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SURVEY OF RESOURCES FOR COMPUTER APPLICATIONS IN SRI LANKA

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SURVEY OF RESOURCES FOR COMPUTER APPLICATIONS IN SRI LANKA

by

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A thesis submitted in partial fulfillment of the requirements for the degree of Master of Engineering.

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"THE SCIENCE OF COMPUTERS AND OF COMPUTING HAS COME UPON US WITH SUCH RAPIDITY THAT IT CAN PROPERLY BE TERMED "PRESENT SHOCK" RATHER THAN "FUTURE SHOCK" AS TOFFLER CALLS IT. THIS IS PARTICULARLY TRUE WITH RESPECT TO THE MEN OF COMMERCE, OF INDUSTRY, AND OF GOVERNMENT AND ALSO TO THOSE THAT HAVE THE RESPONSIBILITY OF EDUCATION."

Theodre J. Mock and Miklos A. Vasarhelyi,
University of Southern California.

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ABSTRACT

This survey covers the resources for computer applications in Sri Lanka. It includes the computer hardware, software, usage, personnel, organisations, and training facilities available in Sri Lanka.

The survey was based on primary data collected by personal interview and secondary data from various sources.

There are currently 33 computers, with the largest main memory being 128 K bytes. A rapid growth is seen in computer installations, with a marked shift towards small business computers. Most, if not all applications software is sequential record file based and not DBMS based. The usage of the general purpose computers are mainly in accounts, insurance, payroll, and statistics. Application software packages of topical interset with a high level of integration are being developed locally by hardware vendors. There is shortage of experienced and trained computer personnel. A significant proportion of the computers are in the private sector. Computer education and training facilities are very minimal. Most of the computers are concentrated in the Colombo (capital) District. IBM has a significant portion of the market, with WANG showing remarkable growth for a new computer vendor in Sri Lanka. ICL is the other major vendor. High proportion of the computers are on outright sale.

The indications are that growth of computers would continue. Recommendations are made for the consolidation and further utilization of computers in Sri Lanka. The most siginificant include the establishment of a Computer Applications Authority, District Computer Centers, planned computer education programs including a first degree in computer software engineering and the use of television for computer courses. The need for the President's 'imprimatur' for computer usage is mentioned.

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last by no means least, to my family who have undergone many a hardship and suffering in seeing the 'Oleman' through university.

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1. INTRODUCTION

Sri Lanka is a country of fourteen million people. (FIG.1.1 & FIG.1.2). It had a gross national product (GNP) of 140 US Dollars in 1977, thus falling into the category of a most seriously affected country (MSAC). In 1977 there was a change of government, and a new constitution enacted which created an executive President's post to enable a coordinated and concerted effort to be made for the rapid development of the country's economy. Since then, the country has changed its socio-economic policies from a centrally planned and state controlled economy to an open market economy. Most restrictions on imports, foreign exchange, and foreign investment have been eased. There is an expectation that the free market forces led by multinationals and local entrepreneurs will contribute to (a) The reduction in chronic unemployment, (b) The improvement in foreign trade and thus balance of trade, and (c) BETTER MANAGEMENT PRACTICES LEADING TO MORE PRODUCTIVE ORGANISATIONS. The government has announced its intention to modernise management in all sectors.

In this context it could be expected that computers (which have been used extensively in developed and developing countries for processing data to obtain information which is vital for decision making) will be used in more and more application areas in Sri Lanka, in both the public and private sectors.

However, there is a general lack of information regarding resources for the development of computer applications in Sri Lanka. Planners, Consultants, Data Processing Managers, and other interested workers are hampered in their work by this lack of information.

In many countries there are various periodic reports on computing available. There are no similar reports available on computing in Sri Lanka. This Survey of resources for computer applications in Sri Lanka is intended as a contribution, albeit small to cover this vital requirement for Sri Lanka at this time. In addition, it is proposed to suggest areas that could utilise computers effectively and based on the findings of the survey to suggest guidelines to mobilise resources to use computers in the economic and social development of the nation.

FIG. 1.1 SRI LANKA IN SOUTH ASIA.

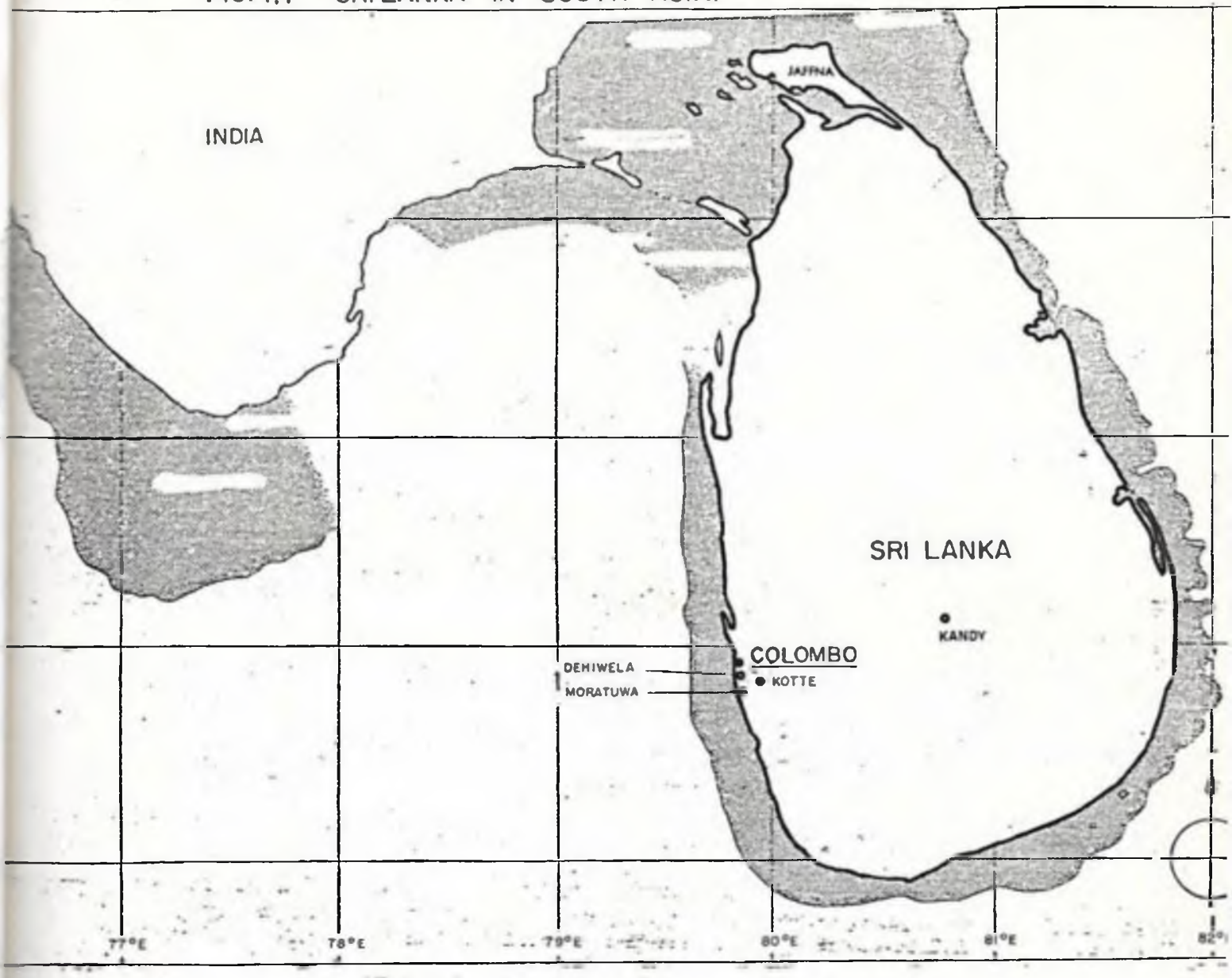


FIG. 1.2 SRI LANKA IN THE WORLD

2. METHODOLOGY

2.1 DATA GATHERING.

The personal interview was the principal method of gathering information for this survey (FITZGERALD, 1973). The author conducted these interviews in Sri Lanka.

In additon secondary published and unpublished information was also obtained from various sources in Sri Lanka. A complete list is given in the Bibliography (FERNANDO, 1980).

2.1.1 VENDORS AND USERS.

The approach adopted was to meet a vendor or user and explain the purpose of the survey, and leave behind a questionnaire to assist the interviewee to gather the relevant information, for a subsequent interview. This procedure although time consuming gave rise to a consistent collection of data.

Further information on vendors status was obtained from the Registrar of Companies. Computer import values were obtained from the Department of Customs.

2.1.2 EDUCATION AND TRAINING.

In order to gather information regarding computer educational programs, the Ministry of Higher Education and the Universities in Colombo were visited, and the outstation universities contacted by phone.

2.1.3 THE COMPUTER SOCIETY OF SRI LANKA.

General information regarding computing was obtained form The Computer Society.

2.1.4 PUBLIC AND PRIVATE SECTOR.

Since the Government Treasury is the sole public agency in the country responsible for the budgetary system of the Sri Lanka Government and the Public Sector Corporations, it was visited to determine the status of the budgetary systems. Visits were also made to various Ministries, Departments, Research Establishments and a District Secretariat. In the private sector information was obtained from the Chamber of Commerce.

2.1.5 IMPORTS.

The data relating to the value of data processing machine imports was obtained from the Department of Customs. The number of computers imported was computed using data from the vendors and the installations.

2.2 ANALYSIS AND REPORTING.

After all the data was collected and the references obtained, the data was analysed at AIT. A comprehensive directory was made (FERNANDO, 1980), consisting of detailed description of all computer users; computer vendors; Customs classifications of DP equipment; value of DP imports; letter and questionnaire to computer users; letter and questionnaire to computer vendors; literature review and methodology; Sri Lanka's history, geography, political policy trends, economy and their effect on computer technology transfer; history of data processing; computer imports; computers in Sri Lanka; computer applications; computer usage; computer liveware; computer education and training; Computer Society of Sri Lanka; constraints to computing; computer economics; future of computing; conclusions and recommendations; a complete Biliography; and the architecture of the first computer in Sri Lanka.

2.2.1 PRESENTATION OF FINDINGS.

An overview of resources available for computer applications is presented here. Wherever possible diagrams and tables have been used to present the major findings. They consist of the history of data processing; computers installed; computer imports by year and origin of imports; batch/interactive, geographic, sale/rental and age distribution of computers; computer users; computer vendors and profiles; computer types; computer models;

computer and programming language usage; DBMS and programming languages available; computer personnel; and computers in the economy.

The comprehensive directory that has been prepared referred to earlier has been used as a reference for this thesis.

2.3 SCHEDULE OF WORK.

The time span available for data collection in Sri Lanka was 55 working days. This was devoted mainly to collect information on the users and vendors. The time remaining was spent in finding information on Computer education and training, and future application areas. Analysis and presentation phase has consumed the last two and a half months.

3. SRI LANKA AND COMPUTER TECHNOLOGY

Although computer technology was introduced to Sri Lanka in 1964 its growth has been limited. This has been due to the government policies which restricted growth, and not been due to the inability of the people to assimilate and use this technology. In other areas such as engineering and medicine, Sri Lanka has been keeping abreast of times. With a long civilisation and a free education system from Kindergarten through University the literacy rate is an unusually high 88%, for an Asian country. In addition , with 40% of the population under 14 years, the amenability for training and assimilating technology is present in the Sri Lankans.

4. GROWTH OF COMPUTERS IN SRI LANKA

Data processing started in Sri Lanka circa 1946 with conventional card machines(Fig 4.1). The first computer an ICT 558 was installed in 1964. Untill 1970 there were 8 computers installed. During this period computers were allowed to be imported on the justification of the system to be computerised. The initial computers were general purpose computers of the type IBM System 360/20s, 360/25s and ICL 1901s. They were installed in 3 large state sector corporations, Central Bank, Census Department and 2 private service bureau firms. The 2 private firms being allowed to import computers to replace obsolete DP equipment. Due to the sheer magnitude of the problems handled by these modest computers they had an impact on society (KARUNARATNE, 1976). In the period 1970-1977 the growth of computing has been slow due to government policy (CHANANA, 1973).

Some of the early applications were

- Population census	12,7	M people/
	2,2	M households
- National provident fund	3,0	M employees
- Examinations	350,000	candidates
- Warrant billing	300,000	warrants
- Insurance	200,000	policy holders
- Electricity billing	175,000	customers
- Telephone billing	35,000	subscribers
- Stock control	20,000	items
- Payroll	12,000	employees
- Budgetary control	600	accounts/3 B Rs.
- Engineering design		
- Engineering education		
- Import/Export reports		
- Service bureau operations		

From 1977 a rapid growth in computing is seen by number and value (Fig 4.2, & Fig 4.3). This is due to the policy of the government to encourage modernisation. It is also due to the reason that the economy has taken an upturn (Fig 4.4), and that inexpensive computers are available in Sri Lanka. The percentage of computer imports in comparison to the total imports is less than 0.05%. Currently there are 33 computers installed.

The growth in computers has shown an 8 fold increase in the private sector. This is partly due to the tax incentives available for modernisation (FERNANDO, 1980). This trend is not evident in the public sector, where it is less than 2 fold (Fig 4.5).

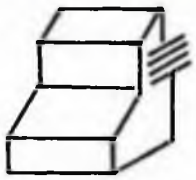
The computers that are being installed are mainly the small business computers (Fig 4.6). Due to their low cost and capability they are appropriate for the establishments in Sri Lanka. This pattern is evident in most developing countries. The average main memory capacity of computers in Sri Lanka is 46K bytes, with the largest being 128K bytes. The average direct access storage device capacity is 22M bytes, with the largest being 180M bytes (FERNANDO, 1980). Thus large databases to be accessed by DBMS cannot be established.

While the majority of the computers are under 3 years, there are some computers of 10 years vintage still being used (Fig 4.7). Of these on economic grounds alone the IBM System/360-25s should be replaced with the latest technology computers (FERNANDO, 1980).

Only a small proportion of the computers use cards solely as an input medium (Fig 4.8). However there are 10 large data preparation installations using card key punches. These should be replaced by key-to-disk/tape equipment (FERNANDO, 1980). The majority of computers use terminals for direct data entry or diskette media for data input. These computers are capable of interactive development of programs due to the availability of terminals.

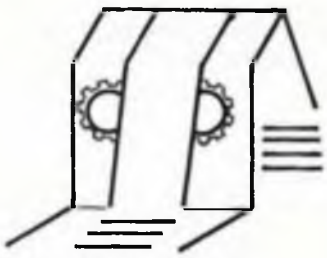
FIG. 4.1 HISTORY OF DATA PROCESSING IN SRI LANKA.
(Source : Fernando, 1980)

1946



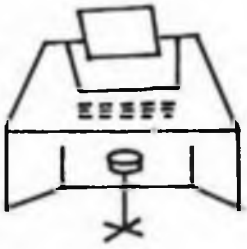
POWER SAMAS, HOLLERITH DP EQUIPMENT

1954



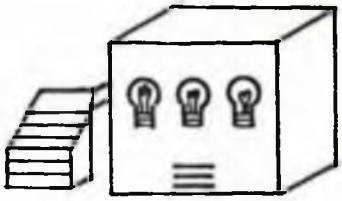
ICT FORMED

1962



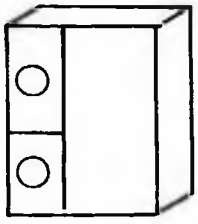
IBM ARRIVAL; 80 COLUMN EQUIPMENT.

1964



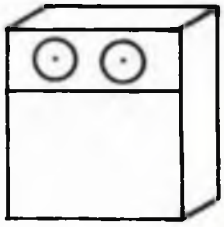
1 ST COMPUTER ICT 558

1967



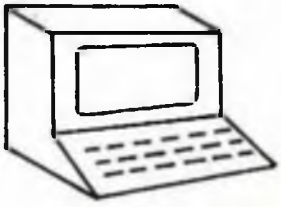
2ND GENERATION COMPUTER ICT 1901

1969



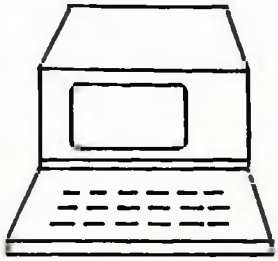
3RD GENERATION COMPUTER IBM S/360

1977



1ST INTERACTIVE COMPUTER WANG 2200 T

1978



IBM SYSTEM / 34

FIG. 4.2 COMPUTERS INSTALLED IN SRI LANKA.

(Source : Fernando , 1980)

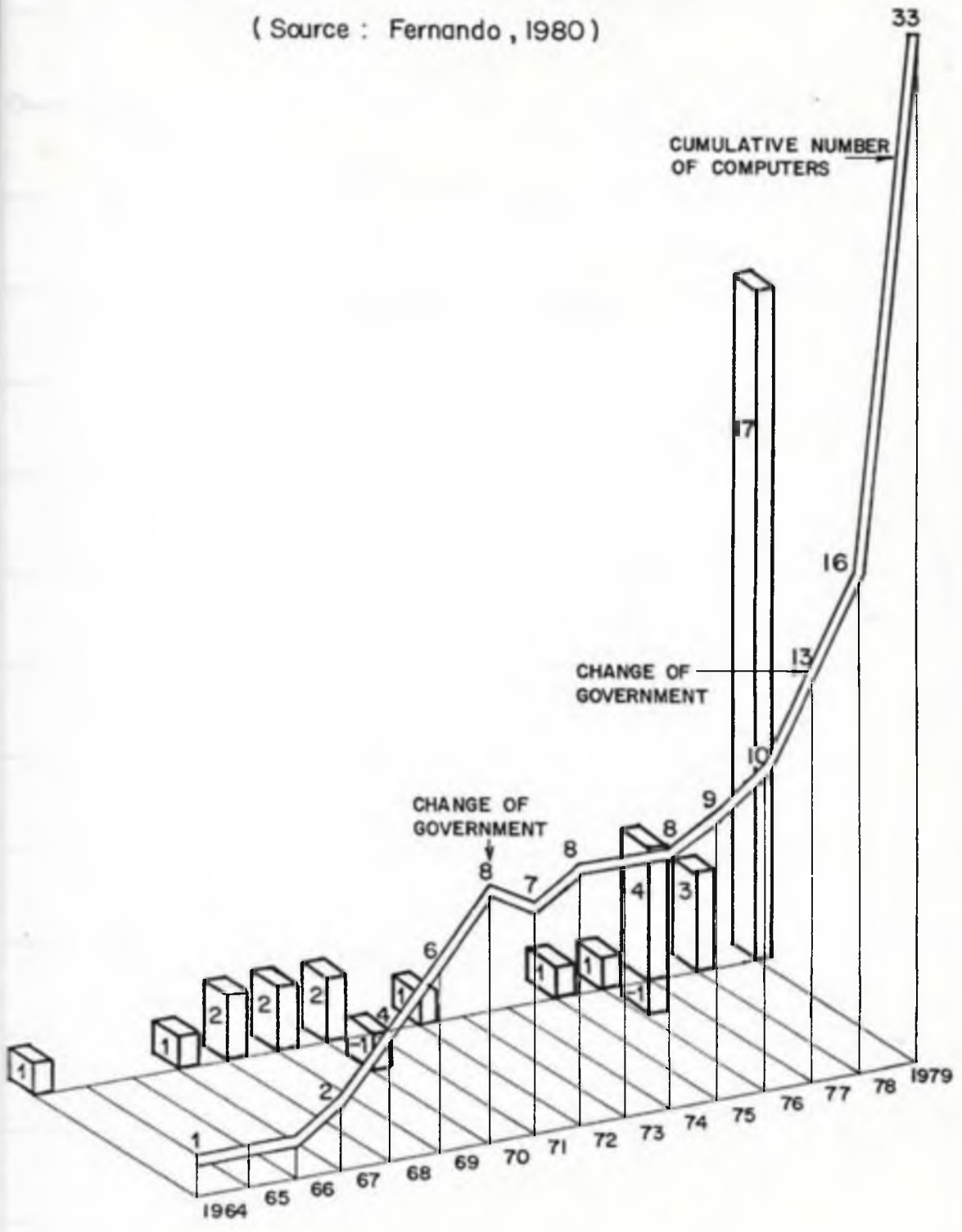
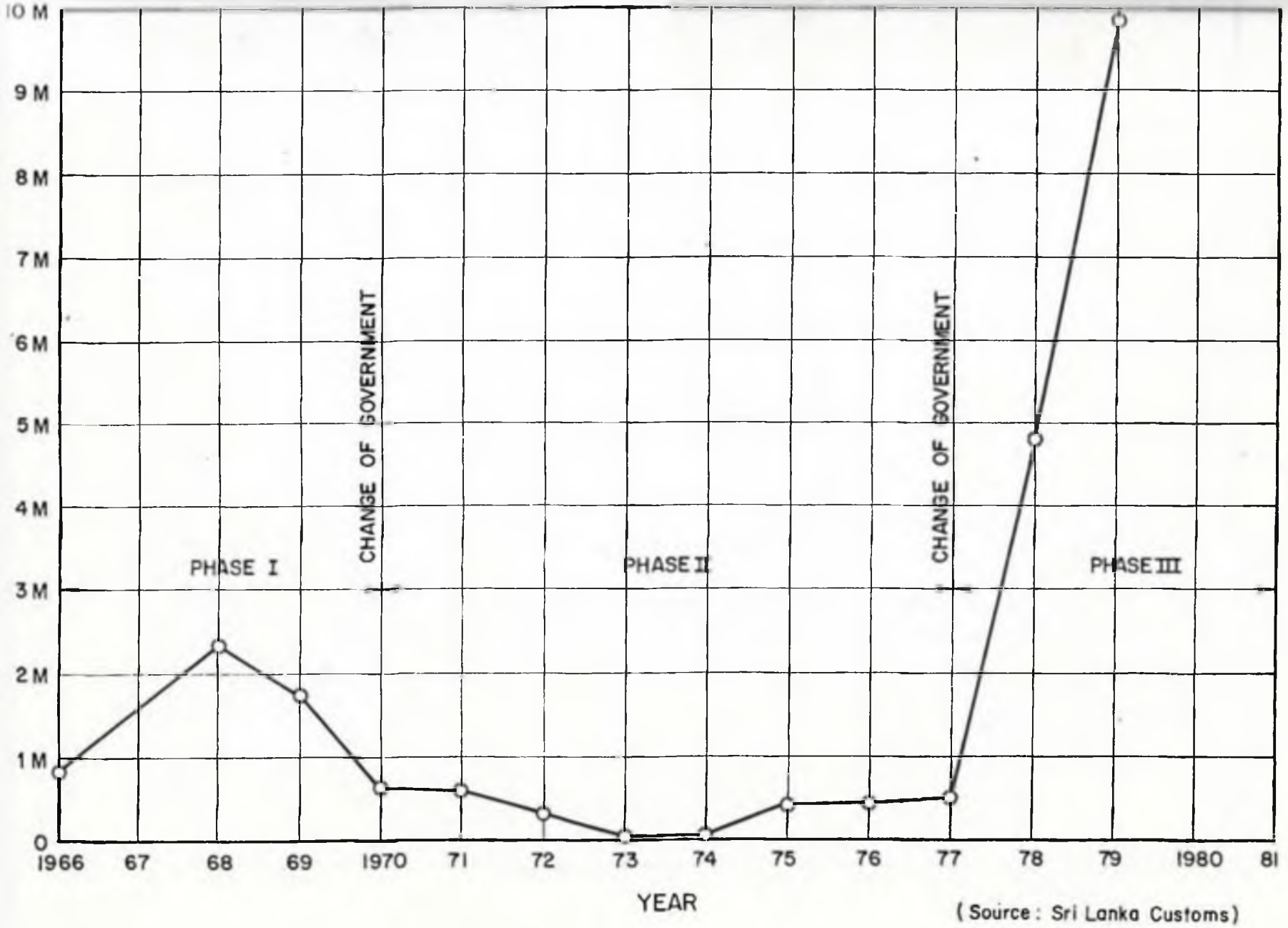


FIG 4.3 VALUE OF DATA PROCESSING MACHINES IMPORTED INTO SRI LANKA
PERIOD 1966 - 1979



(Source : Sri Lanka Customs)

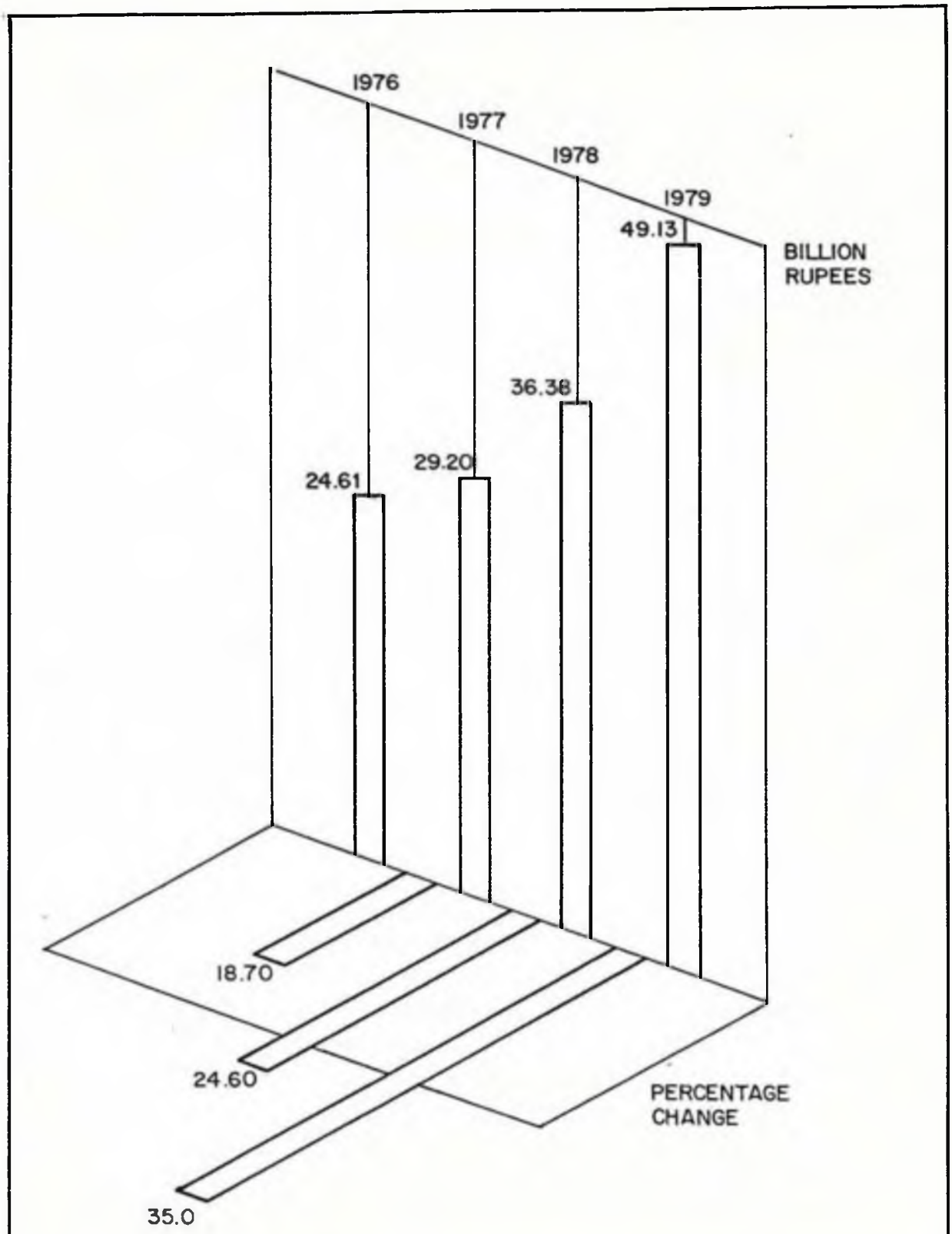
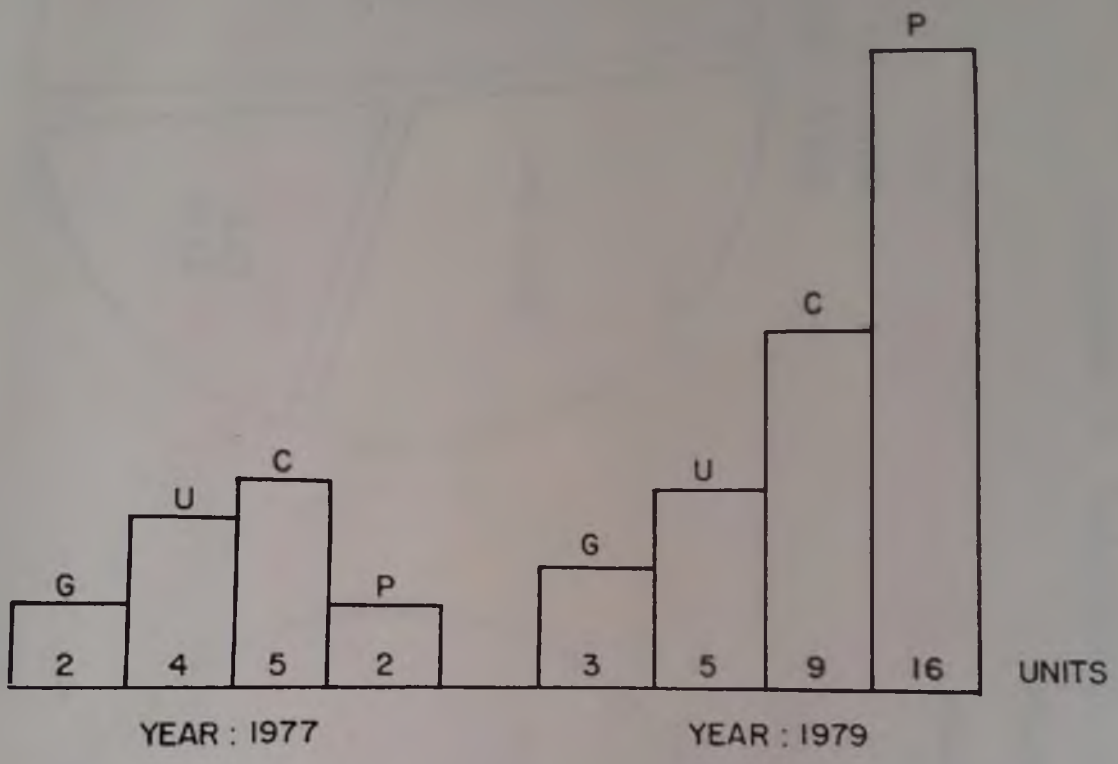


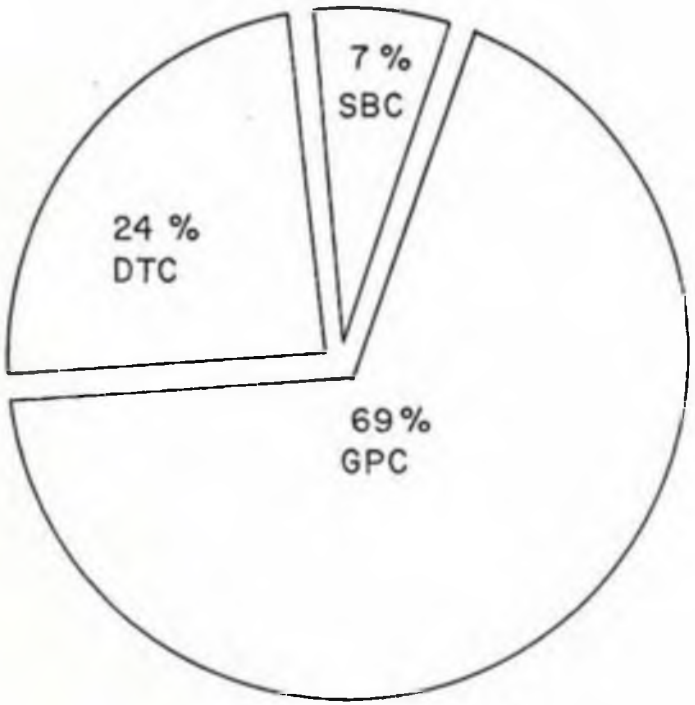
FIG. 4.4 SRI LANKA GROSS NATIONAL PRODUCT. (Source : Census & Statistics)

FIG. 4.5 COMPUTERS BY TYPE OF USER

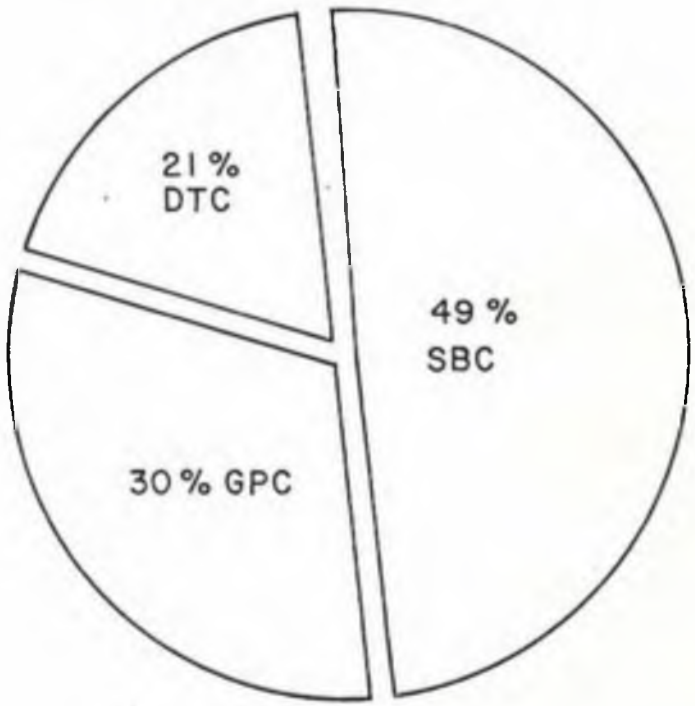


G = GOVERNMENT
U = UNIVERSITY
C = CORPORATION
P = PRIVATE

(Source : Fernando, 1980)



YEAR : 1977
Units : 13



YEAR : 1979
Units : 33

SBC : SMALL BUSINESS COMPUTERS
DTC : DESK TOP COMPUTERS
GPC : GENERAL PURPOSE COMPUTERS

FIG. 4.6 COMPUTERS BY CATEGORY.

(Source : Fernando, 1980)

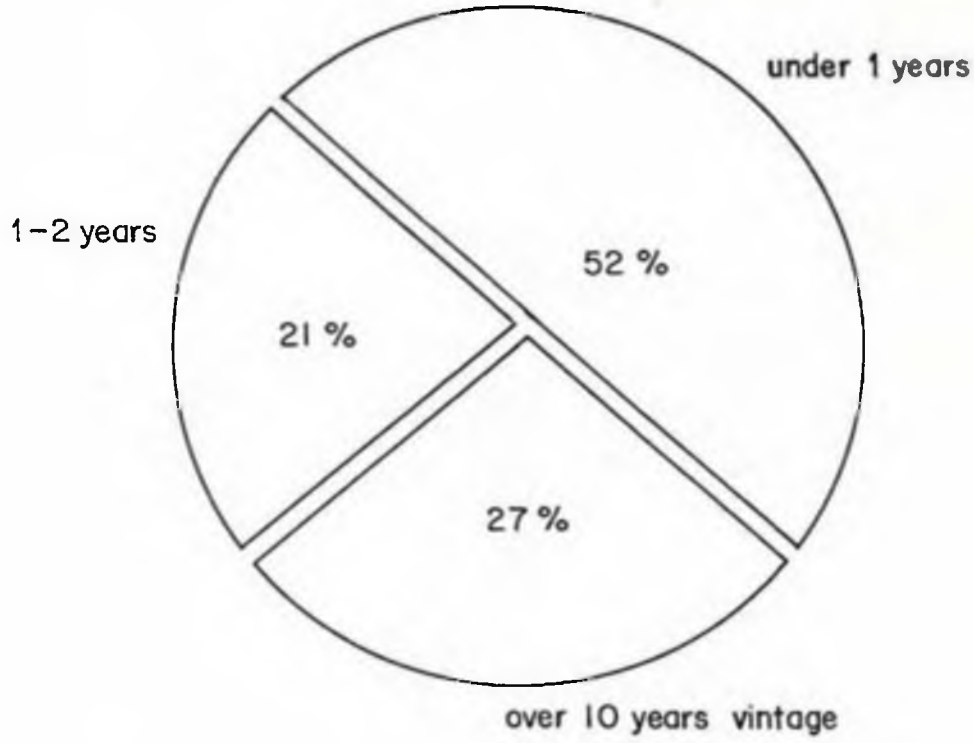


FIG. 4.7 COMPUTERS - AGE DISTRIBUTION

(Source : Fernando, 1980)

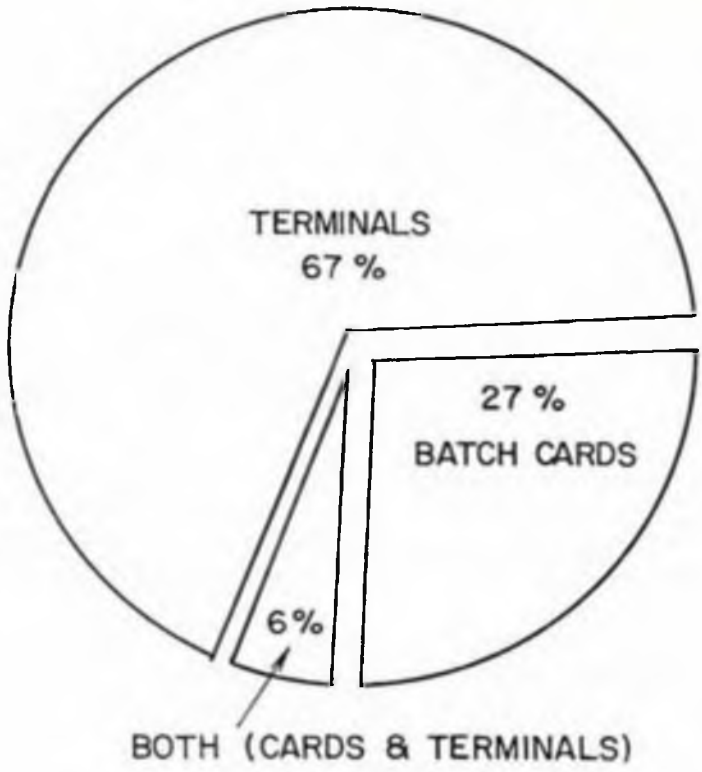


FIG. 4.8 COMPUTERS BATCH / INTERACTIVE

(Source : Fernando, 1980)

5. COMPUTER UTILIZATION

5.1 COMPUTER USERS.

There are 33 computer installations in Sri Lanka (Table 5.1). The computers are distributed among the Government, Public Sector, Universities and the Private Sector (Fig 4.5), with a significant proportion in the private sector. Fourteen of the installations offer computer service bureau facilities (Table 5.4).

The procurement of computers have been more on outright purchase than rental (Fig 5.1). This is somewhat unusual compared to the situation in other countries, but is most likely due to the capital allowance available on outright purchase. IBM is the only vendor offering computers on rental in Sri Lanka.

There is no typical size category of establishments using computers. Establishments with as small as 39 employees and upto 60,000 employees are using computers with a financial turnover ranging from 1 million Rupees to 7000 million Rupees.

The administrative and business centres are in Colombo. Thus there is a heavy concentration of computers in the Colombo District, of which most are in the city of Colombo (Fig 5.2). However, since the universities are spread geographically and the administration is being decentralised, there is a need for computing power to be available in the districts. In addition it will enable the outstation schools to have access to computers for education.

ID	CUSTOMER	SYSTEM	MODEL	YEAR	MEMORY KB
	FACULTY OF NATURAL SCIENCES, UNI.COLOMBO	HEWLETT-PACKARD	9825 A	1977	24
	POSTGRADUATE INSTITUTE OF AGRICULTURE	HEWLETT-PACKARD	9825 A	1977	8
	AGRICULTURAL RESEARCH & TRAINING INST.	HEWLETT-PACKARD	9825 A	1977	8
	PURE BEVERAGES LTD.	IBM	534	1979	48
	LEVER BROS.LTD.	IBM	534	1979	48
	ST. ANTHONY'S INDUSTRIES	IBM	534	1979	48
	JAY KAY COMPUTERS LTD.	IBM	534	1979	64
	SRILANKA CENTRAL TRANSPORT BOARD	IBM	534	1979	64
	FREE LANKA TRADING CORP.	IBM	534	1979	64
	SRI KRISHNA CORP.	IBM	534	1979	48
	MSL COMUTERS LTD.	IBM	534	1979	64
	CHEMANEX LTD.	IBM	534	1980	48
	FACULTY OF ENGINEERING, UNI.PERADENIYA	IBM	1130	1972	32
	UNIVERSITY OF MORATUWA	IBM	1130	1975	32
	INSURANCE CORPORATION OF SRILANKA	IBM	360/20	1969	16
	PETROLEUM CORPORATION OF SRILANKA	IBM	360/20	1969	16
	DEPT. OF CENSUS & STATISTICS	IBM	360/25	1970	48
	CENTRAL BANK OF CEYLON	IBM	360/25	1970	48
	EXAMINATION DEPARTMENT	IBM	360/25	1970	48
	KG INDUSTRY	IBM	5110	1979	48
	ICL CEYLON	ICL	1501	1975	16
	DE SILVA, ABEYAWARDENA & PIERIS	ICL	1501	1979	16
	MEDICAL COLLEGE	ICL	1503	1975	16
	FAMILY HEALTH	ICL	1503	1979	32
	STATE ENGINEERING CORPORATION	ICL	1901	1977	64
	AMS DATA SERVICES	ICL	1901A	1979	32
	MAHAWELI DEVELOPMENT BOARD	ICL	2093	1979	128
	STAFFORD MOTORS	WANG	PCS II	1980	8
	DATA MANAGEMENT SYSTEMS LIMITED	WANG	2200	1975	16
	CENTRAL ENGINEERING CONSULTANCY BOARD	WANG	2200 T	1979	64
	HEBTULABHOY	WANG	2200 T	1976	32
	JAFFERJEE BROTHERS	WANG	2200 T	1977	16
	NATIONAL INSTITUTE OF BUSINESS MNGMT.	WANG	2200 VS	1979	128

3 OUTPUT RECORDS

TABLE 5.1 COMPUTER INSTALLATIONS IN SRI LANKA.

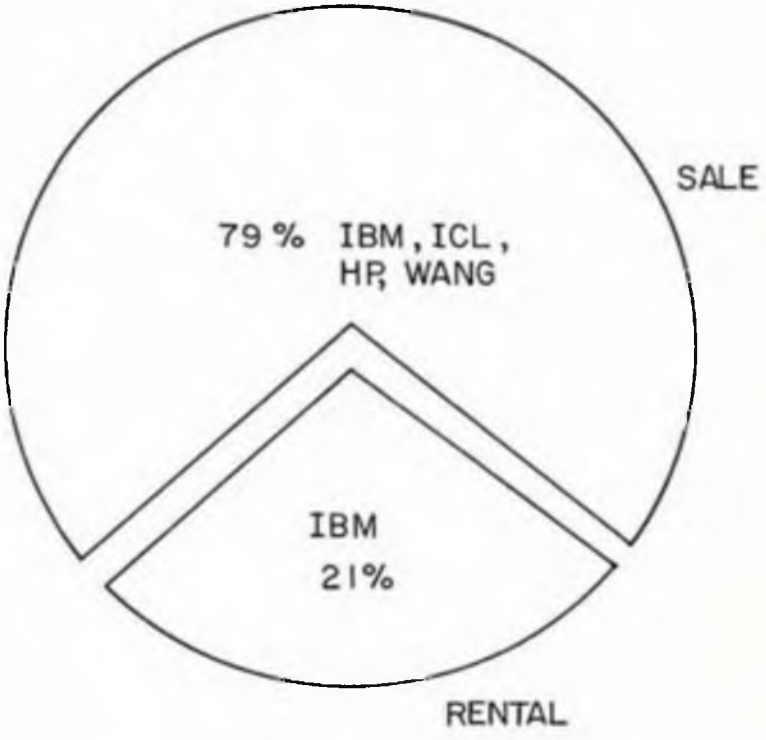


FIG. 5.1 COMPUTERS SALE / RENTAL

(Source : Fernando, 1980)

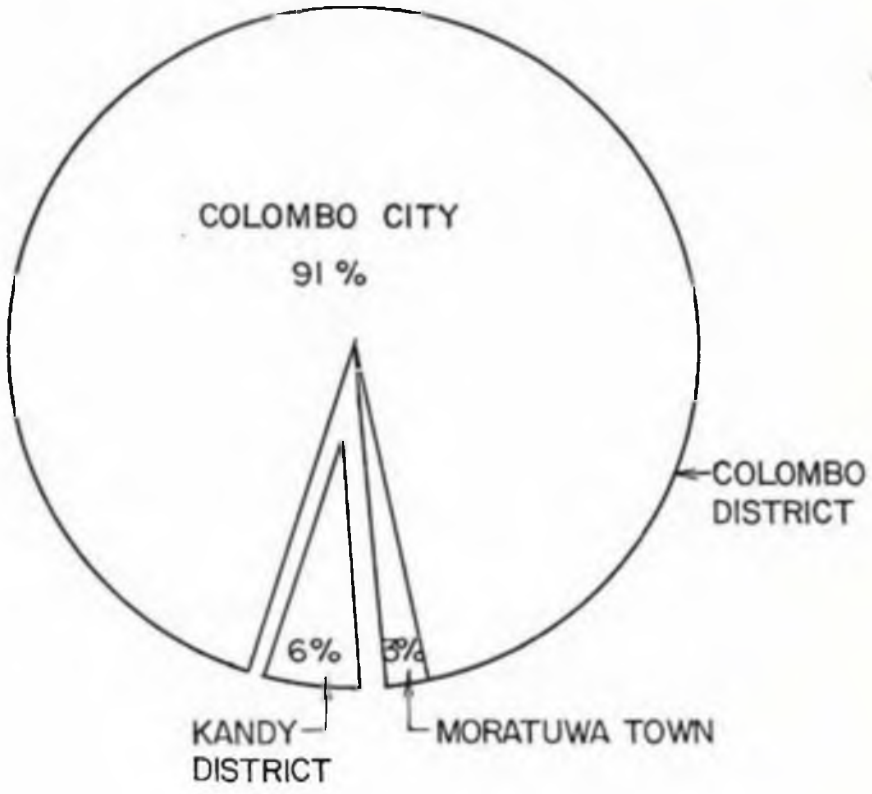


FIG. 5.2 DISTRICTION OF COMPUTERS BY LOCATION.

(Source: Fernando, 1980)

5.2 COMPUTER USAGE.

The usage of all computer categories in Sri Lanka is over one shift working. The usage of the general purpose computers indicate about one and half shift working (FERNANDO, 1980). The breakdown of usage of these computers is shown in Table 5.2. Only one general purpose computer has been used for less than one shift. The small business and desktop computers are being used for about one shift during normal office hours.

TABLE 5.2.COMPUTER USAGE - GENERAL PURPOSE COMPUTERS.

APPLICATION	USAGE (hours)	PERCENTAGE
Accounts	7154	21.8 %
Insurance	4320	13.7
Payroll	3698	11.3
Statistics	2908	8.9
Examinations	2533	7.7
Banking	1943	5.9
Education	1904	5.8
Tea-Production	1500	4.6
Inventory	1181	3.6
Land Survey	945	2.9
Engineering	856	2.6
Tea Auction	600	1.8
Research	383	1.2
Sales	72	0.2
Others	2750	8.4
TOTAL	32747	100.0

5.3 COMPUTER LANGUAGES.

The usage of computer languages is indicated in Table 5.3. RPG II is the most popular, with BASIC also widely used. The programming languages being used indicate that computers are being used more for commercial data processing of a report generation type than scientific computing. All computer languages that are available for procurement are listed in Table A3.2 in the Appendix III.

TABLE 5.3.COMPUTER LANGUAGE USAGE IN SRI LANKA.

LANGUAGE	No. of USERS
RPG II	15
BASIC	9
FORTRAN	7
IBM ASSEMBLER	7
COBOL	6
ICL CDE	4
PL/I	3
ICL PLAN	2

5.4 COMPUTER APPLICATIONS.

TABLE 5.4.APPLICATIONS COMPUTERISED BY INSTALLATION.

APPLICATION	BUREAU SERV.	PAYROLL	ACCOUNTING	STATISTICS	STOCK CONTROL	SALES	BILLING	COSTING	REESEARCH	TEACHING	TEACHING/TRAINING.	SURVEYS	ENGG./DESIGN	PERSONNEL	EPF	RBB/RAUCTION	CENSUS/SUR	LEAN/SURVEY	TEACHING/PRACTICE	BANK/LOAN	CUSTOMS	EXAMINATIONS	INSURANCE	ORDERS	CNSTRC. MNGM	PROJECT MNGM	MIS
INSTALLATION																											
A.R.T.I.				x					x		x	x															
AMS DATA	b	x	x	x	x	x	x	x		x										x	x						
CENTRAL BANK	b	x	x	x				x							x												
C.E.C.B.									x				x					x									
CHEMANEX	b	x	x		x	x	x	x		x				x													
DSA PIERIS		x	x		x	x	x			x																	x
CENSUS	b		x	x								x					x				x						
EXAM DEPT	b			x													x					x					
E'FAC PERA	b	x	x						x		x		x														
S' FAC COL	b			x					x		x	x															
FAMILY HLTH.				x								x															
FREE LANKA		x	x		x																				x		
HEBTULABHOY		x	x		x	x				x						x											
INSURANCE		x	x											x									x				
JAFFERJEE		x	x		x	x				x						x											
JAY KAY		x	x		x	x		x		x																	
KG INDUSTRY		x	x		x		x	x																			
LEVERS		x	x			x								x													
MAHAVELI/SUR	b												x					x									x
MEDICAL CLGE				x					x		x																
MSL COMPUTER	b	x	x		x	x	x	x		x				x													
N.I.B.M.	b			x							x																
PETROLEUM	b	x	x	x	x	x	x	x				x															
POSTGRAD AGR				x					x		x																
PURE BEVRGS.						x	x																				
SRI KRISHNA	b					x																					
SLCTB		x		x			x								x												
ST.ANTHONY'S		x			x																						
STATE ENG	b	x	x	x	x			x	x				x														
MORATUWA UNI	b	x							x		x	x	x		x									x			
STAFFORD		x	x		x	x																					
Total	3 1	1 9	1 7	1 4	1 3	1 2	8	8	8	7	7	6	5	4	3	2	2	2	1	1	1	1	1	1	1	1	1

5.4.1 INHOUSE SOFTWARE.

Most of the installations prefer to develop their own software. They consider it cheaper and more appropriate for their applications. The applications that are being handled by the installations are listed in Table 5.4. The software developed tends to vary in sophistication from installation to installation. It depends on the calibre of the staff at the time of systems and program development. Integration levels too vary. Due to the small size of the computer hardware systems and large nature of the applications handled, the programs have been designed rather for memory optimisation and speed than maintainability considerations (KARUNARATNE, 1976). Systems like the Examination system are highly integrated, and provide management information, in addition to routine report generation. There are also a few mediocre systems. A case in point, being the running of a payroll program after payment has been made for the sake of good record keeping. There are also some computer systems where the input file has to be sorted using conventional machines before being fed into the computer. In addition, in this system after the errors are corrected the cards have to be inserted in the correct place in the input card file before running the job again. However there are many computer installations with susbsystems which are designed taking a systems view of the organisation. The Provident Fund System (Central Bank) is tightly audited by many controls within the system.

5.4.2 APPLICATION PACKAGES.

The hardware vendors ICL and WANG have developed very topical application packages which are highly integrated. (See FERNANDO, 1980 for a complete description). These are for tea and rubber auctions, for the buyers and brokers. They have got orders for their hardware systems because of the availability of these packages. Other than PERT (Project Evaluation and Review Techniques), COCENTS (CObol CENsus TabulationS) and a few other imported packages, there is no widespread usage of imported packages in Sri Lanka.

5.4.3 DATA BASE MANAGEMENT SYSTEMS.

Data Base Management Systems are being contemplated by 5 major users. There is only one user (NIBM) who is well advanced in its planning stage with hardware and a DBMS package installed. The application relates to the monitoring of performance of 22 Public Corporartions with their performance data in the data base. This application may also involve teleprocessing. The

country's first. The others will have to change their hardware systems with larger machines before embarking on data base management systems. Only the Insurance Corporation has a system design worked out for Vendor bids. The plans are at an advanced stage for a change in computer system.

5.4.4 OTHER SOFTWARE UNDER DEVELOPMENT.

Management Information Systems are planned by five new users. They include market research and forecasting, and research into the manufacture of tea to evaluate the effects of manufacture on prices; an integrated accounting system with subsystems consisting of payroll, inventory, billing, sales and purchases; a MIS with order entry and stock forecasting system. Other systems are an inventory control system to highlight non moving stock items; a personnel system and a new EPF (Employees Provident Fund) System (SLCTB) to incorporate online interogation.

5.5 COMPUTERS - SECTORAL DISTRIBUTION IN THE ECONOMY.

The distribution of computers by sectoral composition of gross domestic product indicates very low utilisation in Agriculture, Manufacturing, and Communications sectors of the economy, and none in Ownership of Dwellings, Mining and Quarrying, and Electricity and Gas (Table 5.5).

TABLE 5.5.COMPUTERS-SECTORAL COMPOSITION OF GDP.

SECTOR	GDP * (Rs.M)	%	COMPU -TERS#	%	GDP Rs.M/ COMPUTER
Agriculture	13,776.5	37.9	1	3.0	13,776.5
Trade	6,566.0	18.0	12	36.4	547.2
Manufacturing	4,726.4	3.0	2	6.1	2,363.2
Services	3,213.4	8.8	10	30.3	321.3
Communications	2,865.8	7.9	1	3.0	2,865.8
Construction	2,162.3	5.9	3	9.0	720.8
Finance	844.6	2.3	2	6.1	422.3
Public Administ--ration & Defence	802.2	2.2	2	6.1	401.1
Dwellings	664.2	1.8	0	0.0	-
Mining & Quarrying	586.9	1.6	0	0.0	-
Electricity & Gas	168.9	0.5	0	0.0	-

* CENTRAL BANK. # FERNANDO 1980

The computers per billion dollars is 11 in Sri Lanka. In comparison, in South America it is 10-12 and in USA it is 80 (BOEHM, 1970).

5.6 COMPUTER VENDORS.

There is heavy dependence on North American suppliers for Data Processing equipment (Fig 5.3, & Fig 5.4). British and Italian manufacturers are represented. There has been no representation from the Dutch, French, German, or Japanese manufacturers.

The three makes IBM, ICL, and WANG account for 91% of the computers installed. Three Hewlett-Packard computers have been installed; sent on aid directly from foreign agencies. Recently Radio Shack, Data General, and Hewlett-Packard have established dealerships. No computers have been installed by them so far. The computer manufacturers represented so far have been limited. Thus the users have not had sufficient alternative hardware systems available to procure. This has been remedied to some extent by the recent dealerships established. Burroughs and NCR have representation but are not active at the present time in computer systems. The most notable absentees are the large American mainframe and mini computer manufacturing companies.

The computers available are listed by make, category and model in Table A3.1, programming languages are listed in Table A3.2 and database packages in Table A3.3 of Appendix III.

5.7 COMPUTER PERSONNEL.

The basic qualification of personnel in computer installations is shown in the Fig 5.6, Fig 5.7, and Fig 5.8. There is a large portion of personnel with qualifications lower than 1st degree, working in the data processing installations. Even among the systems and programming staff those with below 1st degree qualification form a significant 33% and 42% respectively. In addition most of the 1st degree and postgraduate qualifications are in non-computer fields. Thus it is seen that the majority of the personnel available are not suitably educated in advanced computer techniques, which get reflected in some of the systems that have been designed. Thus there is an urgent requirement for good education and training programs in Sri Lanka.

TABLE 5.6. AVERAGE SALARIES OF COMPUTER PERSONNEL IN SRI LANKA

CATEGORY	SALARY
Systems/Programmer	Rs. 1465/- ($92)
Computer Operator	Rs. 742/- ($46)
Other DP Staff	Rs. 840/- ($53)
Other Staff	Rs. 971/- ($61)

A recent survey of engineers and scientists with 1st degree indicated that 51% of engineers and 91% of the scientist get below Rs.1401/- ($88). Thus there is no pressure due to salary reasons for systems/programmers (whose 1st degrees are usually in science) to move out of the computer field. However there is a constant migration to foreign countries, since the salaries are high in comparison to Sri Lanka.

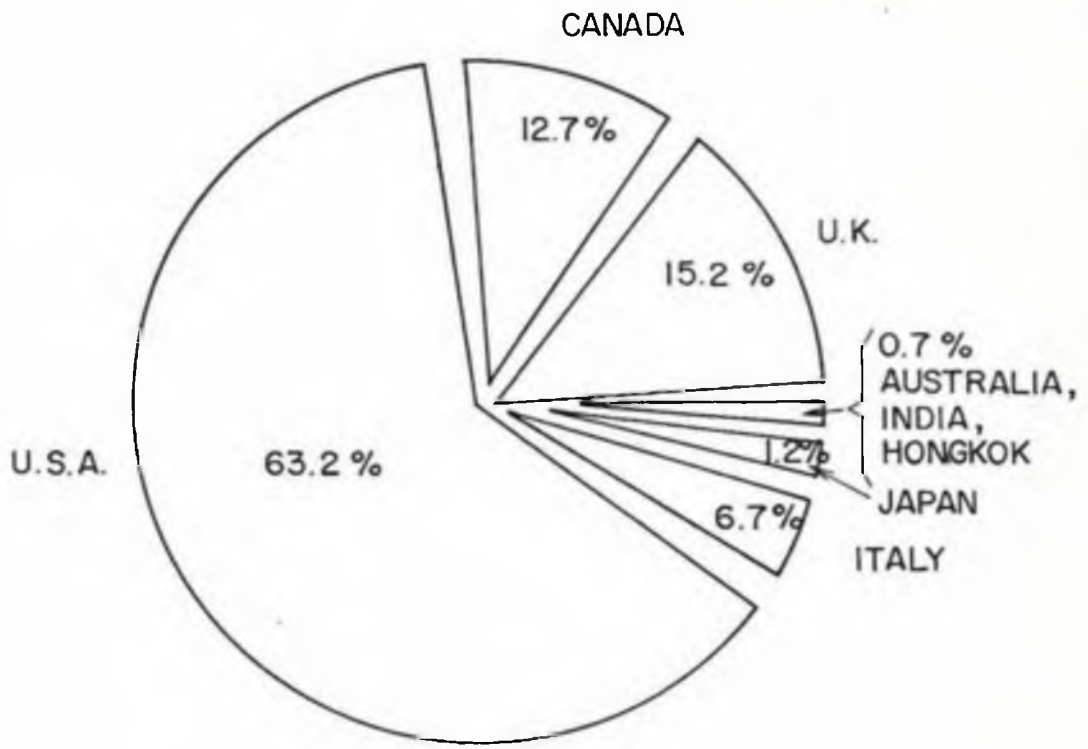
5.8 EDUCATION AND TRAINING.

There are no degree programs (1st or postgraduate) in computing in Sri Lanka, at any of the Universities. The Engineering Faculty, Peradeniya has for its engineering students a one term optional computer science course of 36 hours duration. It consists of Fortran programming. About 5 students take this course.

National Institute of Business Management has started a training program combining, systems analysis, Cobol, computer architecture and data base management systems. It is conducted over 4 months. The fee is Rs.15,000/-($950). There will be 3 courses a year with 20 places in each course. For top management a course is to be run with 20 places at a fee of Rs.1000/-($60).

The vendors offer free training in computer operations, programming and systems analysis to customers who have purchased computers from them. In addition WANG offers an introductory course on computers, Cobol and data base concepts for Rs.2000/-($125) per participant. IBM and ICL do not offer courses for a fee as matter of company policy. Radio Shack has recently started BASIC language courses.

Since an increasing number of computers are being installed a more formal education program at University 1st degree level is required. In addition advanced computer concepts to already employed systems analysts and programmers is needed. Top management, professionals and users require appreciation and training programs.

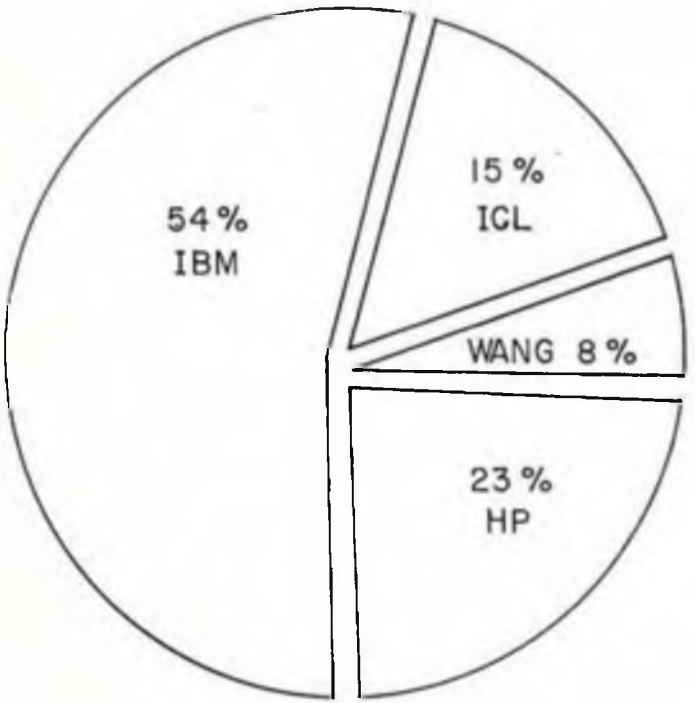


YEAR : 1979

VALUE OF IMPORTS : Rupees 9.84 Million. (US $ 615,059)

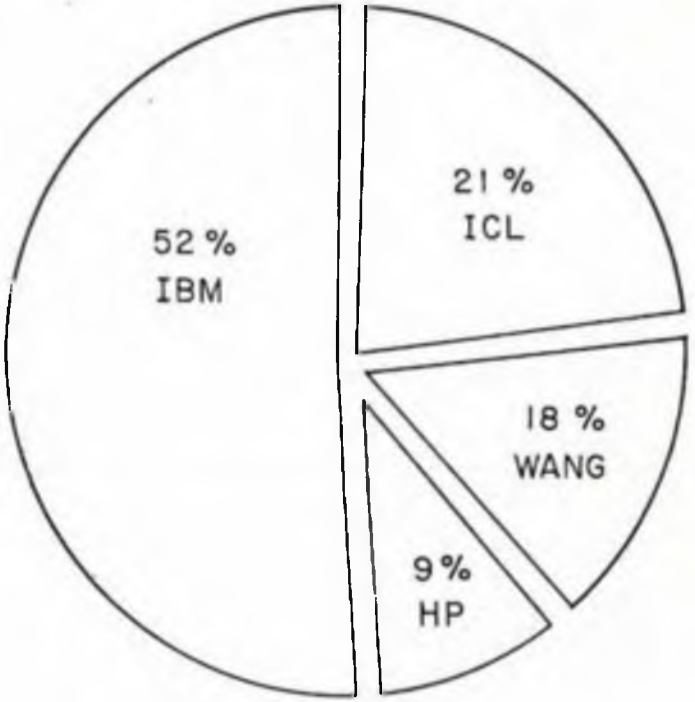
FIG. 5.3 AUTOMATIC DATA PROCESSING MACHINES ORIGIN OF IMPORTS.

(Source : Srilanka Customs)



YEAR : 1977

Units : 13



YEAR : 1979

Units : 33

FIG. 5.4 COMPUTERS BY VENDOR.

(Source : Fernando , 1980)

FIG.5.5 COMPUTER PERSONNEL – FUNCTIONS.

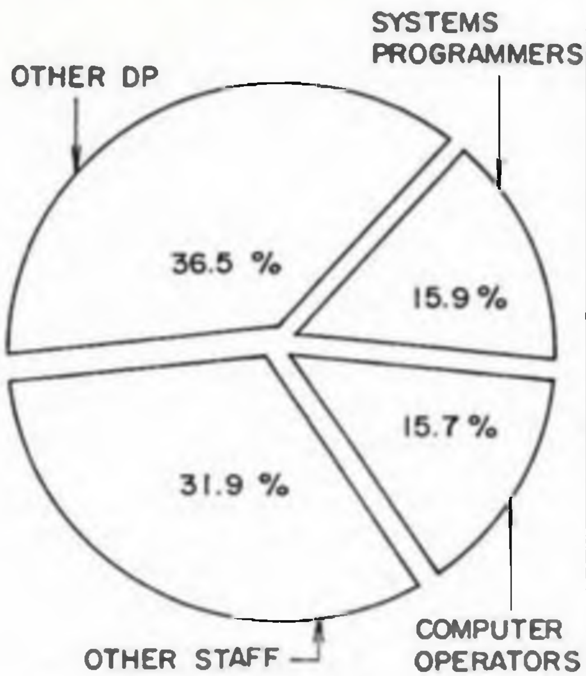


FIG.5.6 COMPUTER PERSONNEL – QUALIFICATIONS.

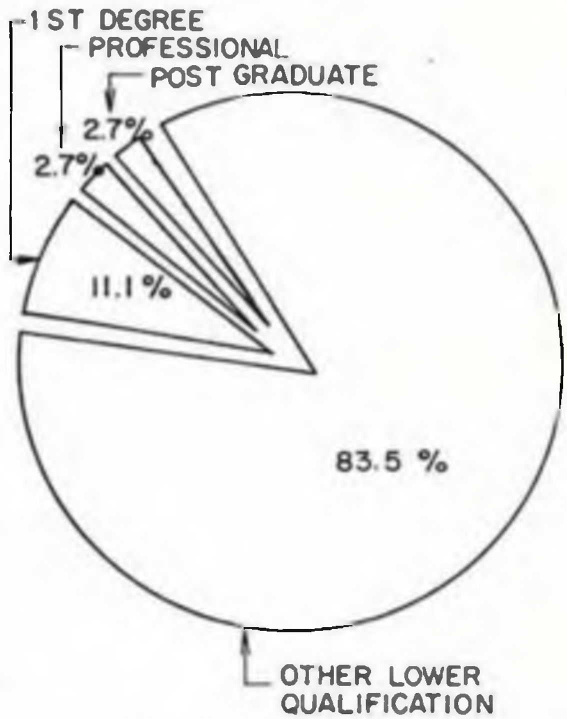


FIG.5.7 SYSTEMS ANALYSTS – QUALIFICATIONS.

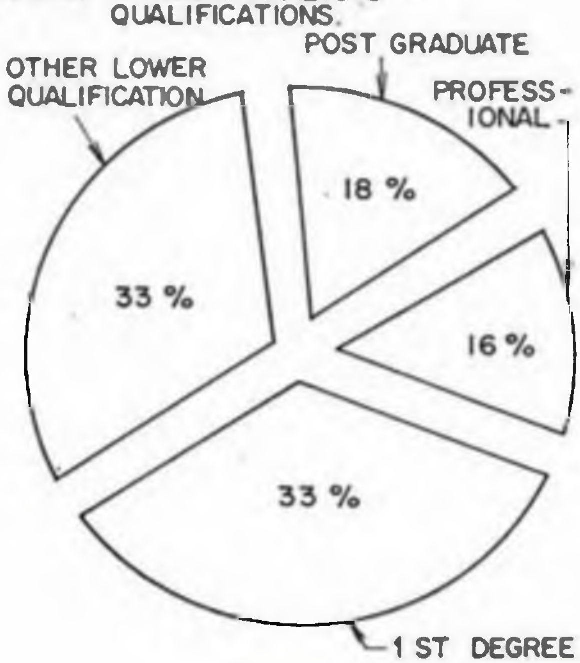
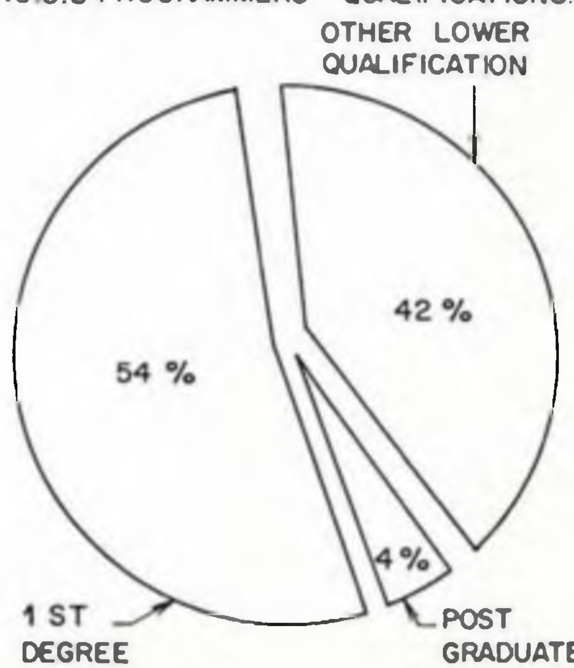


FIG.5.8 PROGRAMMERS – QUALIFICATIONS.



(Source : Fernando, 1980)

6. CONSTRAINTS TO COMPUTING

A common view that was expressed by all computer users was the lack of proper education and training facilities for computer personnel. An allied problem was the sever lack of suitable systems analysts and programmers in Sri Lanka.

Low salaries in the public sector cause a continuous loss of experienced computer personnel to the private sector. In addition the perennial problem of the brain drain to foreign countries of computer personnel is faced by all installations.

Due to the lack of proper service facilities the three H-P model 9825 Computers are not functioning. These systems have been received as a gift from foreign agencies.

All computer users are forced to use automatic voltage regulators and isolators of some kind due to electric power fluctuations and spikes. Air conditioning is another mandatory requirement.

It was also noted that computer sizing or capacity planning was generally left to the computer vendor. The computer salesman is considered as a sort of expert whose 'advice' seems to be taken for granted. This has led to generally under selling of computer capacity initially. In a few cases the fact that the operating system occupied a sizable portion of the installed memory had come as a surprise to the first time user who had to then either run the programs with less sophistication or forced to enhance the memory. The same could be said of DASD capacity. The idea of fixed versus exchangeable disk store, word versus byte, paging versus roll-in/roll-out, compiler versus interpreter and other similar hardware and software features the appreciation of which are required for good computer system procurement is on the whole lacking among computer users and prospects.

Another problem that was found was the lack of management participation and the resultant lack of mangement awareness of the strengths and limitations of computer applications.

Another constraint mentioned was the lack of cooperation by the user staff in computerisation and their not knowing exactly what procedures to follow.

The lack of information on latest products and the non availability of the appropriate hardware in Sri Lanka was also a major constraint. This has resulted for example in the continued use of old key punch machines because key-to-disk/tape machines were not available.

If there was an on-going program consisting of good education and training in computer techniques at all levels of personnel, some of the above constraints could have been avoided. Top management and user staff require general concepts of computing to be imparted to them, while computer personnel require intensive education and good training programs.

The continuous brain drain to foreign countries of computer personnel in itself is not bad for two reasons (a) The country gains from the foreign exchange remittances, gifts etc, especially from those employeed in the middle-eastern countries, and (b) the knowhow which could be gained in working in a foreign country cannot be achieved presently in Sri Lanka, in the field of computing. The real problem and the solution that has to be found is to attract those who have gone abroad to return to the country after a few years.

7. DISCUSSION ON COMPUTING IN SRI LANKA

GIBSON & NOLAN (1974) in their well known paper stated that there are 4 distinct stages in the growth of all EDP facilities. They are

1. Initiation, 2. Expansion, 3. Formalisation, 4. Maturity.

The basis for this framework of stages is the EDP budget for a number of companies when plotted against time forms an S shaped curve. In Sri Lanka the EDP budget for most organisations has been static due to the government policy, or due to the fact that installations are comparatively new. They also stated there are 3 types of growth to be dealt with as an EDP department matures. They are

1. Growth in computer applications
2. A growth in specialization of EDP personnel
3. A growth in formal managment techniques and organization.

Stage 4 maturity being reached in types (1) and (2) by data-base use; type(3) maturity being reached by resource-oriented planning and control.

This has been subsequently updated to 5 stages:
1. Initiation, 2. Contagion, 3. Control, 4. Integration, 5. Maturity.

The 4 growth processors being:
1. Application development,
2. The data processing organisation,
3. Data processing management,
4. User involvement.

Developing countries need not go through all the stages but could leapfrog to stage 4 integration by utilizing consolidated data base techniques and effectively accountable users (SPROWLS, 1977). Sri Lanka has no data base management systems installed. Thus according to the above, it cannot be considered to be mature in applications development.

NOLAN (1979) revised his growth stages to 6. They are
1. Initiation, 2. Contagion, 3. Control, 4. Integration 5. Data administration 6. Maturity

and gave the growth processes as,
1. Applications portfolio
2. DP Organisation
3. DP planning and control
4. User awareness.

Computing in organisations in Sri Lanka is analysed here using

framework of 1976 is also considered wherever appropriate.

Growth of computer applications. The majority of installations are on a proliferation of applications and thus are in stage II (Contagion). All have completed stage I, the typical low level application areas such as payroll and accounting. Five installations are planning to install DBMS and are on the verge of entering stage IV (Integration). There will be a growth in the DP budget of 4 of these installations who have to upgrade their computer systems, and procure appropriate DBMS software. The other has the necessary systems in place for DBMS. The users who have installed vendor suuplied applications packages which are well designed using a systems approach, and data generation and data use are in the user area could be considered to be in stage IV (integration).

DP Organization. Of the 6 pre 1976 commercial installations, 4 have reached stage IV in DP Organisation. The EDP has been set up as a separate utility and the data processing manager has taken on a higher level position. The other two are in stage III (control). The two university computer facilities are in stage I (initiation). Most of the new installations are also in stage I, since the EDP facility is organised under department of first application justification, usually accounts. NIBM is an exception where the DP Organisation is in stage IV, having a Director Computing with a separate computer utility established. And so is CECB with the computer facility separately established.

DP planning and control. Most of the new installations in Sri Lanka are in stage I or II. That is they lack controls and are intended to engender applications development. The 8 old installations are having a strong budgetary planning system and have reached stage IV. However data administration is lacking and no formal programming controls have been established.

User Awareness. CECB was the installation with the highest user awarenes, since the users (engineers) themselves do their own programming and operation. They could be considered to be truly mature users and would fall into stage VI. These are closely followed by the university and research organisations which are also heavily user driven. They could be considered to be in stage IV or V. This pattern has been observed among scientific users (MULLER & RAYFIELD, 1977). The private sector users are also a driving force and could be considered to be in stage III or IV. The Public sector organisations tend to be more in the intiation stage although some have been using computers for about 10 years. In most installations the end users are superficially involved. The computer merely providing more, better, and faster information than manual techniques.

Although SPROWLS (1977) indicated it is possible to by-pass the stages of growth discovered by NOLAN, not many organisations in Sri Lanka have been able to achieve this.

8. FUTURE OF COMPUTING

Based on the views of the hardware vendors and the growth of the economy, it can be expected that computer installations will continue to grow at a rapid rate. Thus it is necessary to plan for this growth now before the future shock is on the Administrators.

8.1 PUBLIC ADMINISTRATION.

The public administration in Sri Lanka is evolving into a matrix organisation. There are 32 Ministers (functional) and a Prime Minister, with the executive President at the apex of the hierarchy. The country is geographically divided into 24 administrative districts with a district Minister heading each district. Thus information flows and budgetary and performance measuremnets are getting more complex. The information flows could be smoothened and expedited by having computer centers in the 24 districts and in the 50 A class ministries and departments. While the primary applications for these computers should be performance evaluation, budgetary control and planning, other subsystems could be developed to assist the various functions. The 24 district computer centers would allow computer facilities to district sub-departments, other public and private organisations and schools in the vicinity. The national budget for 1980 is Rs. 23 Billion ($ 1.5 B), and a modest 1% for control would allow Rs. 234 Million ($ 15 M) for a good system. The other areas in the government that could use computers are to assist in revenue collection and logistics, credit council accounting, personnel, and pension systems etc. In addition societal information systems could use computers very effectively, examples are in criminal information systems, court information systems, hospital information systems etc.

Medical diagnostic system based on an inexpensive desktop computer would an effective solution to the problem of manning rural clinics with reluctant doctors. There has been some success in developing algoritms and flowcharts for medical diagnostics.

8.2 ECONOMY & COMPUTERS.

Every sector of the economy should use computers to assist

decision making. Fig 8.1 shows the various sectors of the economy.

8.2.1 PUBLIC SECTOR.

There are 22 corporations in the manufacturing sector; 12 in the trading sector; 284 tea estates and 5 corporations in the agriculture sector; 6 corporations in the construction sector; 4 corporations in the transport sector; and 2 miscellaneous corporations that are large enough to use computers in the state sector.

Banking.
There are 2 leading public sector banks with about 750 branches. They have ordered 2 IBM System/34s. Once the appreciation of computers is realised, each branch will eventually get one.

Insurance.
There are now 4 Insurance organisations in the public sector catering to the general public. Two are in general and life insurance and the others are in agriculture and export guarantee. There is only one computer in this sector of the economy presently. With branches in the districts, there is potential for more use of computers.

Other Public Sector Bodies.
Air Lanka, the national carrier, Greater Colombo Economic Council and its free trade zone industrialists are the other potential computer users in the near future.

Universities and Research Bodies.
'It is without question that a university should have at least one computer centre on its campus' MORIGUITI (1977). There are 28 academic departments of the various universities that should have a computer for education and reasearch. In addition there are 9 research and consultancy establishments that should have computers.

8.2.2 PRIVATE SECTOR.

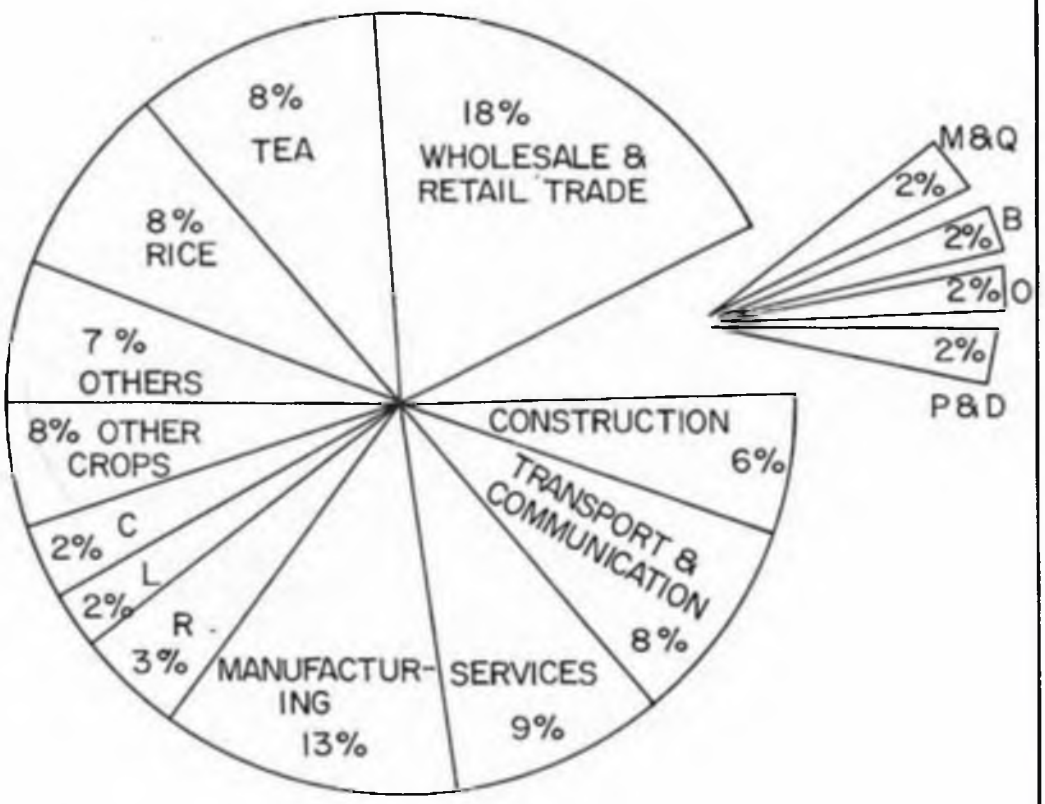
To give an overall view of the private sector, some statistics are presented. There are 1065 broadbased limited liability companies and 6475 narrowbased limited liability companies. In addition 13,088 registered businesses were established in 1979 alone. Fifteen foreign companies registered to conduct business in 1978 and 1979 in Sri Lanka.

Exports.
The private sector is involved in the export sector which is very vital to the country (Fig 8.2). Computers should be used widely to enable the countries products to be more competitive. Some areas of significance are trading in tea, rubber and garments. There are about 50 large exporters.

Tourism
There are about 75 tourist hotels and 20 tour operators who could use computers to give a better service to tourists. Due to the lack of sufficient trained staff, these organisations are finding it difficult to run these effectively, and well programmed computers would be of vital use for these operators.

Construction.
There are 400 contractors and 60 consultants registered with the Consortium of Contractors and Consultants. They are handling building construction mainly for the government. This is a very fast growing segment of the economy and computers could be effectively used for construction management.

Banking
There are 17 banks in the private sector with about 40 branches, which could use computers in customer information systems, and foreign exchange transactions.



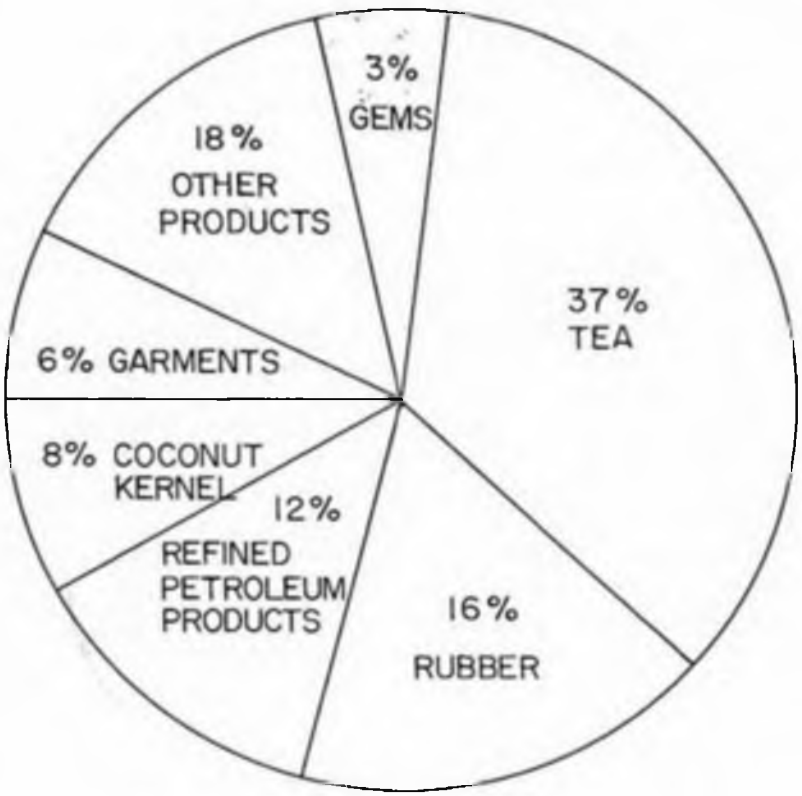
C = COCONUT
L = LIVESTOCK
R = RUBBER

M & Q = MINING & QUARRING
B = BANKING, INSURANCE & FINANCE
O = OWNERSHIP OF DWELLINGS
P & D = PUBLIC ADMINISTRATION & DEFENCE

GROSS DOMESTIC PRODUCT VALUE = 36.4 Billion Rupees.
(2.28 Billion US $)

FIG. 8.1 GROSS DOMESTIC PRODUCT BY SECTOR, 1978.

(Source : Census & Statistics)



EXPORT VALUE : 15.3 Billion Rupees. (0.96 Billion US $)

FIG. 8.2 MAIN EXPORTS, 1979

(Source : Central Bank)

9. CONCLUSIONS AND RECOMMENDATIONS

There is currently a government policy conducive to computer usage, after a long period of government policy limiting its usage.

A rapid growth in computer installations was found in the last few years. A marked shift towards small business computers was observed. There is a significant growth in the use of computers in the private sector, but no such growth in the non-private sector was observed.

There are indications that this growth will continue in the future.

The pioneer computers were used for large applications, although the hardware systems were limited. A few of these application systems had a high degree of integration, while other early applications had a low level of integration. All computer applications software are sequential record based and not DBMS based. Most programs are inhouse developed. A noteworthy development is the highly integrated software packages devloped by ICL and WANG for topical applications. Among these are packages for the local produce auctions. They work on desktop and small business computer systems. It is recommended that all vendors adopt this approach and build software packages for topical application areas, to ensure that computers are productive in the local environment without a long gestation period.

IBM has a significant share of the computer market. WANG shows remarkable growth for a new computer vendor in Sri Lanka. ICL is the other major vendor. A very recent entry is RADIO SHACK, noted for its inexpensive and widely used personal computer systems.

Formal education and training in computer techniques is minimal. There is no university degree program in computing in any field. It is recommended that a first degree program in computer software engineering be started in the University of Colombo.
For the rapid dissemination of computer knowhow, it is recommended that TV be used, as had been done very succesfuly in Japan (MORIGUTI, 1976).
General training at school level would definitely reduce the level of anxiety felt by most people about computers today (WOODHOUSE, 1978). If children are to achieve this understanding, it is necessary for the 24 teacher training colleges to include computer education as a compulsory part of

It is recommended that the Computer Society of Sri Lanka be incorporated by an Act of Parliment. It should give membership to those with sufficient computer experience and high educational standards in order to maintain a professional standing in society, similar to the other professional bodies in Sri Lanka. It should conduct courses for top management and other professionals in the appreciation of computer techniques. It is recommended that a formal scheme of articled trainees be started, who after examinations will aspire to chartered membership of the Society.

Presently unemployment is decreasing, while there is an increasing use of computers in Sri Lanka. There are employment opportunities for trained computer personnel in Sri Lanka. In addition there is a possibility of employment opportunities for Sri Lankans trained in computer techniques in foreign countries, where there is an acute shortage of capable computer personnel.

Since 94% of the computers are concentrated in the Colombo District, it is recommended that District Computer Centers be established, to encourage the widespread use of computers in the other districts.

A Computer Applications Authority under the President, is recommended to encourage and rationalise the use of computers in the public sector (Appendix IV). A Presidential Information System should be developed by the Computer Applications Authority, to monitor the performance of the economy.

The government budgetary accounts of Rs. 23.4 Billion ($ 1.5 B) are late by 4 months. There are very few performance measurements in the government being attempted currently. It is recommended that the entire public administration be computerised by installing computers in the 50 A class departments initially.

It is recommended that computers be used in all sectors of the economy where management techniques are required either due to the high growth rate, or where stagnation or decline has occured due to lack of good management.

The telecommunications development plan needs to include the data communications requirements of the country. There is a requirement for an Act of Parliment to safegaurd the privacy of individuals due to the increasing use of computers. Large dossiers of personal data kept on computers may result in an invasion of the privacy of individuals.

There are sceptics in all societies including Sri Lanka, regarding the requirement for computers and its use. A brief outline is given of a few countries in Asia who have succeded in using modern technology including computers.
Singapore and Hongkong are two densely populated states. They

They have a very high GNP. In fact Singapore has a problem of lack of workers and is importing workers from neighbouring countries.
From the standpoint of industrialisation and modernisation, Japan has shown quite a progress. Before the Meiji restoration, about 100 years ago, Japan had no industry and over 90% of its population were farmers and fishermen. In computers Japan started behind most industrialised countries in 1955, but now ranks 2nd in the world in the number of computers installed (SHIGEM, 1978).

In Singapore the Prime Minister has strongly urged computer techniques in the economy. In Malaysia the King has made an appeal for more computer usage. In Sri Lanka it is suggested that the President gives his imprimatur for the use of computers.

'The longer you wait to take the first step, the further behind you get in the fastest growing technology God has given man to develop' (BENEDICT BR. 1978). It is heartening to note that Sri Lanka has taken that first step.

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A1. APPENDIX I.

A summary of all users in Sri Lanka is presented here. It consists of the sector in which the users operate,ie Government, State, University or Private; a brief outline of the system; Main application area; Size of the organisation in terms of manpower and financial turnover if published; and any special observations. A comprehensive coverage is available in (FERNANDO, 1980).

A1.1 AGRARIAN RESEARCH & TRAINING INSTITUTE. (AGRICULTURE).

This is a state sector institute engaged in research and training in agriculture. It has a Hewlett-Packard 9825 computer system. The main application was in statistical work to support research. The institute has 43 executive officers and 110 other employees. The institute is greatly hampered by the computer not functioning for some time, due to lack of maintenance facilities.

A1.2 AMS DATA SERVICES LTD. (SERVICE).

It is a private sector company engaged in computer service bureau operations. It has an ICL 1901A computer system with 16K words of main memory. The main applications handled currently are the Tea estate production system, Tea auction system for exporters and brokers, Accounting systems and Bank account loan system. This last system calcualtes the interest according to predetermined rules, records the instalments recovered, issues reminders and gives various schedules for the loan account managemnet of a leading local bank. AMS does its own customer engineering maintenance. It has over 10 years experience in edp. The major portion of the bureau work is done for the public sector. A System/34 is on order. An ICL 1901 is also available but is being canibalised for spares.

A1.3 CENTRAL BANK OF CEYLON. (BANK & FINANCE).

The Central Bank is a state sector institution, and has the overall responsibility for the regulation of the monetary and banking system of Sri Lanka. They have an IBM System/360-25

application is the National employees provident fund in which there are 3 million members from 30 thousand employers.A Balance of payments system is under development and it is proposed to have an Integrated economic data base system.

A1.4 CENTRAL ENGINEERING CONSULTANCY BUREAU. (SERVICE).

This is a state sector body engaged in consultancy work primarily in power projects to the Sri Lanka Government. It has a Wang 2200T system with a twin processing capability. The computer system is extensively used for design work by the engineering executives who operate the computer themselves. It is claimed that many design problems that used to take over 3 months are now done in 15 seconds in complete accuracy. As primary consultants to the Mahaweli project speed is the critical factor. User awareness is very high and within the short time the computer has been installed, it could be considered to be a mature user. Various engineering design work has been done with programs written inhouse in BASIC. It had a staff of 907 employees of which 337 were executives. The financial turnover was Rs. 32 million. It is proposed to enhance the computer with an additional terminal CPU and fixed & exchangeable disc storage unit.

A1.5 CHEMANEX LTD. (TRADE).

It is a private sector limited liability company. It is the distributor of CIC the local manufacturer of ICI UK products. The computer is used for bureau work in addition to its own work. The system is an IBM System/34 the first in Sri Lanka, installed in 1978. It has a 48K byte memory, 2 printers and 2 terminals. Main applications are in Accounts and Inventory.

A1.6 DE SILVA, ABEYWARDENE & PIERIS. (TRADE).

They are a tea brokering house, one of the smallest of the 5 brokering houses in Sri Lanka. They are a private sector firm. The computer system is an ICL 1501, a desktop computer. The tea auction brokers package has been given by the vendor. It is a completely integrated file managemnt system, and covers the entire operations of the brokering house providing management information. A good example of what a desktop computer (when intelligently programmed) can do for a small organisation and a developing country in the trading of its primary commodities. This desktop computer not only provides complete documentation

trends, competitive information, accounts and inventory control.

A1.7 DEPARTMENT OF CENSUS & STATISTICS. (PUBLIC ADMINISTRATION).

It is a government department. It uses an IBM System/360-25, which is to be replaced for the 1981 population census with an IBM 4331. The main application for which the computer was used was the processing of data of the 1971 population census. In addition various surveys that are regularly conducted by the department and bureau operations for other public sector and government departments are done on the computer. The main bureau work that is currently handled is the Government Budget System for the Treasury, and the Customs Dept imports and exports classification. These jobs are done monthly. The staff number 1061 of which 186 are executives. The budget of the Department for 1980 is Rs. 17.6 M.

A1.8 DEPARTMENT OF EXAMINATIONS. (SERVICE).

It is a government department. The principle functions are the organisation and administration of public examinations. It has an IBM 360/25 with DASD of 180 M byte capacity, largest in the country. The Computer was installed due to the delay in processing of results manually, and the increasing numbers taking examinations. Another aspect was the rising cost of conducting the examinations handled by the Department. The main applications are the processing of the G.C.E.'O' level and 'A' level examinations, taken by 500,000 and 100,000 candidates respectively. It is a completly integrated system from application stage to the issuing of results, after standardisation. The cost of processing per candidate has been found to be 23% cheaper after computerisation. The Department has 584 employees and the budget for 1980 is Rs. 32.6 M.

A1.9 FACULTY OF ENGINEERING, PERADENIYA. (SERVICE).

It is one of the 5 faculties of the University of Peradeniya, which is a premier institution of higher learning in Sri Lanka. The computer system is an IBM System 1130, with an online drum plotter. The computer is used mainly for lecturers research and teaching purposes. The university payroll of approximately 5000 employees is also done on the computer. There are 677

A1.10 FACULTY OF NATURAL SCIENCES, UNIVERSITY OF COLOMBO. (SERVICE).

It is one of the 5 faculties of the University of Colombo, the oldest university in Sri Lanka. The computer system is a Hewlett-Packard System 9825. The computer system has been received as a gift by the Statistical Unit of the Faculty, and is not functioning due to lack of maintenance facilities. The Unit gives advice on planning, analysis and presentaion of results in connection with surveys, and assists in data processing. It also conducts a course in Fortarn programming for the science students. The language used was HP special BASIC. The faculty has 604 students, and 132 academic staff. It proposes to obtain another computer when funds are available.

A1.11 FAMILY HEALTH BUREAU. (PUBLIC ADMIN.).

It is a project under the Ministry of Health, to provide for the care of families concentrating on infants, mothers, and family planning. They have an ICL 1503 small business computer with a 3 processor configuration. The computer has been recently installed and would be used in the various activities of the bureau. The budget for 1980 is Rs. 39 M, and involces a staff of 2682 of whom 23 are in the staff grade.

A1.12 FREE LANKA TRADING COMPANY LTD. (CONSTRUCTION).

This is a private sector company and is involved in the import and export trade. It is diversifying its activities and the computer an IBM System/34 has been procured for construction management and other applications.

A1.13 HEBTULABHOY M.S. & CO., LTD. (TRADE).

It is a leading trading house in the private sector. The computer system is a Wang 2200T. It has been purchased, along with the tea auction package supplied by the vendor. The main applications are the tea and rubber auction buyers systems. BASIC is the only language usable on the machine.

A1.14 INSURANCE CORPORATION OF SRI LANKA. (BANK & FINANCE).

It is a state sector corporation and was the sole insurer in Sri Lanka untill this year. The computer system installed is an IBM System/360-20. It was installed in 1969 for a period of 3 years only but is still being used. The main applications are life insurance processing, general insurance processing , personnel system, and accounts. The computer is on rental. The financial turnover was Rs. 447 M. in 1978, with 455,000 policy holders. It has a staff of 2750 employees.

A1.15 JAFFERJEE BROS. (TRADE).

It is a private sector company. The first interactive computer system in Sri Lanka was installed at Jafferjee's. It is a leading trading house, now diversified into various fields. It is a leading exporter of tea. The computer a 2200T system is mainly used for tea and rubber auction processing of information.

A1.16 JAY KAY COMPUTERS LTD. (TRADE).

It is a private sector firm. It is a subsidiary of one of the leading brokering firms John Keels. It has an IBM System/34 and is mainly used for the tea auction brokering system. Inventory control and payroll are also being done. A lot of program development is being done since the installation is very new, having been installed in September 1979.

A1.17 KG INDUSTIES LTD. (MANUFACTURE).

It is a private sector firm engaged in manufacturing and trading. It has an IBM System/5110 computer, the only one in the country. The computer system has a comparatively large main memory for desktop computer of 48K bytes. Presntly this is the only computer capable of running APL programming language in the country, another reason why computers cannot be judged by the catergory or price.

A1.18 LEVER BROTHERS LTD. (TRADE).

It is a private sector firm. A leading manufacturer and distributor of detergents, toilet preparations and eatables, it is associated with Unilever a multinational firm. It has an IBM System/34, and the main applications that have been computerised in the short period the computer has been installed are the cost of adjustment of sales, retiremnt benefit liability assesment, employees loan ledger system, and payroll system. The following systems are to be developed Stock control, variance of analysis, maintenance of plant and machinery etc. The computer was installed in December 1979.

A1.19 MAHAVELI BOARD/SURVEY DEPT. (CONSTRUCTION).

It is a state sector body, handling a project of value Rs. 37 B ($ 2.3 B) originally estimated to take 30 years, now being telescoped to 5 years. The project is claimed to to be colossal by any standard. It involves 125,000 ha of irrigable land and calls for the settling of 1 million people, 7% of the population of the country. It is expected to provide 400MW, which will double the present installed capacity. The scheme involves diverting the longest river to the arid north central province before flowing to the sea. It involves constructing 5 big dams.

The computer system installed is an ICL 2903 general purpose computer with 128K bytes (32K Words) main memory. It was installed in early 1979 at the Survey Department premises. It is used for the land survey calculations and progress control of major irrigation structures. It was used by CECB engineers for Mahaveli designs before their own computer was installed. A major enhancement program has been drawn up. The computer system is not being used on project control of the Mahaveli project. ERIM the remote sensing package is being modified to run on the computer, for use by the Survey Department.

A1.20 MEDICAL COLLEGE, UNIVERSITY OF COLOMBO. (SERVICE).

This is one of the 5 faculties of the University of Colombo. It is the oldest medical college in Sri Lanka and is a prestigous place of learning. They have installed an ICL 1503 small business computer system, with 5M bytes of Fixed and Exchangeable Disc Store. The computer has been installed recently.

A1.21 MSL COMPUTERS LTD. (SERVICE).

It is a private sector firm, and is an associated company of a leading audit firm Turquand, Young & Co. The computer is an IBM System/34, installed in 1979. MSL is running a computer service bureau and offer clients inventory control systems, accounting systems, payroll systems and tea auction system processing.

A1.22 NATIONAL INSTITUTE OF BUSINESS MANAGEMENT. (SERVICE).

This is a state sector consultancy and research organisation. It has installed a Wang 2200 VS computer with 128K bytes of main memory. The computer has a virtual storage operating system, which gives each user 512K bytes of virtual store.

The computer system is currently used for training purposes. A data base system application is being developed to monitor the performance of 22 public sector corporations coming under the Minister of Industries. Sri Lanka's first data commonication link maybe established for this purpose to obtain data from the Ministry over the telephone network and another link to the Government Treasury to monitor performance. A data base is also to be developed for the private sector industries reporting to the Ministry of Industries. The financial turnover was Rs. 3M in 1979, with 180 employees.

A1.23 PETROLEUM CORPORATION OF SRI LANKA. (TRADE).

It is a state sector corporation, and handles the entire business of petroleum in Sri Lanka. It operates a refinery for this purpose. All crude is imported, the value being Rs. 2.2 B in 1978. The petroleum distribution network involves supplying 1000 petrol sheds. The computer is an IBM System 360/20 with DASD of 15 M bytes capacity. The main applications are budgetary control, refinery control, refinery costing, sales system, vehicle performance system, and garage costing system. The corporation accounts are ready by the 3rd week of the following month due to the computer system. In addition electricity consumer billing for the Ceylon Electricity Board consisting of 175,000 customers; Railway warrant billing system for 300,000 warrants a month by department; and the tourist statistical arrivals involving about 150,000 cards per year are done on a bureau basis. It is expected shortly, to enhance to new system with data base management System and MIS. It had a financial turnover of Rs. 3 B in 1979 and had 4620 employees

A1.24 POSTGRADUATE INSTITUTE OF AGRICULTURE. (SERVICE)

It is an institute of the University of Peradeniya. The computer system at the Institute is a desktop Hewlett-Packard 9825 computer. It is not working due to poor maintenance service. The computer had been used mainly in research work for statistical analysis. It was installed in 1977. The institute has 100 postgraduate students.

A1.25 PURE BEVERAGES LTD. (TRADE).

It is a private sector company and is a manufacturer and distributor of sweet beverages and preservatives. The computer system is an IBM System/34 installed in 1979. The main applications are billing and sales analysis. An integrated accounting system is to be developed.

A1.26 SRI KRISHNA CORPORATION LTD. (TRADE).

It is a private sector company in the export import business. It has installed an IBM System/34 in 1979. It is in the process of developing systems. The computer is on rental.

A1.27 SRI LANKA CENTRAL TRANSPORT BOARD. (TRANSPORT).

It is a state sector corporation. The computer is an IBM System/34 with 4 terminals. It has been installed in 1979, and is on rental. The computer was installed to clear the backlog involved in the provident fund system of 60,000 employees belonging to the board and 9 regional boards. Another major objective was the inventory control of Rs. 216 M worth of spares stock, of which the non-moving items had reached the alarming figure of approximately Rs. 20 M. The board also runs its own payroll of 2000 employees. There are approximately 6000 busses operated by the 9 regional boards.

A1.28 ST. ANTHONY'S INDUSTRIES. (MANUFACTURE).

It is a private sector partnership involved in manufacture. It was established in 1960. The computer is an IBM System/34. The applications so far developed are an inventory control system, and a payroll system. A MIS is to be developed. The system has

been recently installed. The computer fixed disc store is to be upgraded to 27.1 M bytes and a faster printer is to be installed.

A1.29 STAFFORD MOTORS LTD. (TRADE).

It is a private limited liability company who are the sole importers and distributors of Honda vehicles. A Wang PCS II Desktop computer has been installed. The computer is mainly used to monitor and chase customer orders for motor cycles etc.

A1.30 STATE ENGINEERING CORPORATION OF SRI LANKA. (CONSTRUCTION).

It is a state sector corporation and is the first 2nd generation computer user in Sri Lanka. The computer system is an ICL 1901 with 48K byte (16K word) memory, installed in 1967. The main applications are inventory control, payroll and Bureau operations. As the first public sector computer installation they have been consulted and their computer used by many government and public sector bodies. It developed the examinations system before Examinations Dept installed their own computer. It is currently running the Cooperative Wholesale Establishment inventory system of 50,000 items with a value of Rs. 154 M. Its own inventory system has 20,000 items worth Rs. 38 M. Its list of past and present customers is a whos who of the state sector. It has developed many original systems and have a complete library of ICL application programs. The computer is 13 years old and is planned to be replaced by 1982. The data preparation card key punches are to be replaced in 1981, by a Key-to-Disc/Tape equipment.

A1.31 UNIVERSITY OF MORATUWA. (SERVICE).

The University which is solely for technical and applied science has an IBM 1130 computer system. It is used to a fair degree by students for assignments and by lecturers for research. The University has 3 faculties, Engineering; Architecture and Town & Country Planning; and Physical & Applied Science. There are a total of 2875 students of which 2037 are for non-degree technician programs, 793 undergraduate and 45 postgraduate students. It is proposed to replace the computer with one of larger capacity in 2 years time.

A2. APPENDIX II - COMPUTER VENDORS IN SRI LANKA.

TABLE A2.1. COMPUTER VENDORS IN SRI LANKA

MAKE	VENDOR	VCODE	STATUS
DATA GENERAL	Computer Systems Limited	D- (	OEM
HEWLETT - PACKARD	Metropolitan Agencies Limited	H-P	SOLE DEALER
IBM	IBM World Trades Corporation	IBM	BRANCH
ICL	International Computers (Ceylon) Limited	ICL	SOLE DEALER
RADIO SHACK	Bartleets Electronics Limited	R-S	SOLE DEALER
WANG	Data Management Systems Limited	WANG	SOLE DEALER

TABLE A2.2.VENDOR - COMPANY INFORMATION.

VCODE	REGISTRA--TION NO.	INAUGARAL DATE	AUTHORISED CAPITAL	ISSUED CAPITAL
D-G	PVS 5625	1979	na	na
H-P	PVS 1770	1970s	na	na
IBM	F 286	1964	na	na
ICL	PBS 606	1969	Rs. 500K	Rs.100K
R-S	PVS 5855	1978	Rs. 5M	Rs. 20
WANG	PVS 4744	1977	Rs. 20M	Rs. 50K

A3. APPENDIX III - COMPUTERS, LANGUAGES & DATA BASE PACKAGES.

A3.1 CATEGORY AND MODEL OF COMPUTERS IN SRI LANKA.

TABLE A3.1.MAKE, CATEGORY, AND MODEL OF COMPUTERS IN SRI LANKA.

TYPE MAKE/	DESKTOP SYSTEMS	SMALL-BUSINESS SYSTEMS	GENERAL-PURPOSE SYSTEMS	DISTRIBUTED DP SYSTEMS
IBM	5110	System/34	4331,4341	5280
ICL	1501	1502,1503	2903,2904	7501,7502
WANG	PCS II	2200T,2200VS	--	--
RADIO/ SHACK	Model I, Model II	--	--	--
H-P	System85	--	--	--
DG	--	Micronova Nova,Eclipse	--	--

A3.2 PROGRAMMING LANGUAGES AVAILABLE IN SRI LANKA.

The availability of programming languages marketed in Sri Lanka is shown in Table A3.2. BASIC is available in most computers and is suitable for both commercial and non-commercial work. Fortran is available for scientific work, and RPG II and COBOL for commercial work.

TABLE A3.2. COMPUTER MODELS - PROGRAMMING LANGUAGES IN SRI LANKA

MODEL	ALGOL	APL	ASSEMBLER	BASIC	CDE	COBOL	FORTRAN	PLI	RPGII
D-G									
all	1			1			1		
H-P									
85				1					
IBM									
5110		1		1					
S/34			1			1	1		1
4331			1			1		1	1
ICL									
1500					1				
2903	1			1		1	1		1
R-S									
M-1				1			1		
M-2				1					
WANG									
PCS				1					
2200T				1					
VS			1	1		1			1

A3.3 DATABASE PACKAGES AVAILABLE IN SRI LANKA.

TABLE A3.3. DATABASE PACKAGES AVAILABLE IN SRI LANKA.

COMPUTER	DBMS
IBM 4331	DL/1 DOS/VS
IBM System/34	Data Base Techniques
ICL 2903	IDMS (ICL-Cullinane)
WANG 2200 VS	TOTAL (WANG-Cincom)

A4. APPENDIX IV - COMPUTER APPLICATIONS AUTHORITY.

The role of the Computer Applications Authority (CAA) will be to encourage the use computer techniques for the better management of State Enterprises. This is because modernisation of management techniques, represented by the use of computers has not had an impact on the non-private sector (FIG 4.5).

The CAA should be under the President to establish its national role. Assistance could be obtained from international organisations like UNDP for experts, equipment and sponsored study fellowships. The CAA should be management and applications oriented. The emphasis being the development and use of modern information systems and new technology for the purpose of improving the management of resources and enterprises. The CAA should have an Advisory Board which includes representatives of Government, University, Public Sector, Trade Unions and Private Sector. The services of international experts should be utilised. They should be scheduled, such that effective and rapid counterpart learning is possible. The CAA should have computer equipment to incorporate in the training programs and to develop the use of packages and scientific management aids (RONEL, 1977).

The role of the CAA is not envisaged as that of a watchdog or clearing house for computerisation, but as a catalyst where assistance is required.