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

(SUMMARY)

SEPTEMBER 1984

JAPAN INTERNATIONAL COOPERATION AGENCY

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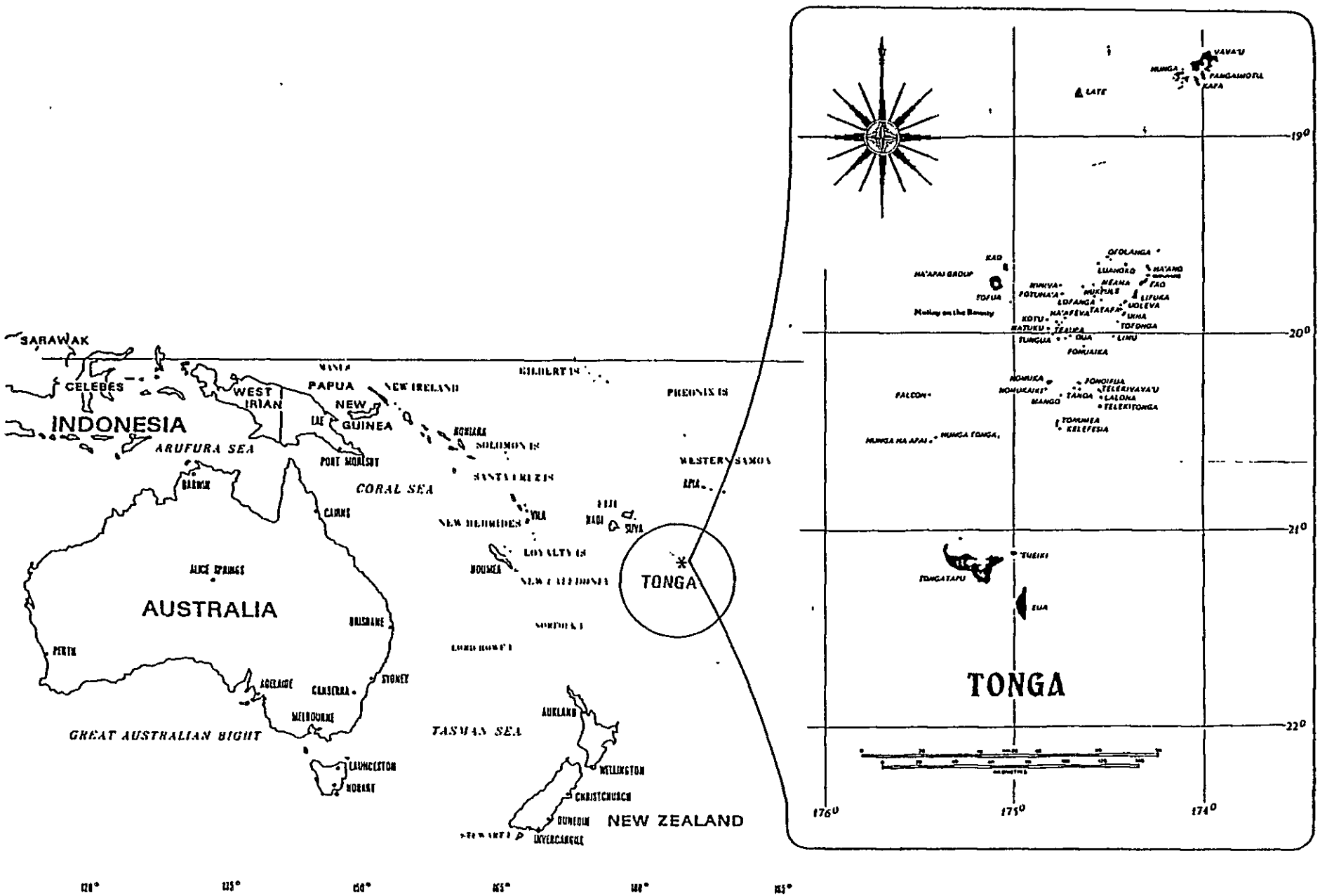
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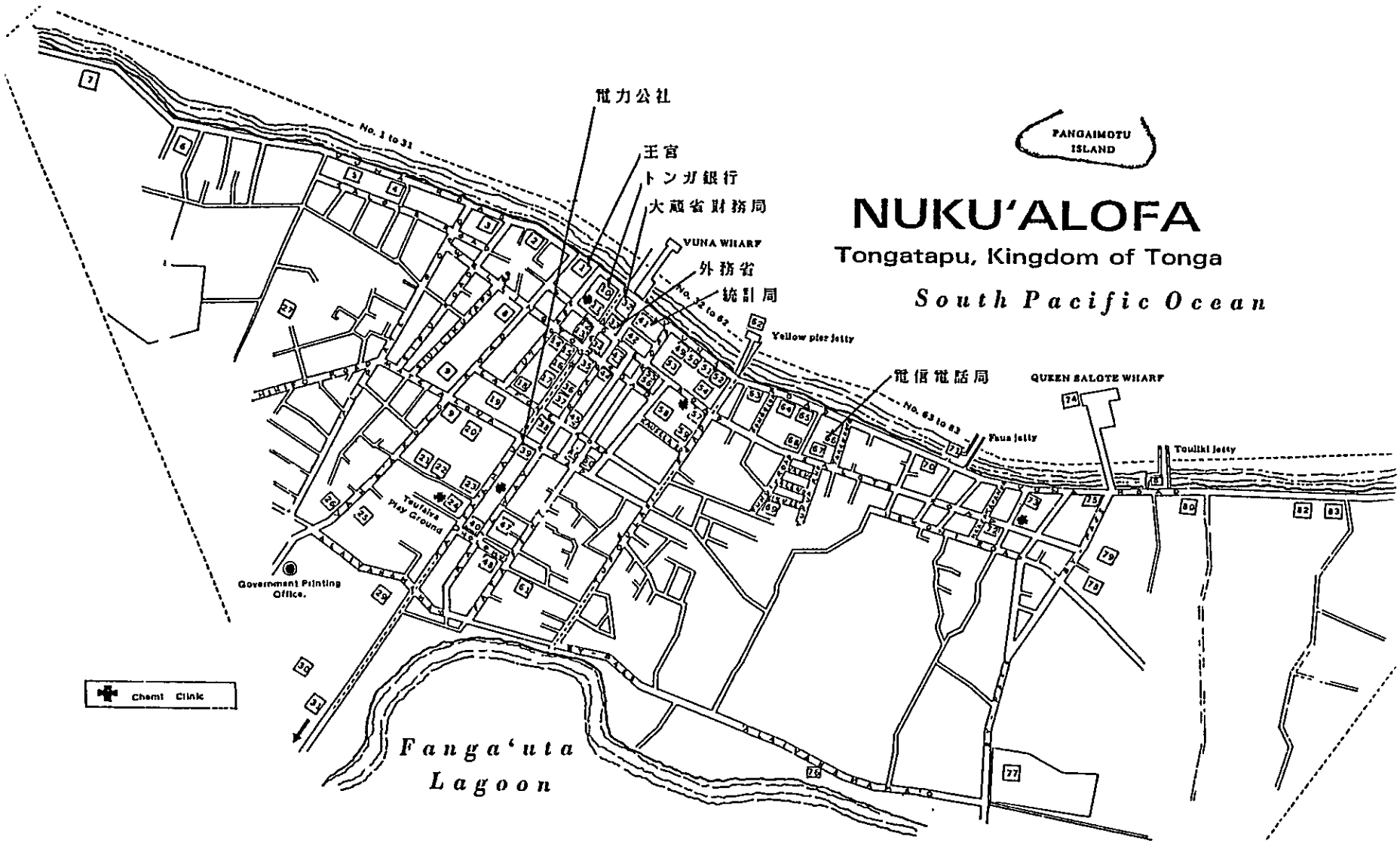

PANGAIMOTU ISLAND
NUKU'ALOFA
Tongatapu, Kingdom of Tonga
South Pacific Ocean
電力公社
王宮
トンガ銀行
大蔵省財務局
VUNA WHARF
外務省
統計局
No. 1 to 31
No. 32 to 62
Yellow pier jetty
電信電話局
QUEEN SALOTE WHARF
No. 63 to 83
Fua jetty
Touliki Jetty
Teufaiva Play Ground
Government Printing Office.
Chemi Clinic
Fanga'uta Lagoon

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

SUMMARY

Chapter I Background and Objectives 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.

The objectives and details are as follows.

1-1 Objectives

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

(1) The data processing jobs at present performed in each office have been analyzed, and future plans for a data processing system were drawn up on the basis of the results. (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 (EDP). (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
(6) Tonga Electric Power Board – Stock Control
(7) Ministry of Police – Automobile Registration and Immigration Control
(8) Tonga Cooperative Federation – Stock Control
(9) Bank of Tonga – Accounting

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 surveyed 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 organization 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 survey.

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 shown in Fig. 1.

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.

Fig. 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.

Chapter II Environments for Computer Introduction into the Kingdom of Tonga

1. The Economy and the Society of the Kingdom of Tonga

(1) Natural Conditions (Geography, Population, and Climate)

The Kingdom of Tonga is an island country which consists of 169 islands situated in the Southern Pacific. These islands are situated in lat. 15° – 23°30'S. and 173° – 177°W., and are a distance of about 8,000 km from Japan (8,091 km between Narita and Auckland, 7,239 dm between Narita and Nadi), about 2,000 km from New Zealand, and about 800 km from Fiji. Three archpelagoes constitute the Kingdom: the Vava'u group to the north, the Ha'apai group in the middle, and the Tongatapu group to the south. Niuafo'ou Island and Niuatoputapu Island, situated north of the Vava'u group, are also a part of the Kingdom. Total area is about 697 km^2 (according to Pacific Island Year Book), of which some 40% is occupied by Tongatapu Island where around 66% of the total population of 92,000 (1979) are living.

The islands are spread out in a long chain from north to south so that, although there are slight local differences in temperature, the climate in the capital, Nuku'alofa, is sub-tropical and oceanic, featuring seasonal southeast winds. The temperature averages 26°C with little seasonal fluctuation through the year; a maximum of 31.9°C and a minimum of 10.6°C have been recorded. Particular care about hurricanes should be taken; these occur between January and April, and have done a great deal of damage on numerous occasions.

(2) Social Conditions (Politics, Language, Traffic, and Communication)

The Kingdom declared independence from the British protective territories in 1970 and now has a constitutional sovereign as a member of the British Commonwealth. The monarchy is based on the social class structure: the Royal family, aristocracy, and common people. This system has enjoyed stability and has a long tradition. The political structure consists of three groups: a national assembly, a cabinet, and a judicial organ. The privy council is the supreme decision making organ in the cabinet. Tongan is spoken as a daily language, but English is also used as a formal language because of the prevalence of English education. Therefore, important official documents, such as budget statements, are written in both languages. Since both languages are alphabetized, they can be easily adapted to office work using machines.

Automobiles are playing a major role in inland traffic and the development of roads is gradually making progress. Ships and airplanes are used for inter-island traffic. The three major islands of Tonga are connected by a regular shipping line and Nuku'alofa port on Tongatapu Island, Neiafu Port on Vava'u Island, and Pangai Port on Ha'apai Island, be-

come active when ships arrive. Regarding airlines, a private air service company (with small-sized planes) and South Pacific Islands Airways are the domestic airlines. In addition to these, Pacific Airways, Nauru Airways, and Polynesian Airways have services through Tonga on their international routes between Fiji, Western Samoa, and New Zealand. It takes about one hour and fifteen minutes to Fiji, and some three hours to New Zealand. For international flights, Fua'amotu International Airport is used.

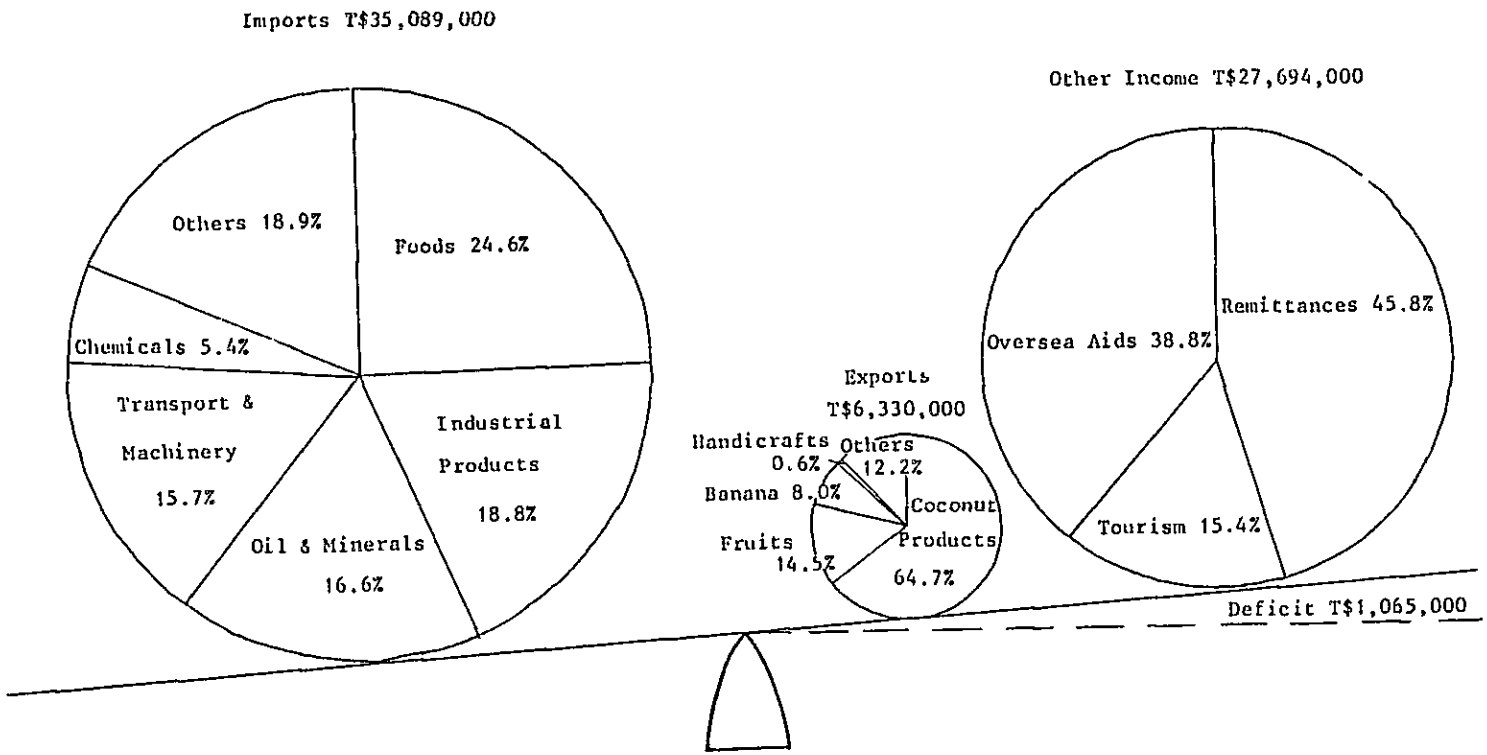
Internal communications by telephone and telegraph are managed by the state-run enterprise, Telegraph and Telephone Department, which was decided to be made a public enterprise, the same as other boards, in July, 1984. As for telephones, through direct-dial service on an immediate basis is available on Tongatapu Island, and radiotelephones are used for interisland communications. For international telegraphs and telephoning, the British company, Cable and Wireless Ltd., has supplied a satellite earthstation, through which instant communications are available, making it easy to communicate with Japan.

(3) Economic Conditions

Referring to the scale of the national economy, the GDP (Gross Domestic Product) of the Kingdom of Tonga showed a nominal total of T$56,570,000 (about 12,600 million yen) and has shown a nominal growth rate around the 10% level for the last several years. The GDP per capita has recorded more than double the nominal growth rate for the past ten years, and amounted to T$580 in 1982. According to the composition ratio of the GDP for every industry in the last ten years, the percentage of primary industries has declined; however, the fields of commerce, transport, and communication (tertiary industries) have increased their percentages. This trend shows that because of a deadlock in the unique Tongan land distribution system, the Kingdom of Tonga's characteristics as an agriculturally self-supporting country have been gradually weakening and at present there is a strong social quest for modernization.

In 1982, the Kingdom made imports of T$41,205,000 and exports of T$3,646,000 in total, recording a large trade deficit. This deficit was induced by structural defects in the system over the last several years. That is, there are few commodities available for export while many goods, from raw materials to machinery and industrial products, have to be imported. The deficit due to the imbalance between exports and imports is covered by remittances from overseas Tongans (about 13 million T$ in 1981 – 1982) and foreign aid (about 11 million T$ in 1981 – 1982), which includes no aid other than money, loans, and investment (See Fig. 2). In the national budget, ordinary expenditure amounts to about T$16,010,000 (about 3.6 billion yen) and development expenditure amounts to about T$4,970,000 (about 1.1 billion yen), while ordinary revenue to cover such expenditures amounts to about T$16,390,000 (about 3.7 billion yen). Accordingly, various foreign aid funds are used for development expenditures.

Fig. 2 Tonga's Economy (1981)



2. Economic Structure of the Organizations for Study

A study for EDP (Electronic Data Processing) is being done for nine organizations which include those of a governmental, quasi-governmental, and private nature. These organizations all have, for one reason or another, various public duties.

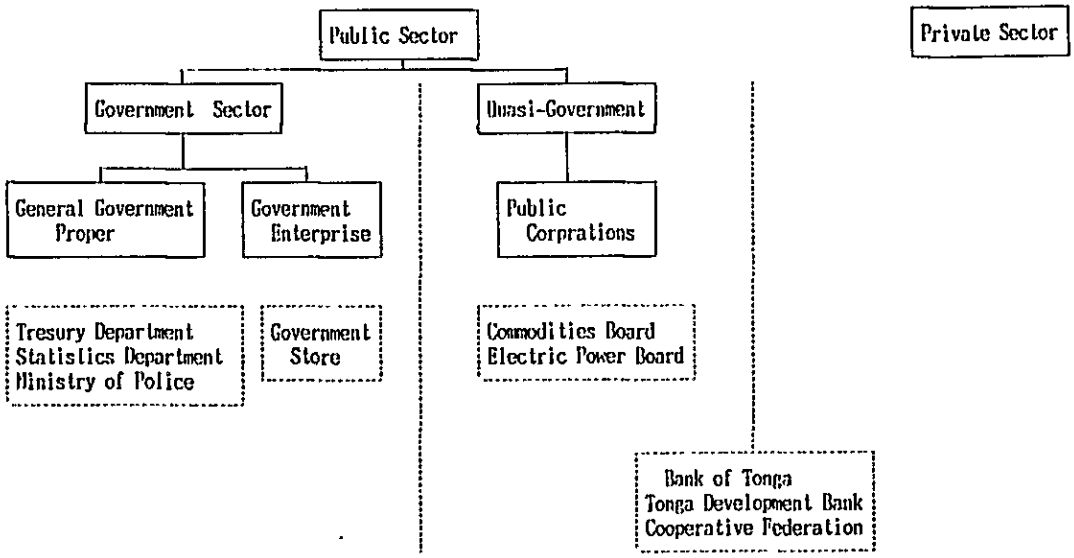
Those departments belonging to the ordinary government structure are the Treasury Department and Statistics Department of the Ministry of Finance, and the Ministry of Police. The Treasury Department is in charge of budget control work such as the payment of wages to officials, and annual revenue/expenditure accounting. This department belongs to the Ministry of Finance, so, regarding data processing, it has close relations with other governmental organizations. In addition, the department has the functions of issuing currency and issuing and selling postage stamps. The Statistics Department makes arrangements for overseas and demostic statistics information, and makes regular publication of statistics for foreign trade, the balance of international payments, commodity prices, and national income. The department, through a survey on data from business firms and private families, and reports on taxes or customs duties, can be said to be closely connected with all information concerning the citizenry. The Ministry of Police is in charge of maintenance of public security, traffic safety, and immigration control, and is dealing with related registration work. Particularly, immigration control has become important due to social problems caused by migration and the year by year increase in the number of foreign tourists.

Among organizations for this study, the Government Store of the Ministry of Works is a governmental enterprise. The Store's main business is procurement of materials for all governmental activities. Because the government plays a major role in the all industries in the Kingdom, the Government Store, which supplies all materials to government organizations, plays an important part in the national accounting process.

Among public organizations in the Kingdom, some are public enterprises acting as quasi-governmental organizations. The Commodities Board and Electric Power Board are such organizations in this study. The Commodities Board is the biggest public enterprise in Tonga, with 860 employees, and consists of the following divisions: construction and related materials sales, and primary production and manufacturing. Each of these divisions has a long history. The Board deals with major agricultural produce for export such as copra, bananas, and vanilla. Moreover, the Board manages housing construction, and operates a soap factory and construction materials sales store. The Electric Power Board operates a retail store for electric appliances, aside from electric supply service. As there are no rivers in any of the Tongan islands; power supply is solely from thermal generation employing diesel generators.

Among the organizations in the study, some are essentially private organizations, which nonetheless have a public character due to their roles and types of assistance funds

Fig. 3 Classification of Organizations



received. The Cooperative Federation, Bank of Tonga, and Tonga Development Bank are such organizations. The Cooperative Federation undertakes mainly the wholesale of imported goods to domestic small retailers (Federation members and non-members). The Federation is also selling handicrafts and dealing with marine products. The Bank of Tonga is a private bank established in 1974. The largest shareholder in the Bank is the Government of Tonga, so the Bank is in charge of such official work as teller business for the Government, foreign exchange reserve management, and implementation of loan regulations. The Tonga Development Bank was established on the Government's initiative as a specialized bank for loans. The Bank makes low-interest loans and promotes private business.

As mentioned above, in the Kingdom of Tonga, governmental organizations which are related to public utilities have close ties with the industrial economy. If, therefore, appropriate technical suggestions and assistance are given to such organizations to reduce initial costs, and a data processing system (with a support system) is established, the Kingdom of Tonga will reap a great deal of social and economic benefits.

3. Environments for Computerization

3-1 Computers in the Kingdom

The computers observed by the study team are as follows (almost exclusively micro-computers):

1)	AED-S100's	Treasury Department (aid from the Australian Government)
2)	AED-S100	Ministry of Land & Surveys (aid from the Australian Government)
3)	Olivetti	Ministry of Foreign Affairs
4)	Apple II	Telegraph and Telephone Department (developed by ITU)
5)	Canon	Ministry of Health (planned)
6)	Olivetti M-20	Tonga Technical Development Holdings Ltd.
7)	Apple II	Seventh Day Adventists Church
8)	Honeywell	The Latter Day Saints Church
9)	KAYPRO II	Polynesian Printing, Ltd.

The study team has reported that, in addition to the above, certain foreigners have privately-owned Osborne and Apple II units, and Cable & Wireless, Ltd., is planning to introduce an IBM micro-computer.

Despite the small number of computer units, a variety of types have been put into use. Such variety may not be desirable from the viewpoint of spare parts supply, exchange of experience, and compatibility of programs. Especially in computerization in governmental organizations, this will be a very important factor to consider.

3-2 Infrastructure for the Introduction of Computers

(1) Staff

In the introduction of computers into the Kingdom of Tonga, human resources are the most important factor. Among governmental organizations using computers, only the Telegraph and Telephone Department has a smoothly operating computer system (Apple II). In the T & T, a foreign specialist is managing the hardware and systems development (technical manager) and Tongan women are performing actual operation.

In the Treasury Department, where a data processing system is under development, data input and operations are performed by Tongan women, but systems development is being handled by a foreigner.

In several government organizations and private enterprises, there are electronics

engineers (mainly foreigners) who can create support for the hardware and software as long as the support requested is only of a basic nature.

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 of 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.

(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, but the actual fluctuations reportedly exceed these figures.

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.

Accordingly, even for microcomputer units to be used in daily work, at least a stand-by generator and CVCF unit (Constant Voltage – Constant Frequency) will have to be attached to the power source.

In the case of important work, a UPS (Uninterruptible Power System) should also be installed.

(3) Maintenance of Hardware and Software

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 system designers, 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.

For hardware maintenance, governmental or private enterprises may, to some extent, supply parts themselves. However, if the user himself cannot restore operations the following should be considered.

(a) Support services will 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.

Software maintenance consists of the maintenance of the Operating System (OS) and the Application Software.

As for the OS, since the present hardware supplied by the hardware distributor is operating well, simply receiving "version-up" from the manufacturer will suffice.

As for the application software, it is advisable in the initial stages to introduce packages already available on the market. In such cases it is essential to receive not only manuals but also user training on program operations and modifications.

If the Tongan Government undertakes the development of the application software itself, 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). No special software firm is expected to be formed in the Kingdom of Tonga for the time being.

(4) Physical Environment

Recent advances in hardware have greatly improved the capability of microcomputers 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 units should be placed in a room that meets the following requirements, in order to prevent, as much as possible, problems caused by the environmental factors such as temperature, humidity, salt air and dust, as well as the power source.

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

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

1. Statistics Department

The work for study in this department consists of national statistics. At present, the following are related statistics:

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

Statistics published monthly, quarterly, and yearly consist mainly of trade reports. The reports are made through data collated and sent from the Immigration Department, and, a collection of various figures and tables. For statistics purposes, commodities are classified according to the U.N. classification, SITC-Revised. Foreign trade partners listed in the reports include 53 nations. The number of items used in the trade reports is comparatively large, but processing of the collated and collected material is rather simple. In this part of the work considerable standardization in manual processing has already been achieved.

The consumer price index is one of the statistics figures calculated into the Lespeyres Index, with regular price checks at various locations and quarterly collation of the data collected. Price checks are made for 229 items in the five retail shops and markets. For data processing, despite the amount of research included, the work is comparatively easy to formularize because value calculations are almost all averaged.

International income and expenditure statistics are added to the above-mentioned trade statistics, along with current account and capital account balances. These statistics are published quarterly. Further, statistics are estimated using data from accounting reports collected from government organizations, private enterprises, and the Bank of Tonga. Therefore, an arrangement of data providing a basis for estimates is necessary. In other words, data from various organizations should be standard in format.

Calculations for the national economy consist of very comprehensive statistics, including national production and expenditures calculated from various business statistics and social surveys. The results of these calculations are issued yearly. These statistics are estimated from data reported by all economic organizations, ranging from public to private. Data from home industries and agricultural production, which are not included among data reported, are taken into account in the family budget survey. As mentioned above, the process of gathering national economic statistics includes both surveys and estimations, so it is not easily formularized.

The Statistics Department is, at present, planning to introduce EDP with the goal of centralization of national statistics work. In relation to this, the Department is encountering the following three problems.

1) Expansion and diversification of related work
2) Shortage of staff resulting from organizational expansion
3) Centralization of staff in the survey section

The Department is expanding its work to include statistics for agriculture, industry, and labor, so it is necessary to standardize the forms for surveys and analyses. The Departmental organization is also expanding as the work increases, but it is still being confronted by a lack of staff specially educated in statistics. Therefore, the Department is dispatching staff abroad in order to cultivate specialists.

An overall family budget survey is scheduled to be made in 1984 throughout the Kingdom of Tonga, and a national census is to be made in 1986. Because of this, it is assumed that more manpower will be required in the future for the time-consuming survey work.

As mentioned above, for the expansion of the organization and its work, efficient management is required in the Statistics Department and the introduction of an EDP is being planned. It is expected that manual collating work, which has become routine, will be automatically processed by the EDP, and the data from various social surveys will also be EDP processed in a shorter period of time and with better organization.

Since there is staff available for EDP within the Department, if an appropriate hardware is obtained, and existing packages for collation are available, self-development of the system should be possible to a considerable extent. For statistics and analysis, a unit with a capacity greater than a microcomputer is required, regardless of size. Statistics and analyses require the collation of various basic data such as customs clearance data, the establishment of a future database, and processing for censuses (with seasonal adjustments).

2. Treasury Department

The Department's work under study is budget control. Budget control work includes a compilation process to make compilations and adjustments of budgets presented from each department, and an aggregation process to provide a total balance picture for annual revenues and expenditures. Concerning the latter, the aggregation process is more significant in data processing.

The aggregation process includes the following accounting work:

1) Checking
2) Sorting
3) Recording

Namely, this is a process to perform, through data processing, checking, sorting, and recording of the data supplied to the Treasury Eepartment. Annual expenditure vouchers and revenue vouchers are among materials brought in to the counter clerk of the Department. These vouchers are received at the counter and then inspected according to budget items (checking). Next, they are classified into cash and check accounts before being entered in the cash book (Sorting). A daily trial balance is made by aggregation of the annual expenditure and revenue vouchers. A monthly trial balance is made by aggregation of the daily trial balances and journal vourchers brought in monthly. These are finally compiled as a balance sheet (Recording).

In the present accounting system, there are delays in the aggregation of annual expenditure and revenue, and of imperfect checking on over-expenditures. These problems result from both internal and external causes in the department. The internal cause for delays is due to unnecessary repetition of work such as postings, adjustments, and calculations. The external cause is the delay in data processing of other related organizations. The internal cause can be eliminated with the accounting system which is under development for the AEDS-100 unit already in the Treasury Department. In order to eliminate the latter cause, since it is related to the governmental system of the Kingdom of Tonga, data processing systems should be improved in other government organizations such as the Government Store, the Customs and Tariff Department, and the Inland Revenue Department. If improvements can be accomplished, it is expected that each organization will be able to exchange data with other organizations through the computer systems.

In the Treasury Department at present, two systems, for balancing revenue and expenditure accounts and for payroll accounting of the government staff, are under development using AEDS-100. Despite the efforts of the staff, the development plan is encountering difficulties such as slow response time of the computer and insufficient hard disk capacity. The cause of these difficulties seems to be the limited file capacity of the random access type dBASE II. Two solutions may be suggested in connection with this. One solution is to change to another system such as the sequential file system with COBOL language; the other another solution is hardware oriented: continue use of dBASE II while increasing hard disk capacity or replacing the disks with a Winchester disk. The latter solution is better in terms of ease of implementation.

Anyway, it is practical to promote system development with the AEDS-100 for the time being, while completing the EDP for budget control in the Department itself (balancing of revenues and expanditure accounts, and payroll accounting of government staff).

If the computer is replaced by a higher level unit in the future, and if a data processing network between other organizations is formed, budget control in the Treasury Department will be made more efficient. Concerning this, the upgrading of the computer should be made taking into account compatibility of the disk data after other major

organizations will have made improvements in their individual EDP systems. An on-line system with improved communication circuits could be considered in the future.

3. Tonga Development Bank

The work for study in the Tonga Development Bank is loan management, which is broadly classified into the following processes.

1) Receipt of Loan Application
2) Implementation of Loan Approval
3) Implementation of Loan Disbursement
4) Receipt of Loan Repayment and Check of Arrears

Namely, there are two steps in loan management. In the first step, approval is made for the amount applied for (Registration Process). In the second step, disbursement is made for the approved loan and repayment of the loan is received (Accounting Process).

In the "Receipt of Loan Application" process, borrowers make loan applications to the Bank (lender). The data processing consists of receiving the application and posting it to the loan application register. In the "Implementation of Loan Approval" process, approval is made for the application and a loan implementation sheet is prepared before being entered in the loan approval register.

In the "Implementation of Loan Disbursement" process, disbursement is made individually for each approved loan. The data processing consists of the checking of the loan application sheet before the issuing of the check and entry in the ledger card. The "Receipt of Loan Repayment" process covers three repayment methods: direct repayment at the Bank, transfer from the Bank of Tonga, and salary withholdings. Repayment is checked in the Accounting Division according to the interest card.

As previously mentioned, loan control in the Tonga Development Bank includes both registration and accounting processes, of which the registration process, especially the recording work, is being scrutinized at present. Major problems in the recording work are as follows:

1) Arrears Management
2) Repetition of the calculation and recording of interest
3) Frequent correction of records
4) Maintenance of records

There are as many as six types of sheets and cards in which an interest amount is entered simultaneously with loan approval. In addition, because these papers are prepared in connection with both the Loan Division and the Accounting Division, inefficient repetition of work occurs. As frequent corrections are requested in compliance with the alteration of the loan conditions, it is necessary to be able to update the data easily. Since these forms are being used in both divisions, attention should be paid to maintaining them

properly.

Even taking into account the above problems, the EDP plan has considerable merits for the Tonga Development Bank. Therefore, it seems that an EDP plan for the loan registration process should be promoted. The EDP system will be expanded, in the future, to be connected with loan accounting, and possibly all accounting systems in the Bank.

4. Government Store

The Government Store belongs to the Ministry of Works, and supplies various goods primarily to government organizations and even to the public. There are 13,000 stock items, so stock control has become a problem. The discrepancy between figures on account and the inventory value is estimated to be $250,000. Other estimates, however, are as high as $500,000.

In the current system, there is a critical bottleneck which should be removed; study for improvement is under way in the Store. Furthermore, the study for computerization is being made concurrently. In the beginning of the study, an inventory catalog was prepared, Preparatory work has been completed, and, at present, only maintenance work is being carried out. As the second step, a study concerning the types of output materials and output intervals has been initiated.

Computerization in the Government Store is highly necessary for stock control and other work, and is greatly desired. However, systematization for the stock control of as many as 13,000 items is possibly problematic to undertake first, so initial application of the new system should be made to payroll accounting; it is more systematic work than stock control. After stable operation of the accounting system has been accomplished, the introduction of a stock control system should be made.

Because the development of the stock control system has a close connection to accounting work, their studies should be made at the same time in order to create a smooth interface. The hardware configuration for stock control in the Government Store is a duplex system with a backup CPU. Even if one unit is down, another one can back it up. Several work stations can be connected and multiuser multitask processing becomes possible. The stock data are mainly stored in an on-line fixed disk, and direct conversational retrieval is possible. At the time of inventory (within the warehouse), portable entry devices are used and data are handled by off-line input.

Interfaces with other organizations, and especially the close tie with the Treasury Department, should be maintained in the accounting process. Since the data are often transferred to other government organizations for voucher-check, the process for data collection should be made particularly efficient.

5. Commodities Board

The Commodities Board is the largest organization in the Kingdom. Its business includes a wide range of activities, from the purchase of primary produce to the running of factories and retail stores. Every division had its own accounting section previously, but they have all been integrated into a single unit of the Head Office by the recent organizational re-shuffle. As there are more than 800 employees, the payroll process entails a considerable volume of work. Rapid data collection from branches is also important for consideration, because they are scattered all over the country.

The growers' information system is very greatly desired to be computerized. Strong requests for computerization for the compilation of sales data at each store, and for income and expenditure control in construction projects, have been made. Data volume for the purchase of primary produce and the sales of goods is large, and the purchase of copra alone creates as many as 200 items of data daily. Therefore, a considerable amount of data must be processed. There are about 3,500 stock items in the Board, and despite having a well-arranged warehouse, there is a discrepancy between figures on account and the inventory value.

The introduction of computers for the Board should be made step-by-step. In the first step, the payroll accounting, growers' information, and sales information systems, which are easily computerized and should obtain high efficiency, should be computerized. In the second step, the accounting system should be constructed so as to be the center of data processing in the Board. Next, in the third step, a stock control system should be prepared. It is the role of the EDP manager to introduce the computer system step-by-step. The special EDP section should be established in an organization at least as large as the Commodities Board and the EDP manager should take charge of the introduction of the system.

As for hardware, several single-work stations are sufficient for the first step; however, simultaneous processing with multiwork stations will be indispensable in the second step, and thus, the latter units should be chosen for introduction. Because of the large number of vouchers issued, the work station should be connected with a serial daisy-wheel printer equipped with a front inserter for single voucher printing.

6. Tonga Electric Power Board

The Tonga Electric Power Board is the exclusive electric power supplier throughout the territory of the Kingdom. It has power stations and a power supply network on Tongatapu and Vava'u Islands, and they are scheduled to be expanded in the future. At the same time, the development of a power supply system is under way on the other islands with the aid of the Australian Government.

As a result of the study, stock control has been taken up as an object for the intro-

duction of an EDP system. The warehouse of the Board houses parts for electric engineering work and electric appliances which the Board is selling. In the existing system, stock control is being carried out with a ledger and coded bin cards, in which are entered requisitions issued by various department. Monitoring of reorder levels and purchase periods is also being performed with this system. No ideas on the bottleneck in the existing system have been aired by interviewees in the Board. The Board has an interest in schedule control and in the use of computers in technical fields as well. The study team has made the recommendation that the stock control system be implemented with a small-sized computer.

7. Ministry of Police

The Ministry of Police has requested a total computer system which includes, primarily, crime information, vehicle registration, and immigration control functions. However, the study team has taken up only vehicle registration and immigration control. These are included in the Scope of Work; work related to personal privacy has been deleted from the Scope of Work.

(1) Vehicle Registration

The Traffic Department deals with the following:

1) Vehicle registration
2) Driver's license registration
3) Violations of traffic regulations and traffic accidents

The Department wishes to use a computer to handle the first two items. Therefore, the information mainly to be dealt with concerns vehicle registration cards and driver's licenses. The number of automobiles registered was 2,490 units in 1981 and 3,086 units in 1983. There seems to be a considerable number of unregistered automobiles. Finally, there were 4,526 license holders as of December 1983.

The main bottlenecks in control are as follows:

- It takes a long time to identify the owner of an automobile.
- On patrol, it takes a long time to confirm if a person driving a car has a license. It is also time-consuming to check into the types of vehicles which a driver is licensed for. The current law does not require a driver to carry his license while driving.

The following three items are considered the main objects of computerization

a) Quick retrieval of vehicle information
b) Quick retrieval of driver's license information
c) Qualitative improvement in driver's license control

(2) Immigration Control

The Immigration Department is in charge of immigration control, visa control (immigration cards), and passports.

1) Visa Control

The number of visitors to Tonga was recorded as 75,415 for 1982. The immigration cards are now filed alphabetically using the names of visitors as the reference key. Three persons are assigned to the visa control section and two of them are at the airport.

Problems in control are as follows:

- It takes time to find a specific card due to the large number of cards involved.
- A retrieval key or keys, other than name, is needed for reference.
- Sometimes, it is necessary to search for a card which was issued many years before. This means cards must be kept for a very long time.
- It is difficult to ascertain when a visitor leaves. Identification of illegal entries is also difficult.

2) Passport Control

The number of passport holders is estimated to be about 60,000 at present. When a passport is issued, an overseas card is made for each holder, with a photograph of the holder on the back. These cards are kept in a box and are stored in alphabetical order by name. Six persons are working in passport control at present.

Many Tongans go abroad to work, with policies toward immigrant workers tending to become strict in neighboring countries. Under such circumstances, problems related to passports and inquiries thereof, both domestic and foreign, have increased. Orderly storage and efficient retrieval of passport information is required.

(3) Future Plans for Data Processing Systems

Both vehicle registration and immigration control are the work of the Ministry of Police. Because these are completely different types of work, both in the nature of the work and where it is performed, systems development should be done separately. However, data processing for both can be performed mainly by a registration and retrieval system. In this respect, use of a microcomputer and database oriented language is the best choice. Meanwhile, it is necessary to design the system with attention to the fact that handwritten data by visitors causes problems for processing in visa control. It is also required that the system design recognizes the fact that a separate process for the photograph file is needed in passport control.

For the vehicle registration and immigration control systems each, it is necessary to groom both operators who can make input and retrieval of data, and computer maintenance staff. For the operators, a general knowledge of computers and operation training should be provided. For the maintenance staff, it is necessary to provide detailed knowl-

edge about computer hardware and software, and information about the computer system implemented.

In Phase II, immigration control, which has greater importance, is taken up as a case study. In the case study, a basic design and development plan are made for the immigration control system.

8. Tonga Cooperative Federation

The Tonga Cooperative Federation made its start as a cooperative organization which imports and wholesales consumer goods to the primary organizations (the Federation members). At one time it almost went bankrupt but has been rebuilt by basic structural improvements, along with foreign aid. Proceeds have steadily increased and business has also been expanded. The Federation has come to contribute to domestic industry through the export of vanilla and sales of handicrafts.

In the study, stock control in the wholesale stores was taken up as an object for computerization. Stock control is the most important work in the Federation. In the current wholesale business, operations control by the Head Office and sales activities in the stores are clearly separate. Under such a system, Tongans are being trained in the science of management. At present, stock and accounting data are compiled through the processing of sales invoices and frequent manual inventories. A particularly heavy workload is centered daily in one post, creating a bottleneck. The Secretary Manager has a concrete and practical plan for computerization, which can easily be handled by a small-scale computer unit. Therefore, the study team recommended a control system with a small-scale computer using a POS terminal. This system is close to a sales control system in function, and is very practical.

9. Bank of Tonga

The Bank of Tonga is the only commercial bank in Tonga. The shareholders in the Bank are as follows:

The Government of Tonga	40%
Westpac Banking Coop. of Australia	20%
Bank of New Zealand	20%
Bank of Hawaii International	20%

The Bank has been entrusted with the following important functions by the Government.

- Management of foreign reserves in foreign countries
- Holding of payment accounts of governmental organizations

The Ministry of Finance imposes some optional constraints on the Bank's lending. The Bank, however, sets its own criteria for lending, within these constraints.

Items handled by the Bank include savings, loans, checks, letters of credit, foreign exchange, and customer surveys, as well as general banking. The staff numbers 120, and is well trained. The Nuku'alofa Head Office is usually busy with customers throughout the day.

The following bottlenecks have been acknowledged by the Bank.

- The present unit (NCR32) is obsolete and should be useful for only two – three more years.
- There are many breakdowns (NCR32 and NCR299), and spare parts are difficult to obtain. Because of this, delays occur in the processing and journalizing of vouchers.
- It takes time to prepare the payroll for the staff, and calculation of interest is also time-consuming.
- For debts, loans, and advances, accurate information cannot be provided on a timely basis.
- It is impossible to make pseudo-updating of accounts in daily operations.
- Delays occur in preparation of reports for the Bank's management.
- Delays and errors occur in balancing.
- Growth of the Bank and an increasing volume of activities must be handled.

The Bank of Tonga has the following ideas concerning the introduction of computers.

(1) Computerization should be promoted at the Bank's own initiative. Protection of confidentiality should be taken into account. The Bank should not rely on aid from abroad.

(2) Stabilization of the fluctuations in power supply is essential.

(3) The Bank should have a backup unit, despite increased cost.

(4) Computerization should be promoted step-by-step, following the order mentioned below:

- General ledger
- Common deposits
- Savings
- Loans, advances, and repayments

It will take a long time to move into the foreign business sector.

(5) The Bank is interested in the "South Pacific Banking System" software package. The package was originally developed in New Caledonia. However, an English version is being completed and a trial will be made in a bank in the Solomon Islands. The Bank of Tonga is awaiting the results.

(6) It is out of the question to employ a programmer. A front line operator should be groomed as soon as possible.

Since the Bank is promoting an EDP plan for itself, it will be better to put emphasis on the training of systems designers in the future. Because there are many types and a great volume of data to be processed, two units at least, including the backup unit, will be required. When choosing a unit type, it is necessary to take the following factors into account:

a) Many auxiliary units should be available and directly connectable.

b) There should be a large allowance for capacity expansion. It should be possible to continue operation for five years, at least, by adding memory capacity.

c) The unit should have superior on-line functions.

d) The unit should have a structure which is easy to provide maintenance for.

The experiences of banks in Fiji will contribute considerable knowledge for implementing the system.

(1)

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

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

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

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

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

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

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

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

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

nputerization in the Organizations (4)

Chapter IV Case Study for Computer Introduction

1. Ministry of Police – Immigration Control

The immigration control section of the Ministry has put the most priority on the EDP plan, and the Ministry itself also eagerly desires computerization. To this effect, immigration control has been taken up as work for a case study. It is easy to adapt EDP to immigration control because the work has a fixed form and little relation with other organizations.

The computer system can be broadly divided into two parts. One is immigration cotrol on foreigners and another is passport control, mainly on Tongans. There is no relationship between the two systems. In both systems, all inputs are made with the terminal display.

In immigration control, visitor data is registered in the system upon arrival. An inquiry and revision of data are processed by the retrieval program. Upon departure, a mark, to indicate the departure, is entered in the data and remains in the unit in order to make later retrieval possible. The "list of visitors" is made monthly and statistics materials are output when the annual report is made.

In the passport control system, passport holder data is registered upon the acquisition of a passport. The data are used for retrieval at renewal, reissue, and when an inquiry is made. If there is no renewal request on an expired passport, the data are liminated by the cancel program. In this case, nonetheless, the data still remain in the computer, and therefore, later retrieval can be made. The "list of passport holders" is made monthly and statistics materials are output when the annual report is made.

As to hardware, microcomputers with a main memory of about 0.5 MB and an auxiliary memory of about 20 MB are required. Three unit-sets should be installed: one for each above-mentioned system, and one for backup. The backup unit is generally used for word processing. There is no need to have a special computer room, but a special power source should be prepared. Care should be taken about air-conditioning and soundproofing. An on-line function will be required in the future between the immigration department, airports, and harbors. Software which should be prepared include at least an operating system for microcomputers (expected to be CP/M-86 or MS-DOS), language for data base, BASIC, and software for an English word processor.

The required staff for systems development are two foreign nationals (one system engineer, one programmer) and three to four Tongans. One of the Tongans must be educated in computers in an advanced country; this person will take charge of the maintenance of software and hardware in the future. The other two to three Tongans are operation staff. The period required for system development is estimated to be nine months, in which seven months will spent on spot work.

Development costs are estimated to be ¥6,370,000 for the hardware, ¥530,000 for the software, ¥25,750,000 for staff training and software development, and ¥400,000 for miscellaneous expenses, totaling ¥33,000,000.

In forming the system, consideration should be given to the following features.

1) Mnemonic input ability at the time of arrival of a large ship from which many persons will debark.
2) The ability to condense data length and file capacity. For example, whether the cancel and coding of unnecessary items is possible or not.
3) The possibility of reducing input load. For example, direct input in immigration cards using a mark card reader is considered to be effective.
4) Retention of data. That is, old data, retained in the unit for a long time, are required to be transferred to a floppy disk, or hard copy, in order to continue to be retained. In this case, the timing and the method must be scrutinized.
5) Measures are required to be studied for the retrieval of detailed information which cannot be stored in the unit, and also for the management of image information such as photographs.

Fig. 4 Development Schedule of the Immigration Control System in the Ministry of Police

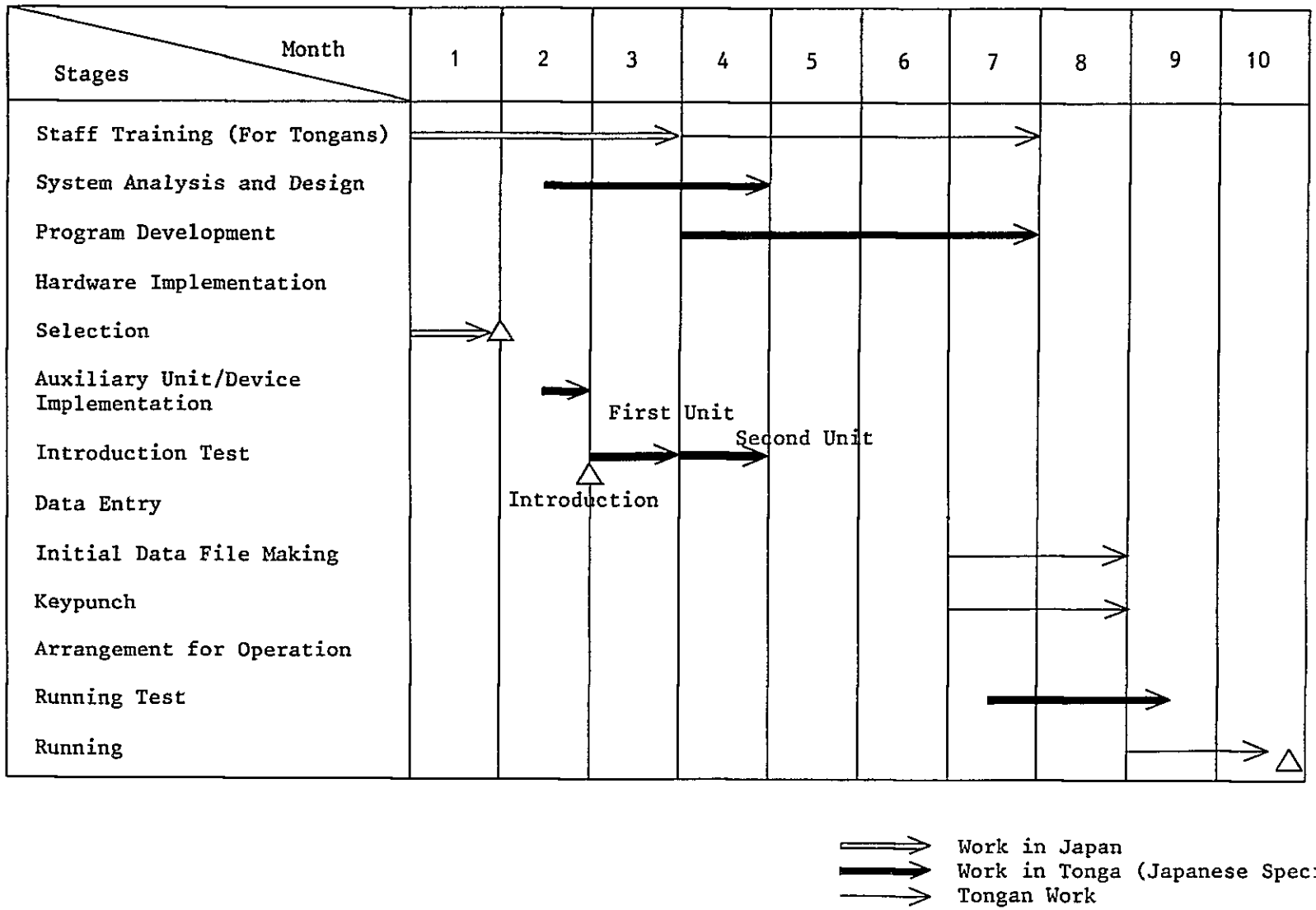


Table 1 Total Cost for Development of Immigration Control

Item	¥1,000	US$1,000
Hardware Cost	6,370	27.6
Software Cost	530	2.3
Training & Software Development Cost	25,750	111.5
Miscellaneous	369	1.6
Total	33,019	143.0

2. Tonga Development Bank – Loan Management

The main work of the Tonga Development Bank is loan management, which consists of loan applications, loan accounting, and statistics processes. The study team has taken up loan management as an object of the case study and made an conceptual design of the system. In the design is shown a guideline for computerization such as the schedule of introduction and staff training, and cost estimations.

The main bottleneck in the Bank's work is that there are many complicated types of office work which require a high degree of accuracy. This bottleneck can probably be eliminated by efficient computerization. For an actual EDP plan, it will be necessary to improve some office procedures, but in the conceptual design, it has been decided to adapt the current system to EDP.

The loan application process is the initial step in loan management; it will require a system in which a data base is retrieved with several key data. The data of an application are input and stored using the name and address as retrieval keys. These data are inspected individually by a loan officer (in this case, past data for the applicant could be referred to). Through this process, the loan officer makes a decision to decline or approve the loan. This is the last decision in the first step of the work. When a decision is made, a record in which loan conditions are described is prepared, and a new account for each applicant is opened with the Bank.

After that, the work shifts to the second step, loan accounting. First, interest calculation is made according to the loan conditions. When interest calculation is done on a flat rate basis, interest for the whole loan period is calculated and entered in the ledger. For interest on a reduced rate basis, calculations cannot be made immediately because the interest is calculated for the highest balance during the month. Thus, there are two kinds of processing in interest calculation, initial, and month-end. Loan disbursement, repayment, and refunds are mainly processed according to the bank statement sent from the Bank of Tonga. Since the statement is issued weekly, such work should be batch processed on a weekly basis. Data in the bank statement are journalized into the above three items

and are stored in the file on each floppy disk. Error check is made for the data and continual corrections are made until no error is acknowledged. After this, the data are put together with other journalized data to make a daily journal. The daily journals are then compiled into a monthly journal (daily) and a closing is made at the end of each month. The results of the above-mentioned interest calculations are also aggregated daily and merged into a daily journal.

Statistics processing is made every three months for various items of information such as the number of various types of loan applications. This is done according to stated reason for application. These materials are made by access and reference to files already stored in the two systems above.

Because loan applications and flat rate interest calculations occur irregularly, such items are processed in real time, as a rule. On the other hand, bank statements, monthly journals, monthly closings, and statistics are processed with the batch system, because they occur at fixed times.

The work is divided between the loan section and accounting section. Exchange of data is made very often betweeen the two sections and the volume of accounting work is quite large. For this reason, the hardware of the system should be of multitask multiuser type with several work stations.

When the system is introduced, a small special section for EDP is required to be set up in the Bank. This section will take charge of operator training, equipment maintenance, and file management, and will be controlled by an EDP manager. For the time being, it is sufficient to have a staff consisting of a manager and a few other persons.

Independent development of systems should be avoided as much as possible. It is desirable to introduce a software package for loan control If system development cannot be avoided, the only way to accomplish this is to rely on engineers from abroad. Development costs will, of course, be high.

Hardware costs are doubled because a backup unit is always required. Costs may be reduced if the government opens a training center for EDP maintenance.

The schedule of introduction and the development costs are shown in Figure 5 and Table 2.

Fig. 5 The Implementation Schedule in The Tonga Development Bank

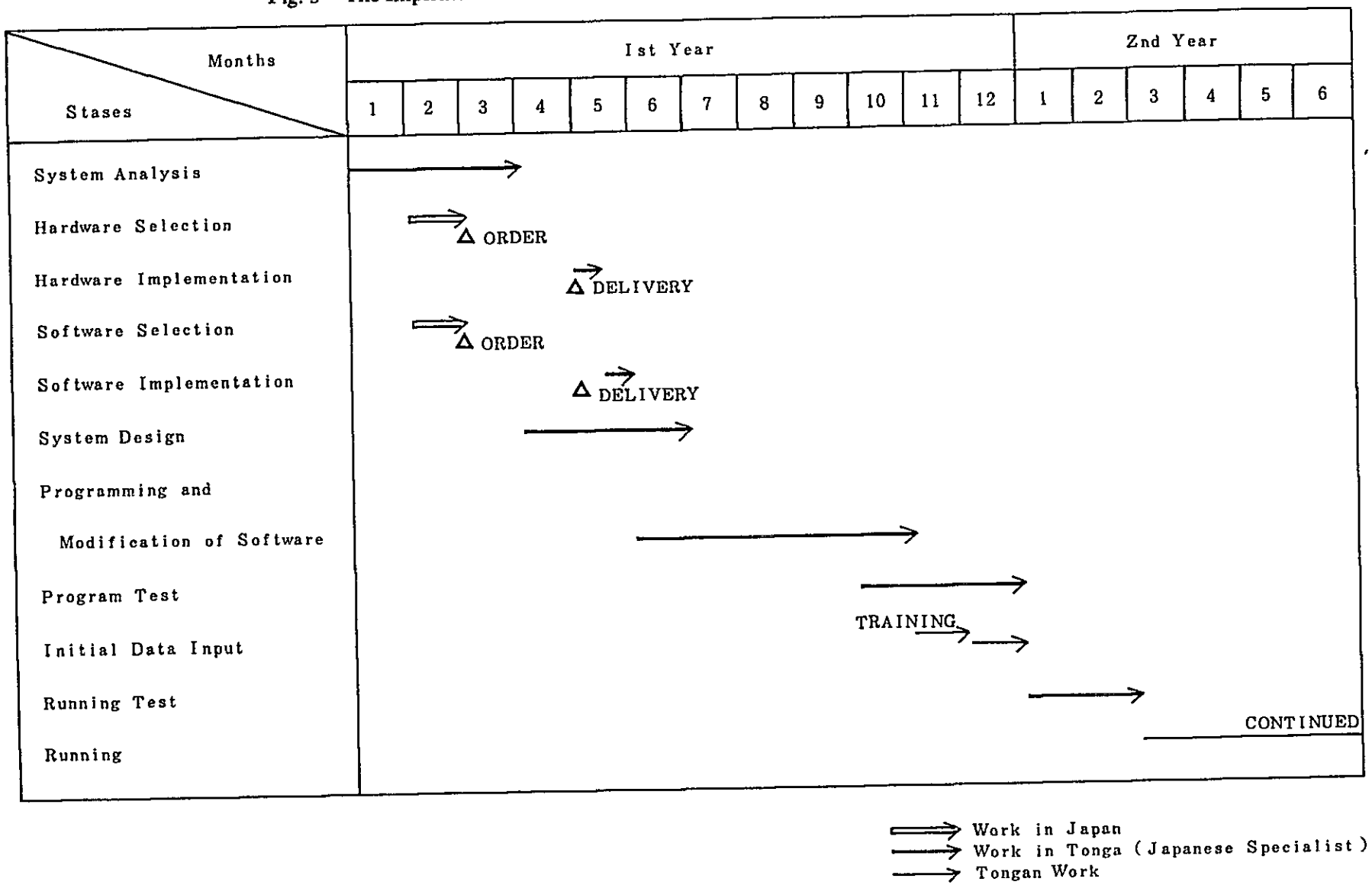


Table 2 Total Cost for Development of Loan Management System

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

Chapter V Conclusion and Recommendations

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

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

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

1. Constraints on the Introduction of an EDPS into the Kingdom of Tonga

For computerization in the Kingdom of Tonga, there are four limiting factors which cannot be ignored.

The first is that Tonga is a small nation. Office work in such nations is generally of a multi-variety small-volume type.

The second is remoteness. Due to this reason, hardware costs tend to increase for back-up units.

The third is the shortage of computer staff. For this reason, independent development of systems is impossible for the time being and acceptance of foreign engineers or introduction of general purpose packages will tend to be realistic. This is not a dis-

advantage but, to a considerable extent, an advantage in the sense that this shows a trend toward increased use of general purpose packages.

The fourth is electric power supply. A backup electric source is required in order to allow smooth computer operation. The total computer hardware required, therefore, considerable increases in cost.

2. Measures to be Taken

The study team recommends measures which recognize the above limitations and are thought to be effective for computerization in the Kingdom of Tonga.

(1) Standards should be established for the hardware and software introduced to the Government of Tonga. Such standards will assure the compatibility of the hardware and software. Particularly, this is indispensable for the basic software, such as OS, DBMS and language processors. Attention should be paid to software, particularly an operating system (OS). The OS is the indispensable basic software for the efficient use of computers, and a superior OS, even with no change in hardware, will improve both efficiency and ease of operation. As for large size computers, in general no other option than using the OS offered by the makers is available. However, in the case of small size computers recommended by our study group, especially microcomputers, the introduction of an OS having no particular connection with the hardware manufacturer is possible. Furthermore, the application program and the basic software other than the OS are created on the assumption that they will be used for a particular OS. With the exception of graphics, by introducing an appropriate OS, the present problem of incompatibility, as seen in the case of the microcomputer programs of different types of machines, will be solved to some extent.

Therefore, the establishment of fixed standards in the choice of an OS is quite important for the proper use of computers.

In addition to the OS, basic software – a group of softwares having more flexibility than the programs for particular business applications (application program) – exists. To this group belongs database management system (DBMS) which performs the collection referencing and processing of data based on a common database. The establishment of standards in introducing these is also desirable.

For the OS, UNIX, used in many mini-computers, or quasi-UNIX, are superior and will play an important role in the future. It seems that both CP/M and MS-DOS, which are the most widely used OS for microcomputers at present, are being made closer to UNIX in function. Considerable memory capacity as well as high calculating speed is necessary; therefore, an 8-bit microcomputer is insufficient and a 16-bit microcomputer or a small business computer should be employed.

(2) The Government should be urged to establish and operate a training center for maintenance. While various types of hardware will be used at different offices, the system will be more efficient and easier to learn if a common software is used. Since computerization in Tonga must rely on foreign assistance, training should be centralized, in view of educational efficiency. The training center will also function as a local center to undertake maintenance for small-sized computers distributed throughout all organizations, and will supply parts, do simple repairs, and operate lend-lease of backup equipment. Moreover, the center will be able to become a local technical information center with materials such as manuals for computers.

(3) Computer introduction should be confined to small-sized computers as a rule. The function per unit size has greatly improved in the past several years. This is due to highly integrated software for which a trend in improvement is expected to continue in the future. Accordingly, at present, the introduction of as many small-sized computers as possible is better than the introduction of one large- or medium-sized computer. That is to say, computerization should be spread out over a wide range, with the improvement of both hardware and software. It should be fully acknowledged that the improvement in computer technology is promoting computerization in developing countries. Progress should be made from a hardware-in-common/software-exclusive type of thinking that was dominant in the past and developed for individual uses, to a hardware-exclusive/software-in-common type of thinking (standard and packages).

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

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

The future conception of the diffusion of EDP in the organizations under study is shown, as a whole, in Fig. 6. Also, Table 3 indicates the number of computers to be introduced into the organizations for a five-year period. Of the total 29 computers, there are 27 microcomputers or small business computers, and 2 minicomputers in the Bank of Tonga.

(1) The First Year

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

1) **Treasury Department**

In this department, the budget control system and the payroll system are being developed with computers and support from the Australian Government. These systems, being reinforced with auxiliary equipment if necessary, must be developed continuously until completion. However, a transfer of people who have been engaged in development is conceivable. Therefore, the organization for system planning and the system control operation should be reinforced and stabilized.

2) **Ministry of Police**

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

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

3) **Tonga Development Bank**

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

4) **Training Center**

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

(2) **The second year**

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

1) **Statistics Department**

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

2) **Government Store**

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

3) **Commodities Board**

A system for gathering data concerning growers which sell goods to Commodities Board will be introduced. It is desirable that the systems have multistation and multitask functions, because the payroll system and the stock control system will be added to them in the future.

4) **Cooperative Federation**

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

5) **Maintenance and Training Center**

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

(3) After the Third Year

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

Fig. 6 Master Plan for The Computerization in Governmental Organization

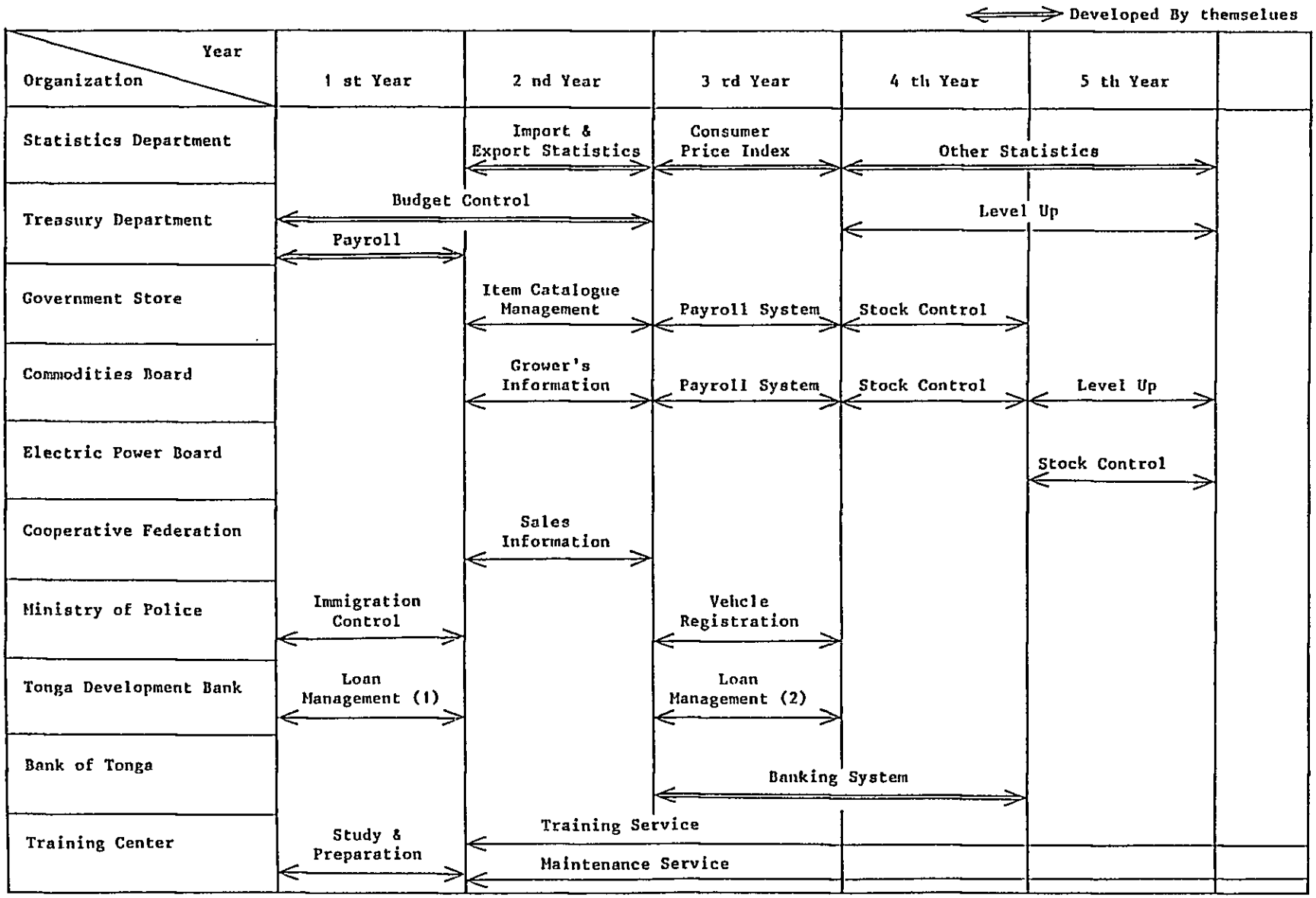


Table 3 Number of Installations by Year

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

* Shows multi-station/Multi-Task Systems

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