan management requires a substantial workforce. The Accounting Department deals with the loan accounts, the borrowing accounts and general management accounts.

Loan accounts particularly important in team of the number of transactions. For example, the number of Loan Disbursements amounts to 9,127 per year with a value about 2,440 thousand Tongan dollars. The number of Loan repayment amounts to 32,887 per year with a value of 1,950 thousand Tongen dollars (actual figures for 1982). The Accounting Department must therefore concentrate much of its workforce in the section dealing with loan management. This trend has been emphasized by yearly growth in the number of transactions and their value.

(2) Proposed Plan

These problems cause inconvenience in the recording operations and in efficiency in the organization. The computerization of loan management offers solutions to these problems. The advantages for the Tonga Development Bank are as follows:

1) Promotion of efficiency in recording and registration operations.

2) Easier access to records for both the Loans Department and the Accounting Department.

3) Automated linkage between the loans recording and accounting.

As the Bank can concentrate the data processing procedures for the loan registration in one section, EDP is expected not only to promote efficiency in data processing, but also to have effect on organizational efficiency.

It is desirable that the Bank introduces the EDP system step by step in the following stages:

1) Computerization of the loan registration.

2) Computerization of loans management (registration and accounting).

3) Computerization of the whole management system including all accounting.

Most records have been formalized, and it would be easy to code the required items. In this respect, the loan action sheet includes almost all loan recording information. The stage relating to accounting operations requires the merging of repayment and disbursement accounts with the content of the loan recording, followed by computerization of loan accounting. Finally, the Bank would design a plan for the integration of loan management, borrowing management and general management into the EDP accounting system.

Little has been done to date with regard to personnel requirements. The Bank must first recruit the required staff and provide general computer training. When the equipment to be introduced has been decided, an expert team consisting of instructors and programmers should be sent to Tonga to train Bank personnel.

The proposed plan for the Tonga Development Bank is examined in detail in the chapter V ("Case Study").

Fig. III-3-1 Loan Registration and Accounting

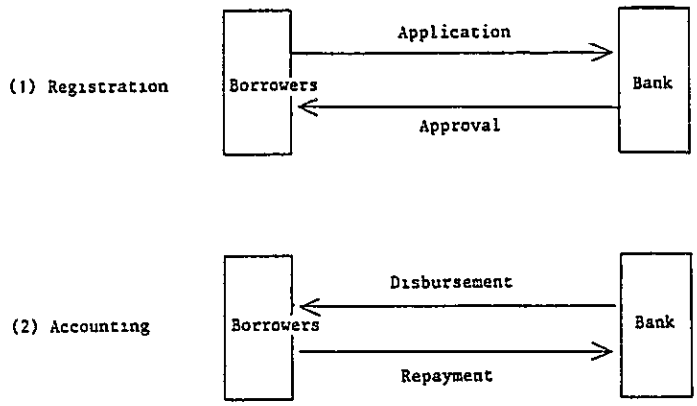


Fig. III-3-2 Loan Recording

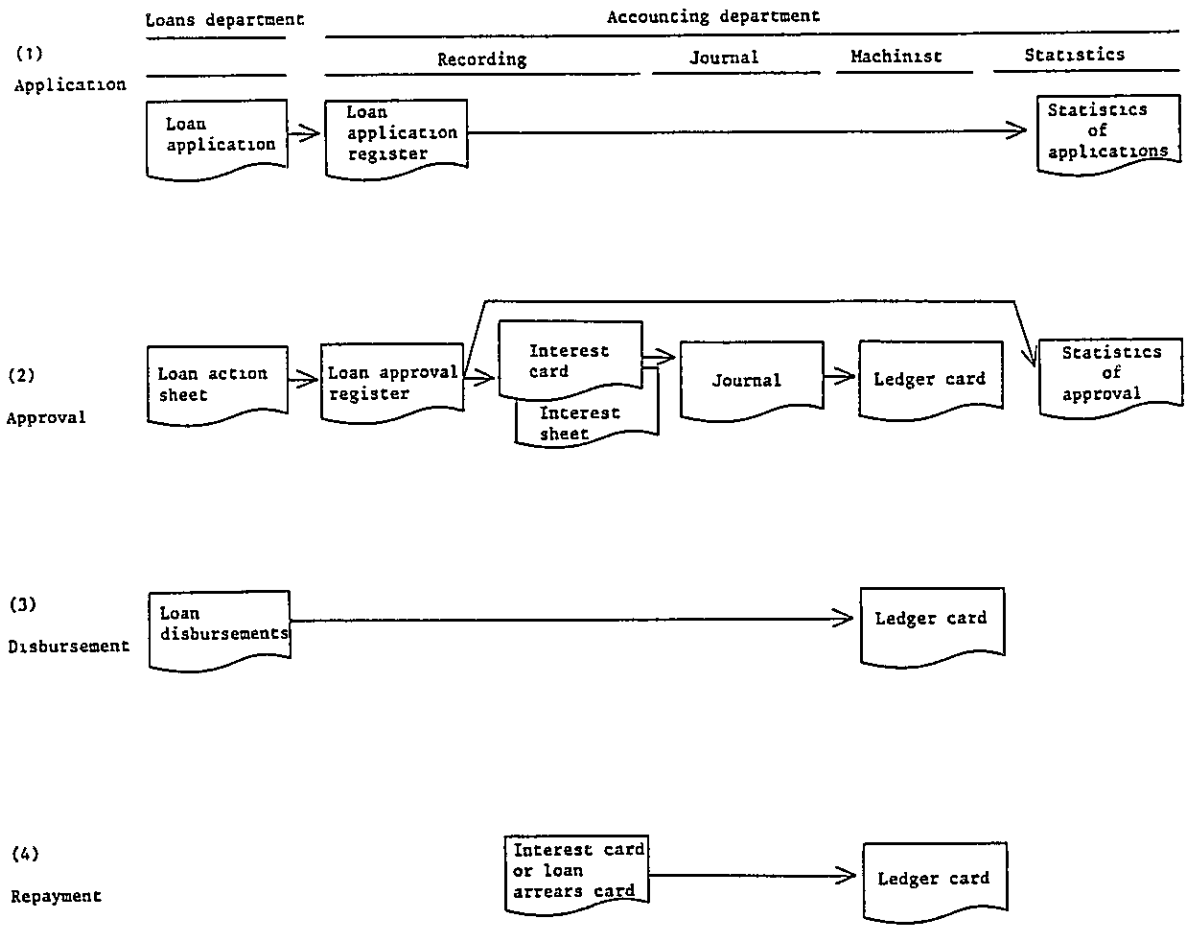
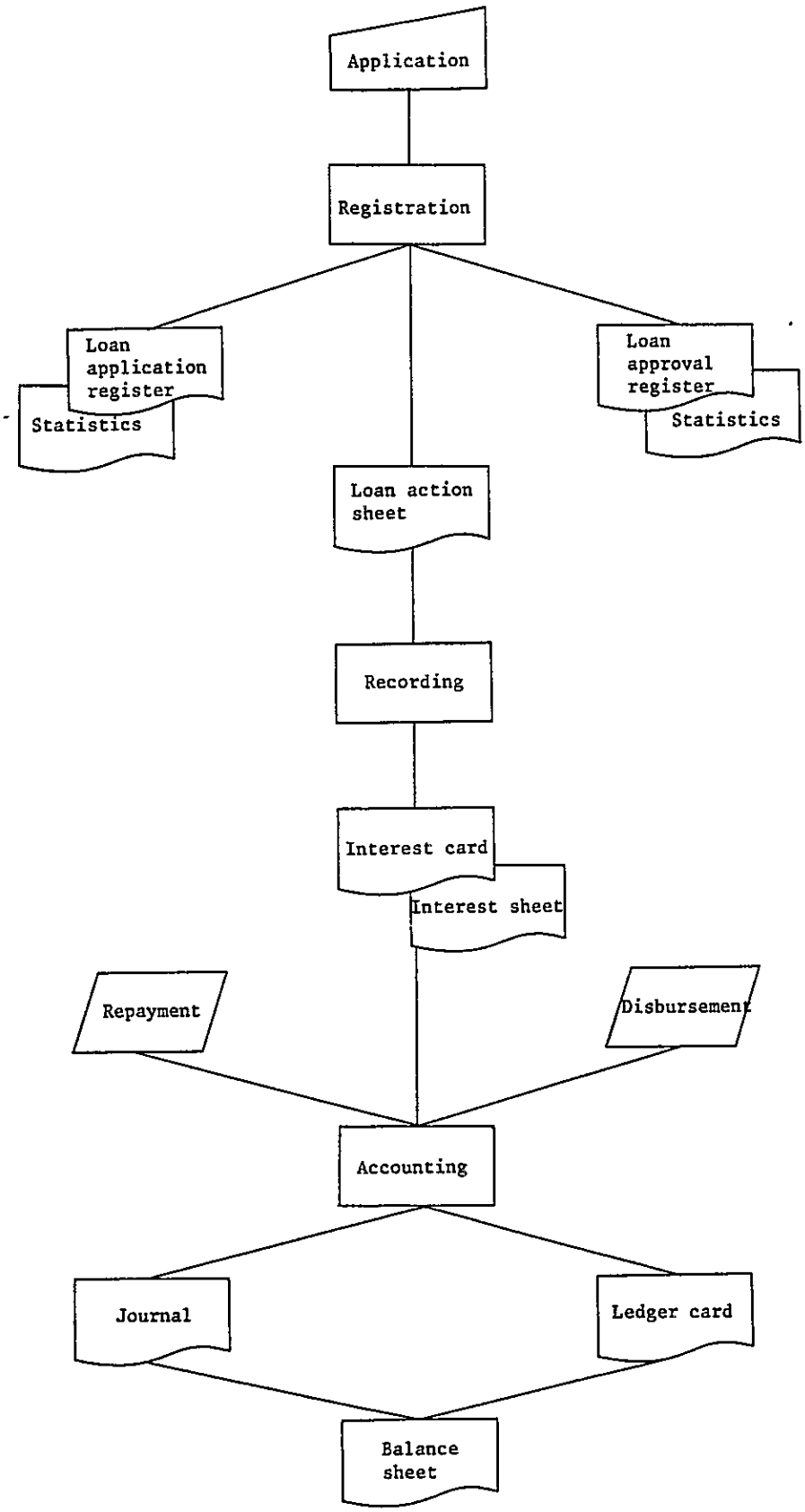


Fig. III-3-3 Loan Management



4. Government Store

4-1 Scope of Work for the Study

The Government Store is a department under the Ministry of Works and is mainly in charge of goods procurement. It supplies not only the Ministry of Works, but also the entire government of Tonga, with 13,000 various stock items.

The study, therefore, was primarily concerned with stock control of items stored in the four warehouses of the Government Store and peripherally concerned with other related work such as accounting procedures. At present, as much as a $10,000 discrepancy has existed yearly between recorded figures and actual stock value. It is estimated that this discrepancy has accumulated to a total of $250,000 to $500,000. It is greatly hoped that the Store can minimize this discrepancy as much as possible.

In order to improve this situation, the Store has recently organized a special team to take inventory and is working regularly to minimize the discrepancy.

The head of the Store is an industrial engineer, and is studying computerization of the Store's functions.

4-2 Present Situation

4-2-1 Organization and Functions

The Government Store is, as mentioned, an interdepartmental office within the Ministry of Works. At present, however, it is being forced to function as if it was an independent governmental organization because it serves as the procurement agency for all governmental organizations.

The organization chart of the Government Store is shown in Fig. III-4-1.

The Store consists of six sections.

(1) Accounting Section

This section is in charge of accounting in the Store. It also prepares statistics on wages and annual reports.

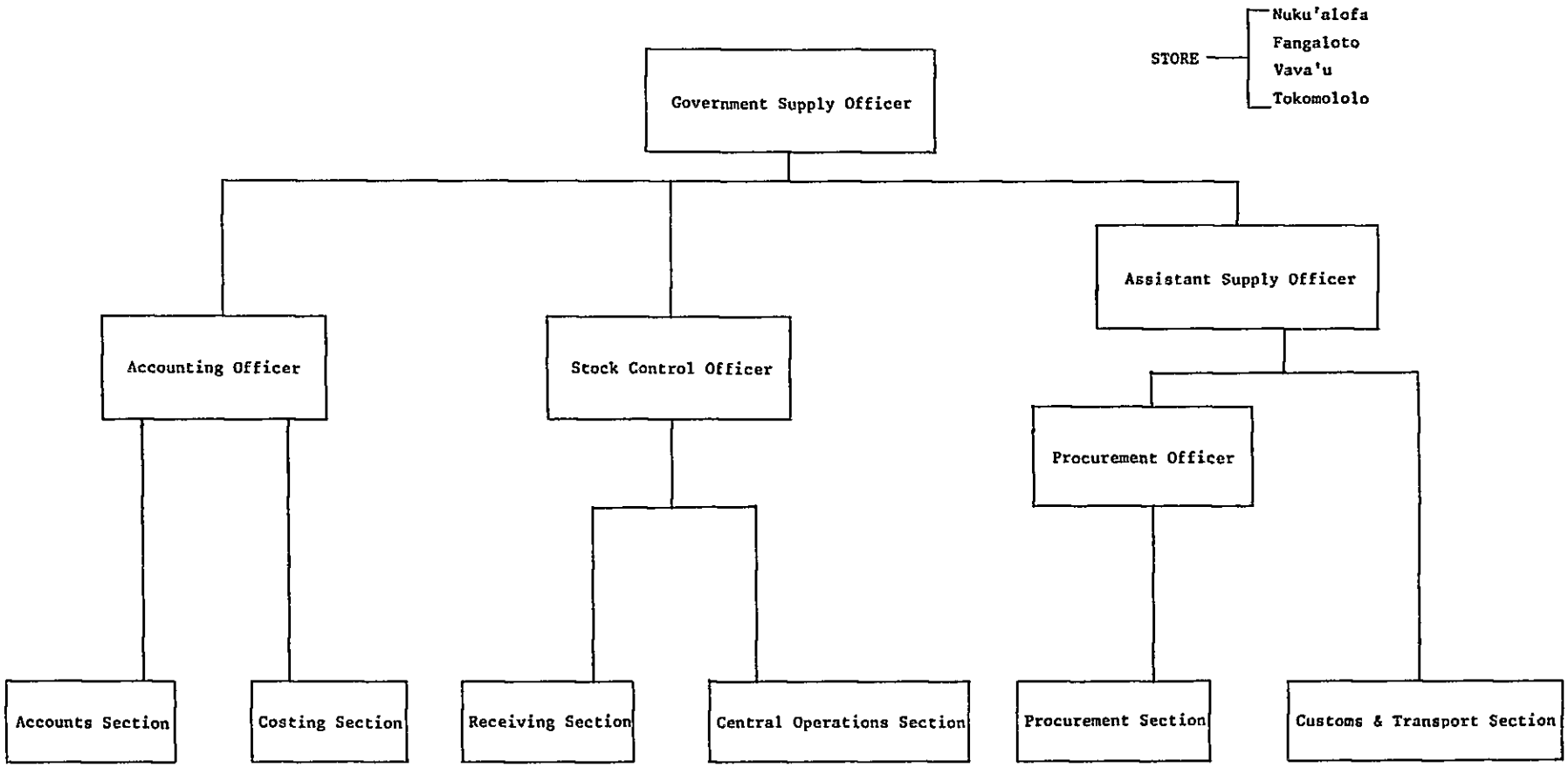
(2) Costs Section

This section is in charge of costs for goods under storage.

(3) Receiving Section

This section makes inspections of all items received in the Government Store and issues receipts for these items. Proper storage of the items in bins is also a duty of this section. If a quantity shortage or a quality defect is found, this section investigates and reports it.

Fig. III-4-1 The Organization Chart of the Government Store



(4) Central Operations Section

This section is in charge of the operations of stores. In order to maintain proper stock levels and prevent discrepancies in accounts, shortages or defects are reported by this section.

(5) Procurement Section

This section is in charge of procurement of all stock and non-stock items. It is also responsible for maintenance of the products catalog.

4-2-2 Data Flow

Stock issuing procedures are as shown in Fig. III-4-2.

(1) A Government department or office which requests goods prepares Form P-2A and submits the original to the Government Store.

(2) A counter officer of the General Operations Section inspects the Form P-2A concerning the following items.

A. Signature
B. Date
C. Stamp
D. Vote
E. Availability of Stock

(3) An issuing officer takes the goods from the bin, along with the Bin Card, which is updated and signed by the officer at the dispatching area.

(4) An officer issuing delivery permission prepares Form G.S.I. in triplicate and enters the form number in the Bin Card. The above-mentioned Form P-2A is attached to the G.S.I. original.

(5) A counter checker inspects Form G.S.I. and the goods.

(6) The requisitioner signs the last page of Form G.S.I. and is given the goods and the second sheet of Form G.S.I.

(7) The last page of form G.S.I. is sent to a ledger clerk and entered in the Ledger Card.

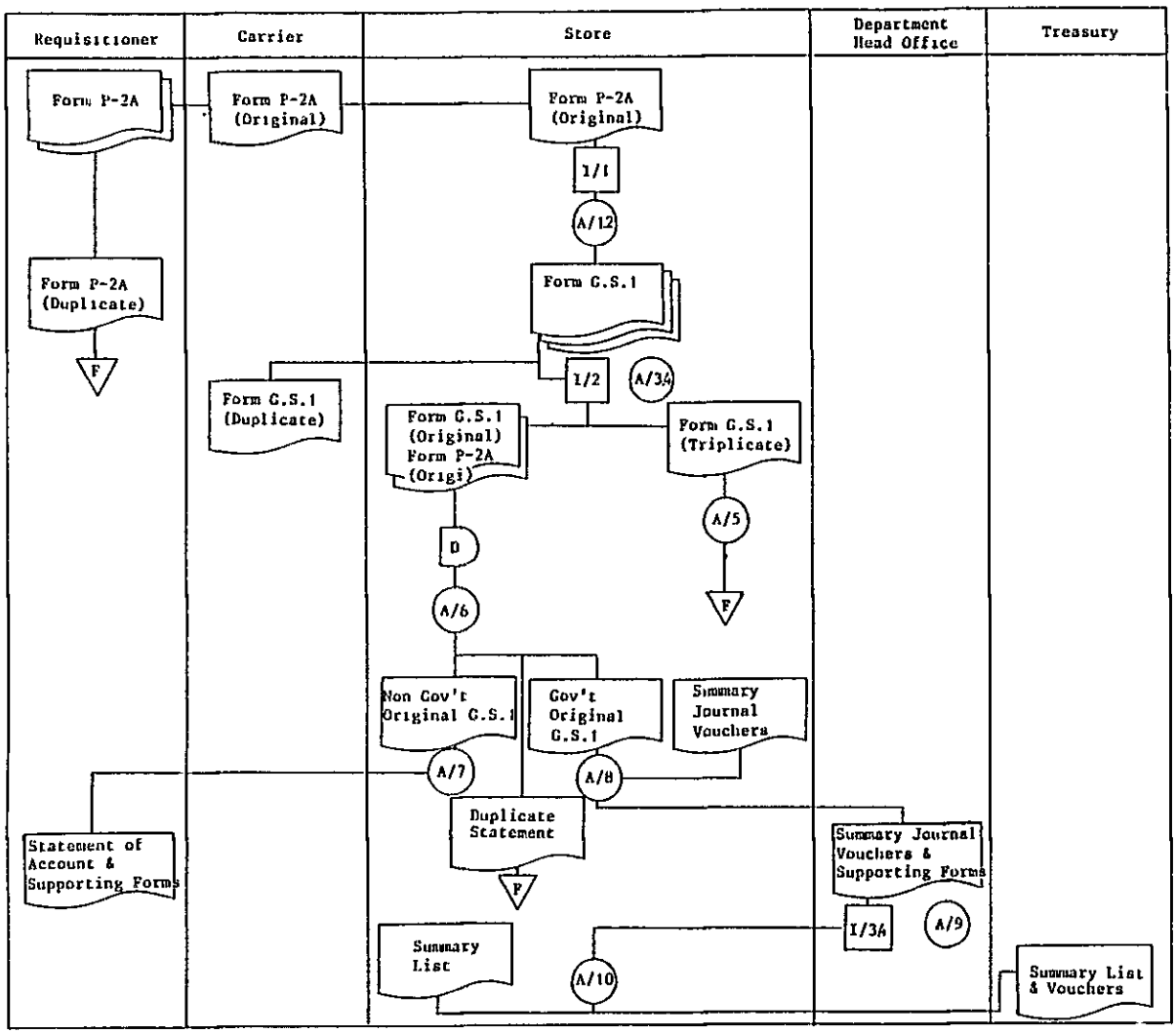
(8) The first page of Form G.S.I. and Form P-2A are sent to a summary clerk and classified before being filed by the end of month. Classification is made according to Votes, Sub-Votes, and Items for governmental organizations, and to other account names for non-governmental organizations.

(9) For governmental organizations, Summary Journal Vouchers and supporting documents are drawn up.

(10) For non-governmental organizations, statements of account and supporting documents are prepared.

(11) The Summary Journal Vouchers are sent to the requisitioners for confirmation and returned after being checked. They are revised at the Store before being sent to the Treasury.

Fig. III-4-2 The Existing Document Flow Chart Between the Government Store and Other Governmental Organizations (Goods Issuing and Accounting Procedure)



4-2-3 Type and Characteristics of Data

Generally speaking, stock control can be considered to consist of the following four procedures.

(1) Collection of stock control information
(2) Estimation of delivery quantities and procurement periods
(3) Determination of reorder quantities
(4) Actual operation of stock control and feedback

(1) Collection of Stock Control Information

Collection of stock information is the most basic task in stock control and it is vital to perform this with speed and accuracy.

The items of information for each stock item are stock quantity and fluctuation, undelivered portions of orders, and in-stock and delivery quantities. These items of information should be collected in detail. In addition, external information such as the stock situations of suppliers and the demand trends of requisitioners are also important. Regardless, the most important thing in the collection of information is that information necessary for stock control is obtainable through "SYSTEMATIC PROCEDURES," under "THE SAME STANDARDS," and in "AUTOMATIC AND STABLE MANNERS." Problems in the present situation can be clarified by making a flow chart for stock information and analyzing it. As previously mentioned, the Government Store has decided to conduct regular inventories with a project team. Information obtained by this team will be valuable for designing a stock control system for the Store. This inventory, therefore, should be made accurately and regularly. However, the amount of stock (13,000 items) is so great that in order to make accurate and regular inventories an efficient method will have to be adopted. For this purpose, classification should first be made quickly between items with large stock fluctuations and others, and an inventory period shall be set for each item. After that, a procedure manual should be made for collecting information. It is essential to make records of delivery and storage as quickly as possible and to prevent discrepancies with actual stock quantities from arising. Most of this work can be incorporated into an EDP system after preparing a procedure manual. It can be said that an EDP system will bring about considerable improvements in this work.

(2) Estimation of Delivery Quantities and Procurement Periods

Based on information collected, estimations are made on delivery quantities and procurement periods. There are two methods of estimaiton. One, called passive estimation, is performed with statistics methods based on actual past records. Another, called positive estimation, is carried out by analytical methods based on the behavior of reasons for delivery and demand. According to volumes requisitioned for a three month period (minimum stock volume) and a six month period (maximum stock volume), the Government

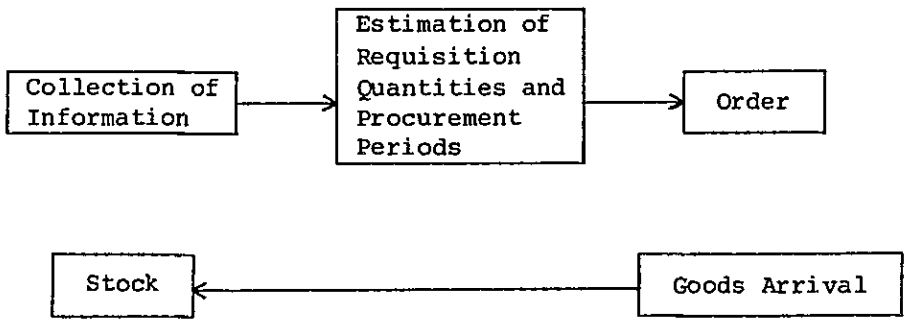
Store has set the stock quantities of all items. If this rule alone is followed, the above-mentioned estimations may be unnecessary. However, for inventory cost reduction it may be more useful to reset stock levels after thoroughly analyzing the inventory characteristics of each item. It is necessary, therefore, to take into account past delivery quantities, statistics on procurement periods, and significant indicators of the requisition patterns of various governmental organizations.

(3) Determination of Reorder Quantity and Timing

This is the most important aspect of stock control and is conducted on the basis of estimations of delivery quantities and procurement periods mentioned in part (2) Accordingly, these should be determined so as to conform with estimations.

(4) Actual Operation of Stock Control and Feedback

Upon arrival, goods ordered are brought under stock control as new stock. In order to create feedback on orders, information concerning the orders should be handled in the way in which the order is identified.



4-2-4 Bottleneck in Current Situation

(1) Discrepancies between Actual Stock Amounts and Values on Record

Under the current stock control system, an annual $10,000 to 20,000 discrepancy has occurred between figures on accounts and the inventory values. This has created a severe problem. It is estimated that such discrepancies have accumulated to a total of approximately $250,000 to $500,000, which must be reduced as much as possible Causes of these discrepancies are losses of stock and/or Bin Cards and mistakes in record entires. The correction of old records seems to be permitted after a great deal of negotiation, however preventive countermeasures should be taken against recording mistakes.

(2) Delays in Summary Journal Voucher Confirmation Procedures

Regarding the delivery of goods to governmental organizations, summary journal

vouchers are prepared at the end of the month, according to Vote, and sent to requisitioners for confirmation. The confirmation procedures take 10 to 14 days, after which the vouchers are returned to the Government Store. In the Store, a revised summary list is made on the basis of corrections by the requisitioners and sent to the Treasury. This being the case, the procedural delay causes a bottleneck not only for the Government Store but also for the Treasury and other governmental departments. Speeding up of these procedures would quicken government outlay control and contribute much to budget operations.

In order to do away with this bottleneck, the Government Supply Officer has proposed a draft for a revised flow of vouchers. (Fig. III-4-3).

Major Category	Single Alphabet Character
Mid Category	2-Digit-Number
Minor Category	"
Subdivision Level	4-Digit-Number

4-2-5 Plan for Computerization

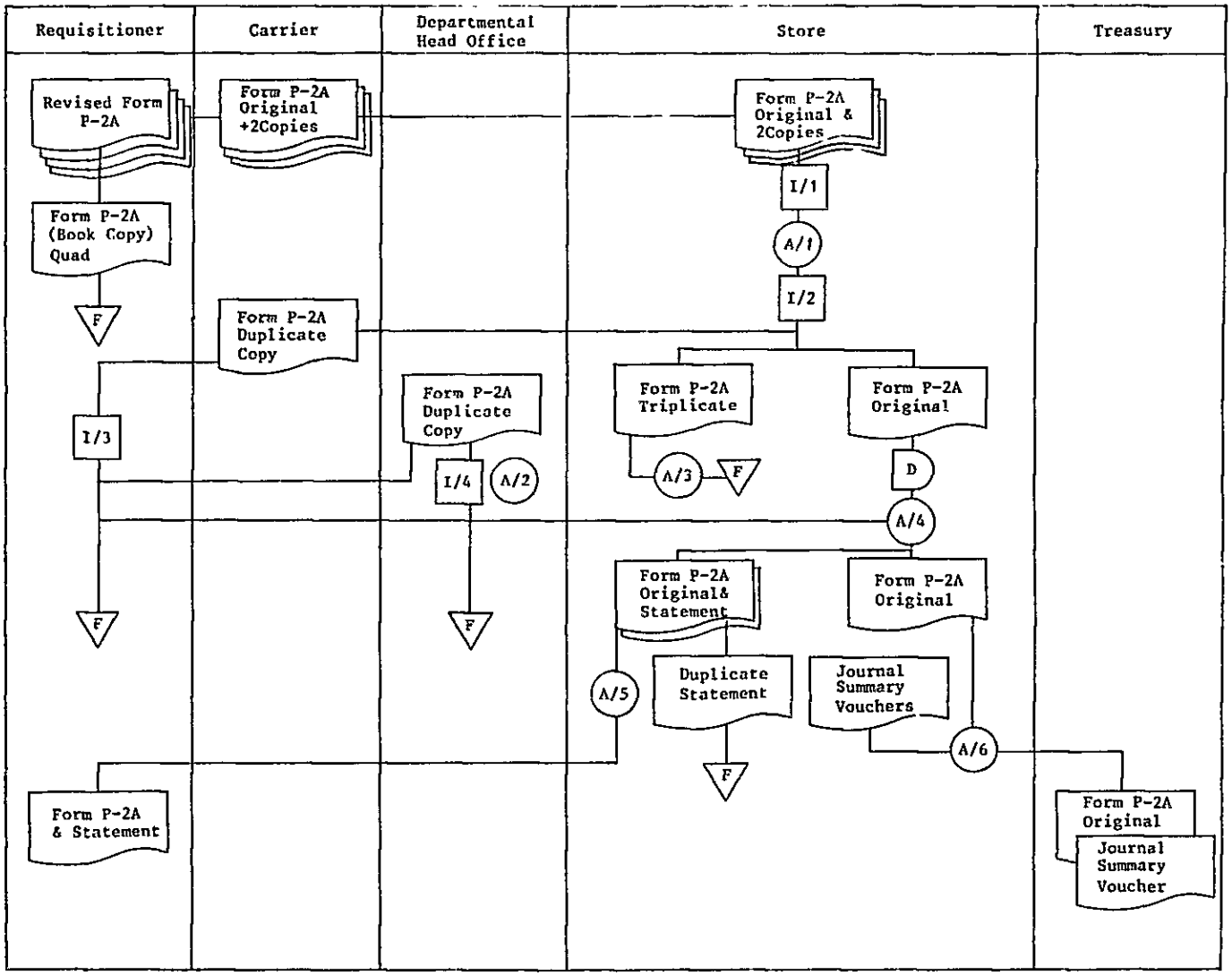
In the Store, the Government Supply Officer is making preparations for computerization and, as a first step, has almost finished preparing a catalog of items being handled. The catalog has 20 codes, consisting of a single Alphabet character, in the Major coding category. To these Major code letters are added sub-codes from three sub-code groups. Since revisions are made by re-typing at present, simply keeping the whole catalog up-to-date entails a large amount of work.

The catalog's coding system is as follows:

In "Computerization of Government Store – Main Objective of Government Store", the Government Supply Office relates that the main objective is to "Maintain supply of products to all Government Departments" and gives four sub-objectives.

Fig. III-4-3 The Proposed Document Flow Chart between the Government and Other Governmental Organization

(Goods Issuing and Accounting Procedure)



Sub-objectives:

1. Strict Stock Control
2. Accurate Accounting Record Entry
3. Improvement of Procurement Costs
4. Reduction of Processing Time until Purchase

The list of functions required to achieve these sub-objectives is shown in Table III-4-1.

4-3 Future Plans

4-3-1 Outlines of the Plan

As clarified in the fact-finding survey, computerization in the Government Store is highly necessary and is expected to result in considerable improvement in the system. In this study, therefore, the study team's draft plan for the Store's computerization, taking into account proposals by the Store, will be presented.

Prior to composition of the draft, the study team set the following limits on the draft.

(1) In the draft, only the Nuku'alofa Store is taken up concerning on-line data processing. Data from the other three (distant) stores is sent to Nuku'alofa and processed after a short delay.

(2) In view of maintenance conditions in the Kingdom of Tonga, plans requiring high-level maintenance techniques and resident engineers were for the time being excluded. In other words, on-line processing through communication lines and the use of equipment larger than mini-computers were also excluded.

The draft itself, on the other hand, aims at the following.

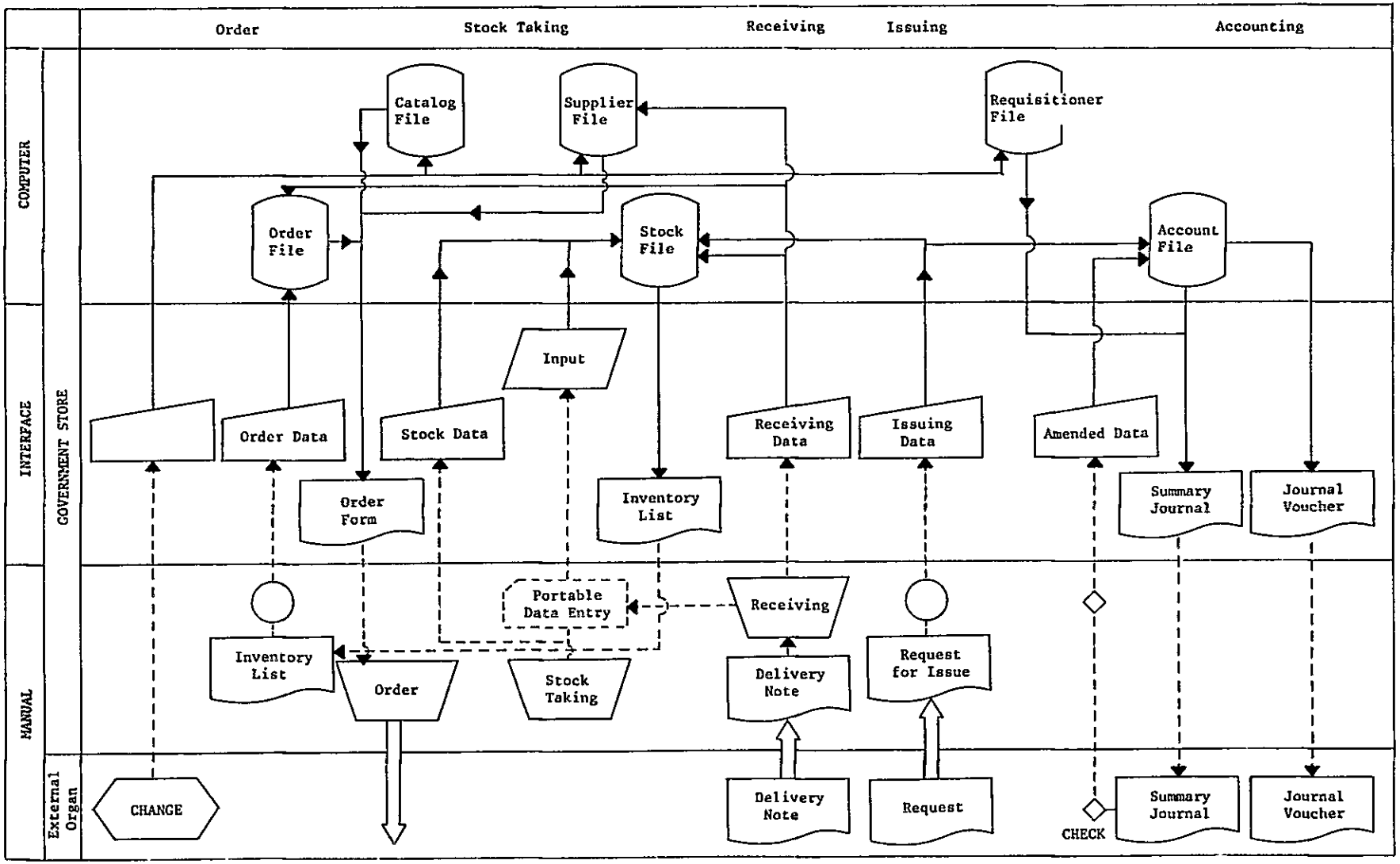
(1) The update of stock quantities in real time.
(2) The output of various stock information regularly and on request.
(3) The printing out of slips.

The outline of the system examined under these preconditions is shown in Fig. III-4-4. In the Figure, data flow is shown in solid lines (within the computer) and dotted lines Each file is in a direct access mode, so requested records can be directly retrieved with certain key items.

Table III-4-1 The Requirement for Output Lists in Computerization of the Government Store

#		LIST NAME	OUTPUT INTERVAL	LINES/ RECORD	NUMBER OF RECORDS	TOTAL OUTPUT LINES
1	Stock Management	Stock Holdings	Mo	1	13,000	13,000
2		Stock Movements	Mo	1	(4,000)	4,000
3		Listing of Slow Moving Stock	O/R	1	UK	
4		Stock at Reorder Level or Below	We	4	UK	
5		Goods in Transit	Mo,O/R	1 or more	UK	
6		Stock on Order Report by Group	Mo	1 or more	UK	1,000
7		Usage past 6 months / 12 months	O/R	4	13,000	52,000
8	Non Stock Management	Purchases for Month by RTP & Dept.	Mo	1		20,000
9		Purchases for Month by Item No.	Mo	1		
10		Non Stock Lists of Goods on Hand	Mo	1		
11	Catalogue Management	Master Catalogue by Stock No.	O/R	5	13,000	
12		Master Cataloge by Alpha Sort	O/R	5	13,000	
13		Abbreviations Listing	O/R	1	13,000	
14	Stock Costing	Price Variation Warning	Mo	1		2,000
15		Stock Cost Update	Mo	1		
16	Debtors and Creditors	Debtors Accounts - Indivisual Accounts	Mo	4		20,000
17		Debtors Accounts - Combined Report	Mo	1		
18		Report of Overdue Debtors	Mo	1		
19		Creditors Accounts - Individual Accounts	Mo	2		
20		Creditors Accounts - Combined Report	Mo	1		
21	Journal Transfer	Monthly Summary to Holding	Mo	1	200	30,000
22		Late Return of Summaries to Treasury	Mo	1	200	
23		Stores Commission Transfer	Mo,Yr	1		
24		Pay in Disbursements	Mo,Yr	1		
25		Committment File - Stock	Mo	1	13,000	
26		Committment File - Non Stock	Mo	1		
27	Procurement	Stock at Reorder Level	We	4	(4,000)	16,000
28		Group Forward Order Lists	O/R	1		
29		Supplier Performance Listing - Stock	Mo	1	13,000	4,000
30		Supplier Performance Listing - Supplier	Mo	1	-	
TOTAL						OVER 162,000

Fig. III-4-4 The Proposed Process Chart after Computerization of the Government Store



4-3-2 Process Flow of the Plan

(1) Catalog Maintenance Sub-System

This sub-system is for maintenance of the stock catalog file in which information is contained. The file is updated both regularly and randomly, and information to be updated originates externally, such as revision information from suppliers. Since the stock file is made on the basis of this file, the two files are managed in coordination with each other. The list in the catalog file is used to make the stock catalog, sources of which are now being arranged.

(2) Order Sub-System

Reorders are usually made on items whose level falls lower than minimum stock quantity. This is done by periodical inspection of the stock file. Reorder quantity and supplier have been fixed beforehand, and the order form can be issued to the supplier. The reorder information is entered in the order file and kept until receipt of the ordered goods. This information is also referred to as part of the stock information for reordering.

(3) Inventory Sub-System

This sub-system is used in all inventories; it corrects the discrepancies between actual stock amounts and recorded amounts found by checking At the same time, the account file is also updated. Input into this system is recommended to be made by a portable type data entry device, which is applicable to data input while taking warehouse inventory. This device has ten keys and a memory capacity of several thousand items. Data stored in the device can be transferred to other files in the host computer with a special adapter.

(4) Stock Delivery Sub-System

Stock delivery is made on requisition from other governmental organizations. In order to issue a copy of the form to the requisitioner, the process should be begun, initially, at a display terminal with a printer and a keyboard.

(5) Goods Receiving Sub-System

Processing is made when reordered goods arrive. Data in the order file is deleted and stock quantity in the stock file is updated. At this time, if an item which has been reordered is different from that in stock, it is necessary to replace the item. Additionally, the account file should be changed accordingly.

Table III-4-2 Selected Lists of the Data Files in the Government Store

STOCK FILE

#	KEY	ITEM NAME	SIZE
1	K	STOCK NO	10
2	K	BRIEF STOCK DESCRIPTION	20
3		UNIT RECEIVED	2
4		UNIT ISSUED	2
5		ISSUING PRICE	10
6		TOTAL VALUE	10
7		REORDER LEVEL	10
8		MAXIMUM STOCK	10
9		QUANTITY AT 1ST OF MONTH	10
10		QUANTITY AT CLOSE OF MONTH	10
11		QUANTITY RECEIVED ON MONTH	10
12		QUANTITY ISSUED ON MONTH	10
13		QUANTITY TRANSFERED ON MONTH	10
14		QUANTITY ADJUSTED ON MONTH	10
15		LAST DATE OF RECEIVE	6
16		LAST DATE OF ISSUE	6
17		LOCATION OF STOCK	10

ORDER FILE

#	KEY	ITEM NAME	SIZE
1	K	STOCK NO	10
2	K	ORDER NO	10
3	K	BRIEF STOCK DESCRIPTION	20
4		DATE ORDERED	6
5		SUPPLIER CODE	10
6		QUANTITY	10
7		ESTIMATED DELIVERY DATE	6
8		PRICE AT ORDER	10
9		UNIT PRICE	10

SUPPLIER'S FILE

#	KEY	ITEM NAME	SIZE
1	K	SUPPLIER CODE	10
2	K	SUPPLIER'S BRIEF NAME	20
3		SUPPLIER'S NAME	100
4		ADDRESS	100
5		COUNTRY	30
6		ACCUMULATED TRADE	10
7		ACCUMULATED QUANTITY	10
8		NUMBER OF TROUBLE	10