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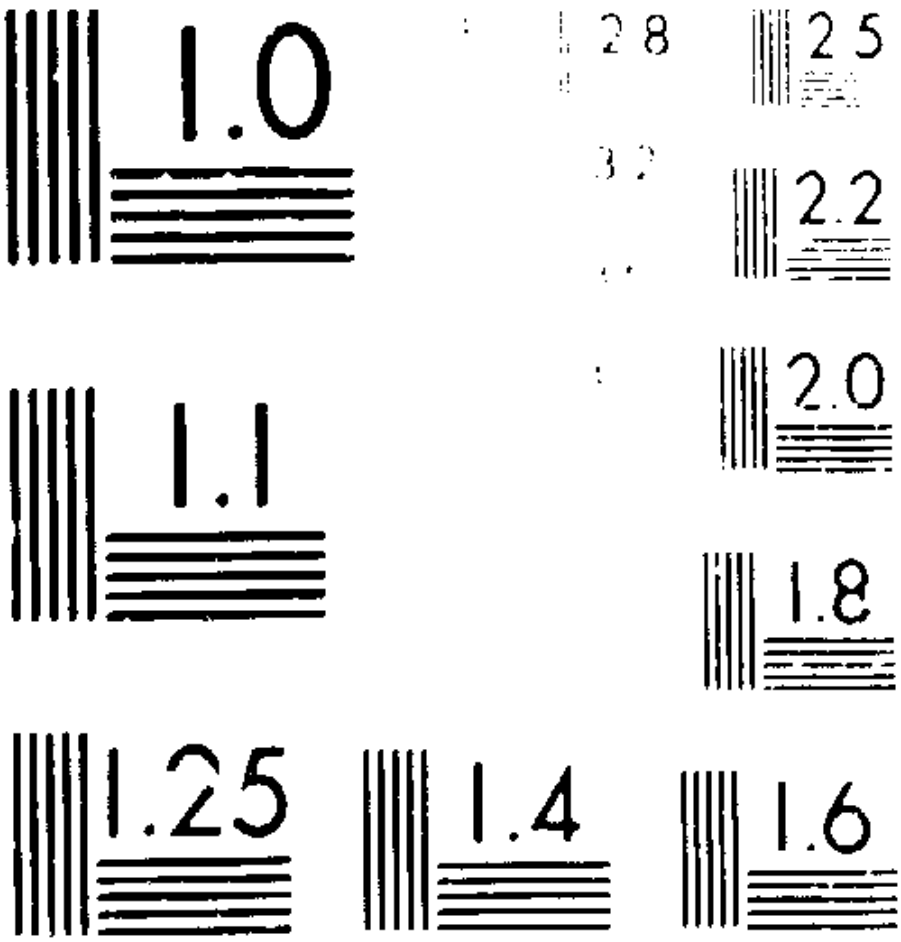
UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org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UNITED NATIONS
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SMALL-SCALE COMPUTER-BASED SYSTEM FOR INDUSTRIAL MANAGEMENT IN DEVELOPING COUNTRIES

prepared by the
Factory Establishment and Management Section

V.82-29443

ESCAP

Explanatory notes

In addition to the common abbreviations, symbols and terms, the following have been used in this report:

A/C	accounts
ACY	Asian Computer Yearbook
AIT	Asian Institute of Technology
ASEAN	Association of South East Asian Nations
B	byte
CAD	computer-aided design
CAM	computer-aided manufacturing
CICC	Centre of the International Cooperation for Computerization
CPU	central processing unit
EDP	electron data processing
ID	identification
MIS	management information systems
NEC	Nippon Electric Company
NSO	National Statistics Office, Thailand
RCC	Regional Computer Centre
S/A	sales analysis
S/P	spare parts
STD	standard computer program
THC	Thai Hino Motor Sales Company
UBA	universal business application

Preface

The information contained in this report is from a project entitled "Establishment and Strengthening Regional Co-operation in the Use of Small-Scale Computer-Based Industrial Management Systems" (US/RAS/78/202). The project, which was concerned with the manufacturing industry in Indonesia, Malaysia, Philippines, Singapore and Thailand was implemented by UNIDO and the Asian Institute of Technology (AIT).

The four main topics dealt with by the project and discussed in this report are:

The project report

A survey of small-scale computer utilization in industrial management in the ASEAN region

Application software: tailor-made software compared with modified standard software packages

The Workshop on Improved Industrial Management through Computer Support

Contributors to this report include Per Hovde, project manager, Mario Tabucanon, Kanchit Malaivongs, Ampai Pornprasertsakul, Pisit Perksanusak.

CONTENTS

Tables

Figures

I. PROJECT REPORT

Background and objectives of the project

The use of small-scale computers for industrial management systems was discussed at four UNIDO-sponsored international meetings: Kampala, Uganda, December 1975; Budapest, Hungary, December 1976; Dakar, Senegal, June 1978; and Budapest, Hungary, December 1978. In following up the recommendations of these meetings, UNIDO has been involved in assisting developing countries in the review, selection and implementation of management systems based on the use of small-scale computers.

The Asian Institute of Technology (AIT) was the counterpart of UNIDO in this project. AIT is an autonomous, international technology institute in Bangkok, Thailand. The Institute was originally established in 1959 and was chartered in 1967 as an independent, international non-profit educational institution by special legislation of the Government of Thailand. The Institute also conducts research programmes in co-operation with other institutions and organizations in the Asian region.

Two divisions and one centre of AIT were directly involved in this project:

The Industrial Engineering and Management Division
The Division of Computer Applications
The Regional Computer Centre (RCC)

A description of AIT involvement with computer applications is in annex I.

The AIT-RCC is well equipped with a large computer installation, the IBM 3031. Nevertheless, AIT did not have modern small-scale computers or expertise in their industrial and managerial application.

In addition to AIT, the National Statistics Office of Thailand (NSO) participated in the project as a local supporting organization. NSO is a governmental organization responsible for effective computerization in the government agencies and for industry in Thailand. It functions under the supervision of the Ministry of the Prime Minister; following policies made by the National Computer/Systems Management and Policy Committee.

The development objective of the project was to improve the performance of the region's industrial enterprises through the increased utilization of computer-based industrial management systems. In addition, the project aimed to strengthen regional capabilities in computer-based management skills, and in consultancy and research, so as to meet diversified requirements stemming from the increased use of small-scale computers in industrial applications in the region.
The immediate objectives of the project were:

The immediate objectives of the project were:

(a) To strengthen management capacities as an aid to industrial management decision making. To provide professional advice and short-term consultancy services for local industries to diagnose computer-based management systems. To develop software packages for local industry;

(b) To strengthen the physical and human resources of the counterpart and local supporting organization as well as to provide regional co-operation with AIT, including the instruction in small-scale computer industrial applications and the computing and data processing capacities of AIT, the manpower capacities of NSO.
To assist the information network of AIT with regard to available software, hardware, and international expertise. To improve regional co-operation through the exchange of experience among Asian countries in industrial applications of small-scale computers

Activities and achievements

The project was divided into the following major activities:

Orientation seminar

Installation and use of small-scale computer at AIT

Training of AIT and NSO staff in the use of small-scale computers

Consulting service to industry in the region

State-of-the-art survey of computer utilization for industrial management in the region

Final workshop to present findings and give recommendations for further UNIDO engagement

The major activites are outlined below.

Orientation seminar (see annex II)

The Orientation Seminar of five days, for representatives from industry and government on "Computer Supported Industrial Management" was carried out at AIT. The main purpose of the seminar was to provide the participants with an opportunity to understand the effective use of small computers in industrial management and to promote regional co-operation in the field of computers' management applications. The Seminar was attended by 28 participants from eight countries in Asia including the host country, Thailand. The Seminar was conducted by Datacentralen, a Danish Consulting firm sub-contracted by UNIDO.

Installation and use of small-scale computer at AIT

A mini-computer was purchased by UNIDO and installed at AIT. This was to provide the AIT faculty and staff practical experience with small computers as a tool in industrial management and to develop and demonstrate software for pilot product application for selected companies within the region.

The computer, a NEC-100/40 from Nippon Electric Company Ltd., (NEC), Tokyo, Japan was installed at the end of February 1981 in the Regional Computer Centre of AIT.

The NEC-100/40 has a basic processing unit with 128 KB memory; a floppy disk with 1 MB capacity; a fixed disk with 38 MB capacity; a line printer 136 characters per line at 310 lines per minute and a work station with a video display and key board.

In addition to the computer fairly extensive system and utility software were delivered with "Accounts Receivable", "Inventory Control System" and "Sales Analysis and Reporting" application packages. Two alternatives for the application software are to use standard, commercially available software packages offered by the computer companies, or, to tailor-make software.

The objective of the pilot project was to study the two different approaches and to get practical experience from both of these two alternatives.

The Inventory Control of Thain Hino Motor Sales Co.(THC), of Bangkok, Thailand was chosen for the pilot project. Thai Hino had a NEC minicomputer installed in 1978 and had developed the application software for their inventory control system. Thai Hino Company was chosen because it was felt it would be feasible to study their tailor-made software package as an example for customizing the standard commercially available inventory control package from NEC.

The work was carried out in close co-operation with THC. After extensive systems analysis of the company's inventory operations, the necessary adjustments (customizing) of the standard NEC Inventory Control Software was implemented. About one week of comparison tests were run with live data with the THC tailor-made package and the customized NEC standard package.

The pilot project showed that the customization of standard, well proven commercially available software packages is possible and in many cases a good alternative with respect to economy of time and from the point of view of the user.

Training of AIT and NSO staff in the use of small-scale computers

In order to strengthen the know-how of AIT and NSO in the use of small-scale computers in industrial management systems, two senior staff members from AIT and two senior staff members from NSO participated in a study tour to Japan to visit users and manufacturers of small computers.

The study tour was arranged in co-operation with the Centre of the International Co-operation for Computerization (CICC), Japan.

The following companies were visited:

CICC
Fujitsu Ltd.
Nippon Electric Company
Japanese Statistics Company
Fuji Dies Company
Nippon Electronics Development Company

A consulting service was offered to selected companies with the object of giving advice in their use of computers for management information and control purposes and to give AIT senior staff members practical experience in the implementation and operation of management information system.

Indonesia

Brantas Project, Surabaja
8-11 December 1981
Government Construction Project
Computer: WANG 2200

Malaysia

Beta Berhard, Jakarta
August 1981
Manufacturing of Foot Wear
Computer: IB S/3

Philippines

Different companies were contacted by the consulting team.
Most time was spent with:
Alhambra Industries, Manila
16 December 1981
Manufacturer of Tobacco Products
Computer: IBM/34

Singapore

ACMA Electrical Industries Ltd., Singapore
11-12 August 1981
Manufacturer of refrigerators and freezers
Computer: Data Point 2200

Thailand

Tanin Industrial Co., Ltd. Bangkok
July 1981
Manufacturer of radio and television sets.
Computer: NCRI-8250

The companies selected for consulting were chosen so as to represent different types of industries, with different needs of computer support for their management as well as being users of different types of small-scale computers.

The consulting service was carried mainly as an advisory service to the selected companies. The time available, a maximum of three days with each company was not sufficient. Therefore instead, advice was provided to management. The main impediments to successful implementation of computers for management information systems were found to be:

Lack of computer expertise in management resulting in insufficient specification of requirements (both hardware, software and from users side) and in no system analysis prior to implementation

Lack of suitable user software and of necessary vendor support

Difficulty in hiring and keeping qualified computer software staff

No official consulting report for each company visited was made as some of the information was confidential.

All companies had a very positive attitude about the service offered.

The schedule and target established in the work plan for the consulting service has not been met. The work plan was also to be of direct assistance to some companies which do not yet have a computer. We were unsuccessful in establishing such contacts for our consulting service.

State-of-the-art survey of computer use for industrial management purposes in the region

In order to strengthen the regional co-operation and to recommend actions for improvements in the use of small-scale computers for industrial management a state-of-the-art survey was carried out. The basis for the state-of-the-art survey according to the Work Plan was to visit 8 to 10 users for interviews, including four of the companies listed above.

It was possible however, within the budget and the schedule of the overall project to expand the survey and thus get a better and more qualified understanding of the use of small-scale computers in industrial management in the ASEAN region.

The Asian Computer Yearbook, (ACY) compiled by the Computer User Association of the southeast Asian countries gives the computer installations, by users name (company), type of business, type of computer and type of computer application. The Asian Computer Yearbook 1980/1981 contains about 1,200 computer installations within the five ASEAN countries. Based upon these 1,200 computer installations in different companies 54 companies were selected to take part in the survey. The selection criteria for companies was that they were manufacturing companies, users of small-scale computers, that they were not multinational companies and that they represented different types and sizes of industry so as to give a representative cross-section for the survey.

The survey was then conducted through questionnaires. Thirty two of fifty four questionnaires were completed.

The State-of-the-Art Report is presented in Section II to this Report. The main findings of the survey is presented below.

Findings

The survey findings and the experience of the consulting service described below provide the main basis for recommendations given at the end of this section.

Status of the use of small computers in industrial management in the ASEAN region

In the industrialized countries the ten-year period after 1965 was the time when computers found acceptance in industrial management and became part of everyday managements.

The state-of-the-art survey carried out indicates that in the ASEAN countries it is so far mainly the trendsetting companies within manufacturing industry that have computers installed for use in management information systems.

The total number of registered computer installations in manufacturing industry in the ASEAN region is 239 installations at year end 1980, according to the Asian Computer Yearbook (ACY) 1980/1981. By checking the registered number of installations in the ACY with the actual deliveries from one computer company to specified customers, it was found that 72% of all deliveries was included in the ACY. It is, therefore, assumed that the total number of computers in use in manufacturing industry in the ASEAN region is approximately 325 computers. Table 1 shows computers registered in the ACY, by country.

Table 1. Registered computers, by country

Country	Computers registered in ACY 1980/81	Assumed number by end of 1981
Indonesia	29	40
Malaysia	40	55
Philippines	85	120
Singapore	60	80
Thailand	23	30
Total	237	325

The growth rate of installations, determined from the survey and from ACY is about 40% per year in the region as a whole, varying from 20-30% yearly in Singapore and the Philippines up to 50% in Indonesia and Malaysia and 30-40% in Thailand.

About 20% of the total number of registered installations is in manufacturing industry. This ratio of approximately 20% is not much lower than that for the industrialized countries. Of the companies using computers more than 80% of them use only small computers (mini and micro). This situation differs from that of most companies in the industrialized world which use a large main frame computer and a number of small computers.

The survey also confirms that in the developing countries in Asia, as in the industrialized countries, the management and control of working capital is the most profitable and quite often the first utilization of computers in industrial management. Eighty per cent of all companies use the functions of accounts receivable and inventory control.

The more general administrative functions as payroll and accounting are the next most frequently implemented functions of a management information system.

Automation on the shop Floor, Computer Aided Manufacturing (CAM), and Computer Aided Design (CAD) is not being implemented in manufacturing industry in the ASEAN region. This because there is really no need to invest in automation in order to reduce the labour content of the products and hardly any of the products of the manufacturing industry in the ASEAN region are of a type where complex shapes or high accuracy requires CAD/CAM design or production methods.

Obstacles to the successful utilization of computers in industrial management in the ASEAN region

From the consulting service rendered and from the state-of-the-art survey. some substantial obstacles have been found to severely restrict the successful use of small computers in industrial management in the ASEAN region.

These main problem-areas are:

(a) Lack of appreciation among the management of the possibilities for improvement of industrial management through the use of computers and lack of personnel with computer experience for implementation of management information systems; (the management awareness problem);

(b) Difficulty in getting software for management information systems that really meets the requirements of the industries in the ASEAN region and difficulty in getting the support needed to get software packages implemented and become operational (the software and the support problem);

(c) The limitation in telecommunication facilities for data transmission which require different system architecture than in the developed countries - i.e. (the communication and system architecture problem).

The management awareness problem

It was found that the possibilities offered by modern computer technology to industrial management were, mainly recognized by younger managers. The top executives in most companies in the ASEAN region are still reluctant to use computers.

In many cases, it was found that the managers who should be the users of the management information system did not take part in specifying their needs nor state the requirements they set to the information system. Setting the specifications and in some cases, even deciding what functions should be computerized is left to the computer experts. When the specified system is being implemented, the managers find that the system does not meet their needs, and confidence in computers suffers.

Experience gained from implementation of management information systems in industrialized countries indicates the need for plans and specifications before the actual implementation of the system.

Lack of careful planning from both management and the computer personnel resulting in insufficient specifications and sketchy system analysis work forces continuous alterations of software and many changes of system concept during development and implementation.

Without proper management attention to this type of problem many management information systems will never become operational and will merely be a costly learning process.

The shortage of experienced software personnel and the problems related to this is discussed in the next paragraph.

Software and the support problems

Two alternatives exist to meet the needs for application software, namely, use of "off-the-shelf" available software offered by the computer companies; or tailor-made software.

The "off-the-shelf", software packages for management information systems offered to industry in southeast Asia are developed in the industrialized countries, for companies of the industrialized countries. With the difference in management style, in operations and in organizations between companies in the industrialized countries and in the developing countries, the majority of these packages do not meet the specific needs of industry in southeast Asia. Since very limited technical assistance and support can be given by the vendors locally to "customize" these software and software support is one of the major bottlenecks prevent rational use of computers in industrial management in the ASEAN regi

Software support has to be given locally and must be readily available in order to be of help to the industry. Relying on experts from the United States or Japan does not work.

The majority of the computer and software vendors in the ASEAN region also have a limited understanding of the problems of industrial management making it difficult for them to give qualified assistance in understanding the users requirements or doing systems analysis.

The majority of the companies taking part in the survey state the lack of suitable application software and the lack of vendor support as their main problems. The majority of the manufacturing companies have, therefore, established their own software groups in order to "tailor-make" the software for their management information system themselves. The survey indicates that nearly seventy per cent of all manufacturing companies develop their own, tailor-made, software.

Similar situations in the industrialised countries in the 1960s have shown that this heavy load on the manufacturing industry to develop their own software - while having really shortage of qualified software personnel will lead to the following situation:

(a) Too much time and effort will be spent in debugging and modifying the software to get even the straightforward tasks operational;

(b) Implementation of software for other highly needed functions in the company is slowed down because the experienced software personnel have to concentrate their effort on keeping operational the software for the functions already implemented.

The communication and system architecture problem

It has been previously pointed out that more than 80% of the companies in manufacturing industry in the ASEAN region are using only mini- or micro-computers. The two main reasons for this heavy focus on small-scale computers are:

(a) Large main frame computer installations in the industrialized countries are economically utilized by being shared by many users, often in geographically separated locations. Such computer operation requires good telecommunication facilities for data transmission which are not available in most countries in the ASEAN region;

(b) Since there has been no prior investment in hardware or software no restrictions on software compatibility exist. The companies are, therefore, quite free to choose the most suitable computer and software now being offered on the market. Really low cost mini and micro makes them suited for use in almost any dedicated function of a management information system.

Recommendations

There is a substantial need to improve the performance of the region's industrial enterprises through increased utilization of computer-based industrial management system. Rapid growth in the use of small-scale computers is taking place in southeast Asia. It is recommended to promote use of these computers to improve the performance of industrial managers in the region.

The recommendations include:

Promotion of management awareness and management proficiency

Assistance and support to individual companies in planning, implementation and operation of management information systems

Education and training directed towards a more long term improvement in industrial management and computerized management information systems

System architecture for Management Information Systems (MIS) for the developing countries

Promotion of management awareness and management proficiency

No doubt the largest problem in the success of the industry in the ASEAN region is the lack of experienced and qualified managers - in both general management position and at middle management levels. It is outside the scope of this present project to look into this overall management problem. However, for successful implementation of a computerized management information system in the manufacturing industry the upper-middle management must be made aware of the possibilities provided with the small-scale computer. Management awareness seminars are one answer to this problem. The management awareness seminars could be arranged along the following lines:

(a) Focus on applications, system solutions and computers that meet the specific requirements of the developing countries (ASEAN region). It must be made clear how these applications improve the competitiveness and profitability of a company;

(b) Separate seminars should be arranged for top managers (Managing Directors) and middle management;

c Duration of each seminar should be a few days only.

Management awareness seminars are to some extent being arranged by a few computer companies in the ASEAN countries.

It should be the task of UNIDO to promote and support the arrangement of such awareness seminars in the ASEAN region. These seminars could be jointly arranged with UNIDO and Management Schools and Universities giving management training.

Assistance and support to individual companies

To solve the software and support problem presented earlier, assistance and support has to be given selectivity to the individual companies. In the short run, industry in the region can not, through on-the-job-training or through formal education of its employees, be self supporting with a system analyst and software personnel of sufficient calibre to successfully implement management information systems. Further, a change in the trend seen in the manufacturing industry today, where about 70% of the companies make their own software from scratch, has to be made.

The industry must to a large degree use **the standard commercially available packages,** with some 'customizing' done to meet specific requirements. The work done in 'customizing' standard packages at AIT as part of the present project proves the feasibility of such customizing.

In order to give professional assistance and support to the manufacturing industry in their effort to take computers into use for management support, national "consultancy and training centres" should be established.

UNIDO could play an important role in establishing such centres and providing expert.

Such "consultancy and training centres" could be established along the following lines:

(a) They should cover the 'total' area of systems analysis, establishing user requirements, software development/customizing, systems operation and training/installation.

(b) They should be attached to or be part of established (governmental) institutions experienced in software development, customizing and systems analysis.

It is recommended that a new UNIDO project be established as soon as possible to establish such a "pilot consultancy and training centre" jointly with AIT, taking advantage of the work done during the present project, the contracts established and the resources and expertise of AIT in management, computers and software.

Since MIS covers a wide variety of functions it is not possible to possess in-depth expertise over the whole area. The most important function for the manufacturing industry to computerize is no doubt the management of working capital. Computerized management and control of working capital is for a large part covered with software for inventory control and accounts receivable.

As a pilot project the consultancy and training centre should, therefore, be established with personnel with good practical experience in implementation of systems for inventory control and accounts receivable.

Based upon the experience gained after two to three years of operation at AIT, similar centres should be established in the other ASEAN countries.

Possible partners for such joint projects with UNIDO in the other ASEAN countries are: Indonesia, Malaysia,(National Productivity Centre of Malaysian Institute of Management), Philippines, and Singapore.

Education and training

Programmes for the development of managers should involve the manufacturing industry, the universities and management schools and the governments of the developing countries.

In the present project AIT is the focal point in the region for the promotion of small-scale computers for management support. One of the immediate objectives of this project has therefore been to strengthen the physical and human resources and the instruction capacities in the field of small-scale computers in industrial management applications of AIT.

To further strengthen AIT's position to better serve the manufacturing industry in the region the following development is recommended within AIT:

(a) More attention must be given to the particular requirement of the management manufacturing industry in the region;

(b) In order to offer a more complete series of courses in computer based industrial management systems directed towards the environments of southeast Asia much closer co-operation has to be established between the relevant divisions and the Regional Computer Centre;

(c) With the widespread use and rapid growth of micro and mini-computers in the ASEAN region the facilities and expertise within modern small-scale computers have to be greatly expanded and courses on several levels on system design, programming and operation have to be offered to the students of AIT.

System architecture

From the industrial user's point of view the two disciplines computerization and telecommunication are closely interlinked. It is felt, however, that it will take time to improve telecommunication within the ASEAN countries. The system architecture for computerization requires that the management information system be separated into a number

of autonomous functions (modules) as opposed to one integrated management information system. The consequences from a system design point are that the common data base for a company is of little use, and on-line data communication for data entry or transactions must be avoided.

II. SURVEY OF SMALL-SCALE COMPUTER UTILIZATION IN INDUSTRIAL MANAGEMENT IN THE ASEAN REGION

Purpose of the survey

The survey was part of the joint UNIDO/AIT Project - "Establishment and Strengthening Regional Co-operation in the Use of Small-Scale Computer-Based Industrial Management Systems".

The object of the survey was to improve knowledge of small-scale computers use in industrial management support in the ASEAN countries.

The survey was to determine:

(a) The use of computers in manufacturing industry as compared to the total use of computers;

(b) Functions or application areas selected for

(c) Sources used for the application software;

(d) Critical factors or problem areas encountered in the use of small-scale computers for management support.

An aim of the survey was that the findings would make it possible to improve the performance of industrial managers in the developing countries.

Scope

The survey was conducted in the ASEAN region, mainly focusing on national manufacturing companies.

A formal and distinct definition of a small-scale computer is not readily available. In this survey, the term small-scale computer is used for mini or micro computers. In the 1970s the small-scale computer was defined as computers with a word length of less than 32 bit and with less than 1 MB of main memory. Since the minicomputers of today have the performance of typical mainframes of 3-5 years ago, the term small-scale computer had to be used with some understanding of the rapid development in computers.

Selection of companies

Companies appearing as users of small-scale computers in the industrial management in the Asian Computer Yearbook 80-81 published by Computer Publications Ltd. of Hong Kong were selected for the survey. It was thus assumed that the majority of the computers installed in the ASEAN region are registered in the Yearbook.

Statistical figures in table 2 relate to the total number of computers and the number in the manufacturing industry.

Computers in manufacturing industry

From the total number of companies and institutions having computer installations, the manufacturing industry was chosen omitting banks, insurance companies, airlines, the service industry, universities, and the public and government sector. Table 2 shows this. We are then left with the following:

Table 2. Computers in the ASEAN region

Country	Number of installations using computers	Number of manufacturing installations (%)
Indonesia	156	29 (18)
Malaysia	261	40 (15)
Philippines	346	85 (24)
Singapore	278	60 (21)
Thailand	149	23 (15)
Total	1 190	237 (20)

Small-scale computers in manufacturing industry

Table 3 shows the number of small-scale computer installations in manufacturing industry vs. the total number of computers in the manufacturing industry.

Table 3. Small-scale computers in the ASEAN region

Country	Number of computers in manufacutring industry	Number of small-scale computers in manufacturing industry (%)
Indonesia	29	26 (81)
Malaysia	40	26 (90)
Philippines	85	76 (89)
Singapore	60	47 (78)
Thailand	23	19 (82)
Total	237	204 (86)

Companies selected for further study

A limited number of companies in the manufacturing industry have been companies selected for further studies. Companies selected for further studies met the following criteria:

They are users of small-scale computers

They are generally non-multinational companies

They generally represent different manufacturing industries of different sizes and with different types of small-scale computers in use.

A list of selected companies, 32 companies responded to the the questionnaire forwarded to each of the 54 companies is given in annex IV.

Responses

Out of the 54 selected companies, 32 companies responded to the questionnaires. Table 4 shows, by country, the number of companies approached and the number responding.

Table 4. Companies approached and those responding to questionnaire by country

Country	Number of companies approached	Number of companies responding (%)
Indonesia	8	4
Malaysia	11	6
Philippines	18	10
Singapore	7	4
Thailand	10	8
Total	54	32(average 60%)

The number of employees per company varies from 31 to 11,000. The range by country of the number of employees is shown below. Details may be seen in annex V.

Table 5. Minimum and maximum exployees in selected companies by country

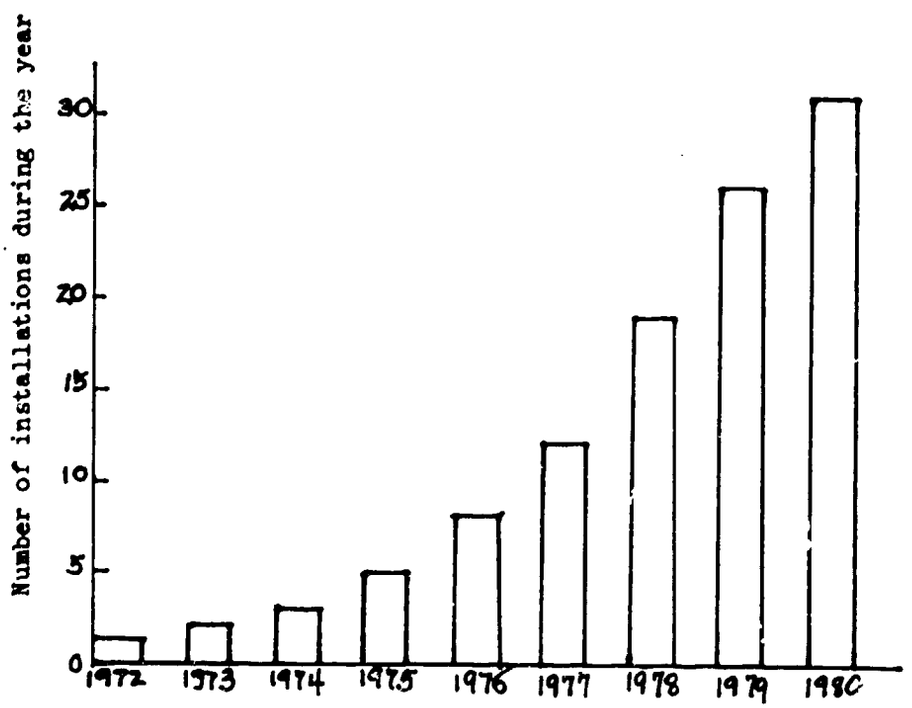
Country	Minimum number of employees in a company	Maximum number of emplcyees in a company
Indonesia	286	5 970
Malaysia	200	2 098
Philippines	31	11 000
Singapore	1 615	2 255
Thailand	249	1 660
Total	31	11 000

The number of people in the computer operation of these companies varies from 2 to seventy people.

Small-scale computers

The adoption rate of small-scale computers within the 32 companies is shown in figure I.

Figure I. Growth of small-scale computer use in manufacturing companies in the ASEAN region



Computers used by the companies taking part in the survey

The following computer manufacturers are represented in the survey through the user companies:

(IBM)	United States
Wang	United States
Datapoint	United States
National Cash Register	United States
Nippon Electric Company	Japan
Data general	United States
(ICL)	United Kingdom
Basic/Four	United States
Hewlet Packard	United States
Texas Instruments	United States
Digital Equipment Corp.	United States

Except for the IBM, most of these computers are supplied by different agents in the region. IBM has supplied their computers to different companies through their own branch offices. All the companies except two have a maintenance contract with the vendor. (See annex VI for details).

Application software

Only a few companies use the standard packages available from the computer suppliers. However, some companies use the standard packages together with their locally developed programs. BASIC, COBOL and RPG II are the commonly used languages by the companies for their software applications. In addition, ASSEMBLY and PASCAL are also used by some of the companies. The statistics of different languages as well as the standard packages are shown below. Details may be seen in annex VII.

Of all the application programmes studied approximately 30% were written in COBOL, approximately 30% were written in RPB II, approximately 30% were written in BASIC; assembly and Pascal consitute the remaining 10%. Approximately 67 per cent of the companies used locally developed software; approximately 25 per cent used standard packages delivered from the computer supplier and 7 per cent used standard packages delivered from the software house.

Administrative data processing

Most of the companies use computers for payroll, accounts receivable, accounts payable and accounting purposes. However, budgeting and personnel are also the areas where computers are being used. Table 6 shows the statistics of different administrative use of computers, further details are given in annex VIII.

Table 6. Administrative data processing

Function	Number of companies using the function					
	Indonesia	Malaysia	Philippines	Singapore	Thailand	Total
Companies	(4)	(6)	(10)	(4)	(8)	(32)
Accounts receivable	-	4	7	4	6	21 (65%)
Payroll	3	4	4	4	5	20 (62%)
Accounting	1	4	7	2	3	17 (53%)
Accounts payable		4	5	2	2	13 (40%)
Personnel	2	3	2	-	2	9 (28%)
Budgeting	-	3	2	-	1	6 (18%)

Inventory control is another main area where computers are extensively used by the companies. Sales orders comes next. Relatively less use is in the fields of requirement planning, master production plan and purchasing. The following table 7 shows the use of computers in the different fields of material and production systems.

Table 7. Material and production systems

Function	Number of companies using the function					
	Indonesia	Malaysia	Philippines	Singapore	Thailand	Total
Companies	(5)	(6)	(10)	(4)	(8)	(32)
Inventory	2	4	9	4	7	26 (81%)
Sales orders	1	2	6	1	5	15 (47%)
Puchasing	-	-	3	-	2	5 (15%)
Requirement planning	-	1	-	-	1	5 (15%)
Master production planning	-	1	-	-	1	2 (6%)

Implementation of the computer system is claimed to be successful in almost all the companies. The responses of the 32 companies are:

Is the implementation of computer system successful?

YES - 30 (94%)

NO - 2 (6%)

Is the hardware (computer) operating satisfactorily?

YES - 27 (84%)

FAIR - 2 (6%)

NO - 3 (9%)

Application software operating satisfactorily?

YES - 30 (94%)

NO - 2 (6%)

Reasons for not satisfactory operation of hardware are frequent failure, slow operation and overloading. The 6% who are not fully satisfied with the software blame slow operation as the reason.

Table 8 shows the areas which, according to the companies, are the most profitable use of their computer.

Table 8. Most profitable applications

Area	Number of companies	Percent of total
Inventory	13	41
Accounting	7	21
Accounts receivable	7	21
Payroll and personnel	6	18
Finished goods production	5	16
Budgeting	3	9
Requirement planning	3	9
Work in progress	3	9
Production planning	2	6
Sales analysis	2	6
Billing	2	6
Online sales order entry	2	6

Eighty-eight per cent of the companies intend to increase the use of computers during 1981-1982. The new areas will be production control, forecasting and preventive maintenance. Details are in annex IX.

The main problem areas of the companies are shown in table 9.

Table 9. Main problem areas

Problem area	Number of companies complaining	Per cent of the total
Lack of vendor support in hardware or software	13	41
Non-availability of qualified personnel	11	34
Lack of documentation	11	34

These complaints are some of the reasons why the companies cannot use standard software packages. A company complained that the vendors themselves were not familiar with the packages. Details of problem areas of different companies are presented in annex X.

Summary and conclusion

This report was based on the survey conducted among different manufacturing companies in the ASEAN region that use small-scale computers. A questionnaire was prepared and distributed to the selected companies. Of the 94 companies, 32 companies responded to the questionnaire. It is believed that the conclusions of this report are valid for the ASEAN region as a whole and will give an overall picture of the region.

Out of the total number of computers installed in this region, 20% of the computers are installed in the manufacturing industries, a figure on par with the western developed countries. Again, out of the total number of computers installed in the manufacturing industries, 86% of the computers are small-scale. This higher percentage of small-scale computer installations shows that the manufacturing industries prefer to use small-scale computers rather than mainframes.

Although a few of the manufacturing industries in this region started using computers in 1972, it was in 1975 that the use of computers became widespread. The number of computer installations in this region shows an exponential growth from 1972 to 1980. In the last few years, the growth rate is 30-40% per year for the region as a whole. In addition to the number of computer installations, the areas of its use have also increased in the same proportion. Out of 32 companies, 30 companies indicated their intention to increase the areas of computer applications during 1981-1982. This shows that computer use will continue to increase at a high rate in the near future.

The companies' main use of computers is in administrative data processing and material production systems. Applications of computers for Computer Aided Design (CAD) and Computer Aided Manufacturing (CAM) are non-existent. It is unlikely that the computers will be applied

in these two areas in the near future, and none have indicated an intention to do so. Software for Inventory Control and Accounts Receivable is the most widely used and most profitable application areas. More than 80% of all companies have implemented either both or one of these application. More than 40% of the companies state that of any single application, inventory is the most profitable. BASIC and COBOL are the two main high level languages used by most of the companies. However, the companies with IBM installations use RPG.

Nearly 70% of the companies have developed their own programs rather than using standard packages. This may be due to the limited understanding of the application of packages and their potential benefits. Lack of vendor support for application software is another reason for this situation. Most of the computer manufacturers supply their computers through their agents and are more interested in selling hardware than software. Lack of awareness about different application packages may also be one of the reasons for developing software programs locally.

Although almost all the companies have indicated that the implementation of computer system is successful, and both their hardware and software performance is satisfactory, most of them complain about lack of vendor support in both hardware and software. It seems that their own developed programmes with limited applications are working satisfactorily, but they are facing difficulties in extending their areas of application. The major problem areas in terms of use of computers as indicated by the companies are (a) lack of vendor support in both hardware and software; (b) non-availability of qualified personnel and (c) lack of documentation.

III. SMALL-SCALE COMPUTER SUPPORT FOR INVENTORY CONTROL

The study was carried out by AIT Personnel as part of the main project. The object of this study was to gain insight in the alternative sources of application software for a computerized management information system. Specifically the study was designed to compare the performance of operation and the sources of manpower required to implement an inventory control system by investigating tailor-made application software vs customizing or adapting a standard commercially available software package.

Organization and summary

It was necessary to select a company to work with which was located near AIT to facilitate easy access to the computer; and used a small-scale computer Nippon Electric Company (NEC) so that its performance could be compared with the NEC-100/40 computer installed at AIT.

Thai Hino Motor Sales Ltd. (THS) met these requirements and agreed to take part in the study. After the study of Thai Hino Motor Sales Ltd., and its computerized inventory control system, the requirements for a similar inventory control system were established. A commercially available standard package for an inventory control system was then studied and compared with the established requirements and specifications. It was found that the standard package did not fully meet the requirements of Thai Motor Sales Ltd. and alternative approaches to meet the requirements were analyzed. It was concluded that the best alternative was to modify the standard package. The necessary modification was implemented in the application software and actual comparison of operation of the tailor-made and the modified standard package could be done.

Company background

THS is a Thai-Japanese joint-venture company established in 1962. The company is the sole distributor of Hino vehicles, the sole distributor of spare parts for Hino vehicles in Thailand and provides maintenance service for Hino vehicles.

THS is a large business and industrial enterprise. The organization of the company consists of eight departments including Electronic Data Processing Department (EDP department) and Spare Parts Department (S/P department) as shown in figure II.

Electronic data processing department

THS acquired their first computer in 1977. The computer (NEC0100/F) is mainly to support the management of spare parts inventory control, spare parts management and spare parts purchasing management. These functions were computerized in order to reduce opportunity and operating costs and also to overcome overload in manual operation of more than 30,000 spare part numbers. This caused the establishment of electronic data processing department in 1977. The existing THS computer has been introduced through five major steps shown in the THS chart figure III. The total time in months refers to time required for completing each sub-step. Cummulative calendar time for step 1 to 5 is also shown. In the introduction of computer step 4 of figure 3, there are three application areas: spare parts sales management, spare parts inventory control management and spare parts purchasing management, developed at this phase.

The organization of electronic data processing department is shown in figure IV. There are seven electronic data processing personnel including, namely, one electronic data processing manager, one assistant to electronic data processing manager/system analyst, two programmers, one computer operator and two key punchers. The present electronic data processing personnel's background education and experience as well as years of experience are shown in table 10.

Spare parts department

The present organization of spare parts department is shown in figure V.

The main functions of the spare parts department are:

Spare part sales activities (in retail and wholesalers)
Spare part inventory planning and control
Spare part account receivable control
Spare part purchasing
Spare part inventory activities
Spare part arrangement, check and entry for each entry.

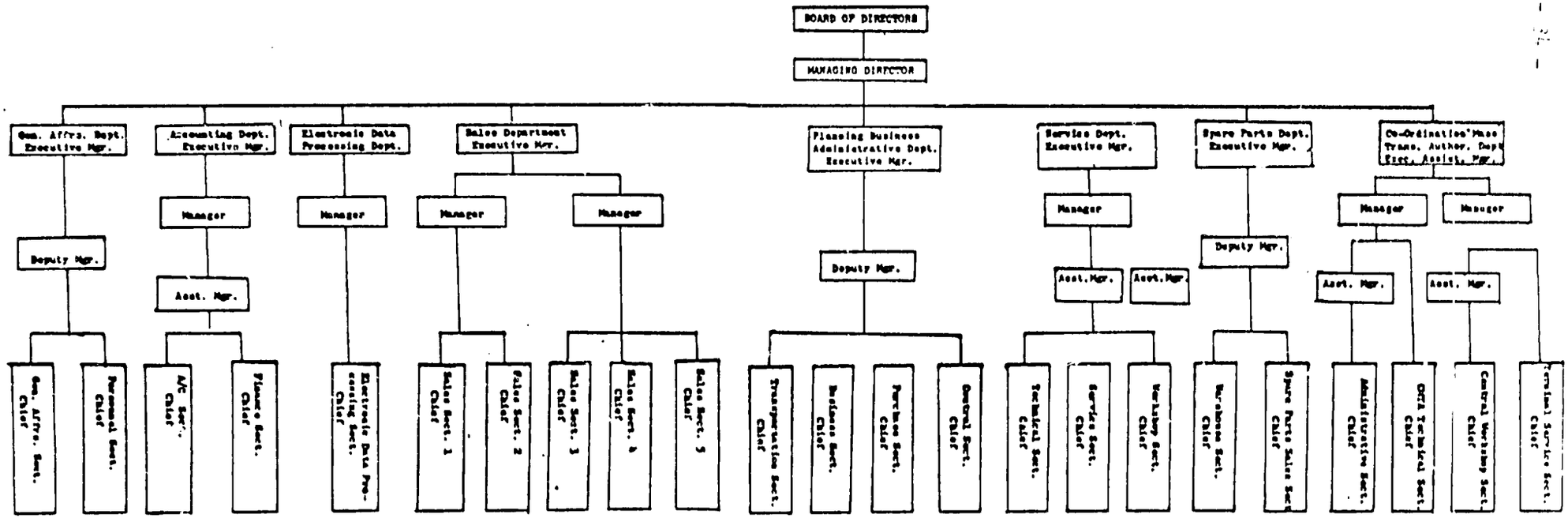


FIGURE II. COMPANY ORGANIZATION CHART

Step	Sub-step	Description	Calender Time in Month	Time Consumed in Month	Expenses in Bahts	Personnel at this Step						Remark
						1	2	3	4	5	6	
1. Feasibility Study	1.1 Application	Study the application of computer for company	00-01	1		x	x				6.1 6.4	1 = EDP Manager
	1.2 Computer	Study the available computer sizes, packages and their prices	01-02	1		x	x				6.3	2 = System Analysts
	1.3 Analysis	Make the cost-benefit of using computer in company	02-03	1		x	x				6.3 6.4	3 = Programmers
	1.4 Budgeting	Expenditure expectation and budget availability	03-04	1	120,000	x	x				6.3 6.4	4 = Computer operater
2. Decision and Planning	2.1 Decision taken	Making decision on using computer or not	05-05	1/2		x	x				6.1	5 = Key punchers
	2.2 Planning	Implementation planning	05-08	4		x	x					6.1 = Top Executive
	2.2.1	-Application areas										6.2 = External Contractor
	2.2.2	-Practical steps in introducing, planning and scheduling				x	x					6.3 = Computer Vendor
	2.2.3	-Budget planning				x	x					6.4 = Application area and users
	2.2.4	-EDP Department plan				x	x					
	2.2.5	-Employment planning			120,000							
3. Set EDPD	3.1	Place	09-11/14	3/6	*	x					6.2	
	3.2	EDPD personnel employed and trained	12-14	3	180,000	x		x	x		6.3	
4. Introducing Computer; System Analysis & Design and Computer purchasing	4.1 Requirements	Application area requirements study and analysis	09-09	1		x	x				6.4	* = not available
	4.2 External Design	Guide line design for detail design, computer configuration design and computer purchased	10-14	5	3,000,000	x	x				6.3 6.4	
	4.3 Internal Design	Detail of application area design	15-15	1		x	x				6.4	
	4.4 Program Development	Program specification and flow chart, computer installation	16-18	3		x	x	x	x		6.3	
	4.5 Program code & test	Program coding (program /documentation), test run and correction	17-19	3	987,000	x	x	x	x	x	6.3	
5. Intallation and modification	5.1 Run	Comparison run and system/program modification	20-23	3	275,693	x	x	x	x	x	6.4	
	5.2 Cost	Cost-benefit analysis	23-25	2	*	x	x				6.4	

Figure III. Steps in introducing computer at Thai Hino Motor Sales Company

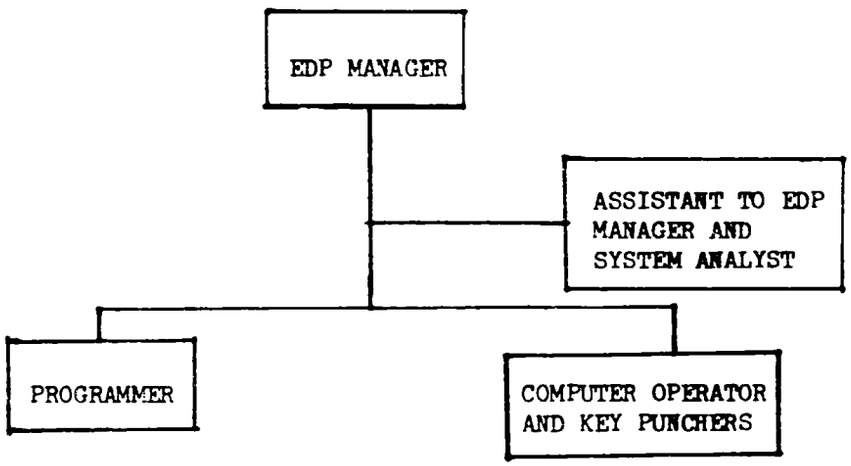


Figure IV. EDP department and organizational chart

Table 10. Electron data processing personnel education and working experience

Position and education	Experience	Years of experience
EDP Manager (Bachelor of Science in Metallurgical Engineering)	Trading company in Tokyo, Japan Training at Hino Motor Japan Spare Part Sales Dept. of THS EDPD	3 0.3 10 4
Assistant to EDP Manager (and System Analyst) (Diploma from a Vocational College)	Training in Stystem Analysis and Computer Programming EDP Department of Hino Japan as System Analyst and programmer EDP Department of THS as System Analyst and Assistant to EDP Manager	1 5 3
Programmers (Bachelor of Science)	Training at NEC representative in computer operation, system analysis, COBOL programming and operating system of NEC EDP programmer	0.3 4
Computer Operator (High School Certificate)	Worked at DATAMAT (NEC representative in Thailand) in key punch and computer operation Computer operation at THS	3 2.5
Key Puncher (High School Certificate)	THS key punching	1

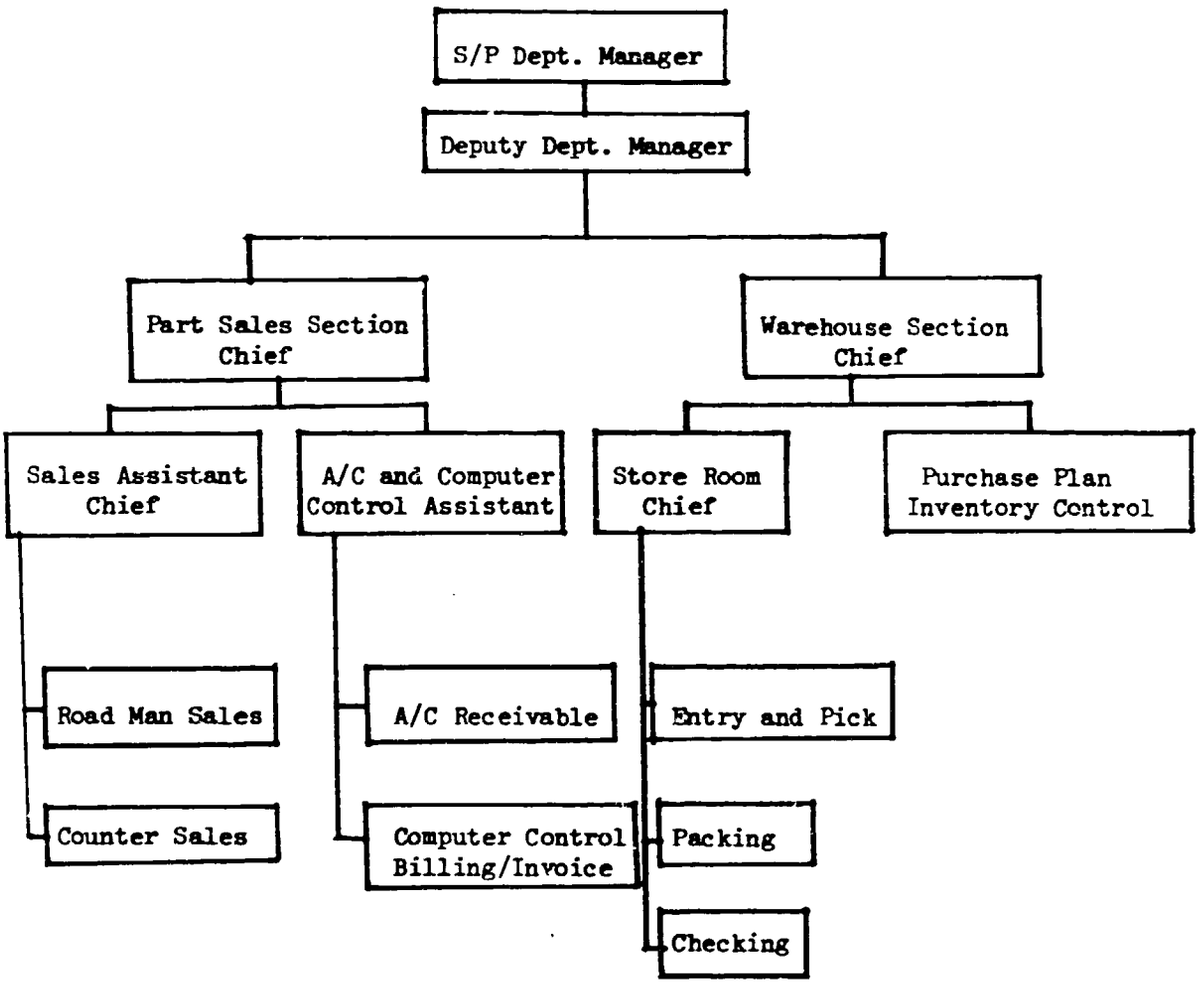


Figure V. Spare parts department organization chart

System analysis and design

All companies introducing management information system have a number of alternatives in obtaining the application software. These alternatives are described below as well as the procedures in system analysis and design.

Choice of obtaining application programmes

The choices for software are to use a tailor-made package, to use a standard package, or to use a standard package and tailor-make the

Requirements and activities of spare parts inventory control

As mentioned earlier, THS requires computer support to spare parts sales management, spare parts purchasing management and spare parts inventory control management. This study concerns spare parts inventory control only and its inventory control information system is shown in figure VI.

Requirements of THS spare parts inventory control

The requirements of spare parts inventory control to obtain low cost and efficient operation are:

Number of spare parts to be controlled, about 32,000 items

Receipt, order and shipping;

Frequency of transaction is 25 times/month
Number of transaction items 5,040 items/month
Number of sales order 3,000 slips/month
Number of sales order item 30,000 items/month
Spare parts stock check 1 time/month
Number of items checked 32,000 items/month

Maximum data file update frequency 23 times/month
Inventory status report 1 time/month

The interface of each system to each department of THS is shown in table 11.

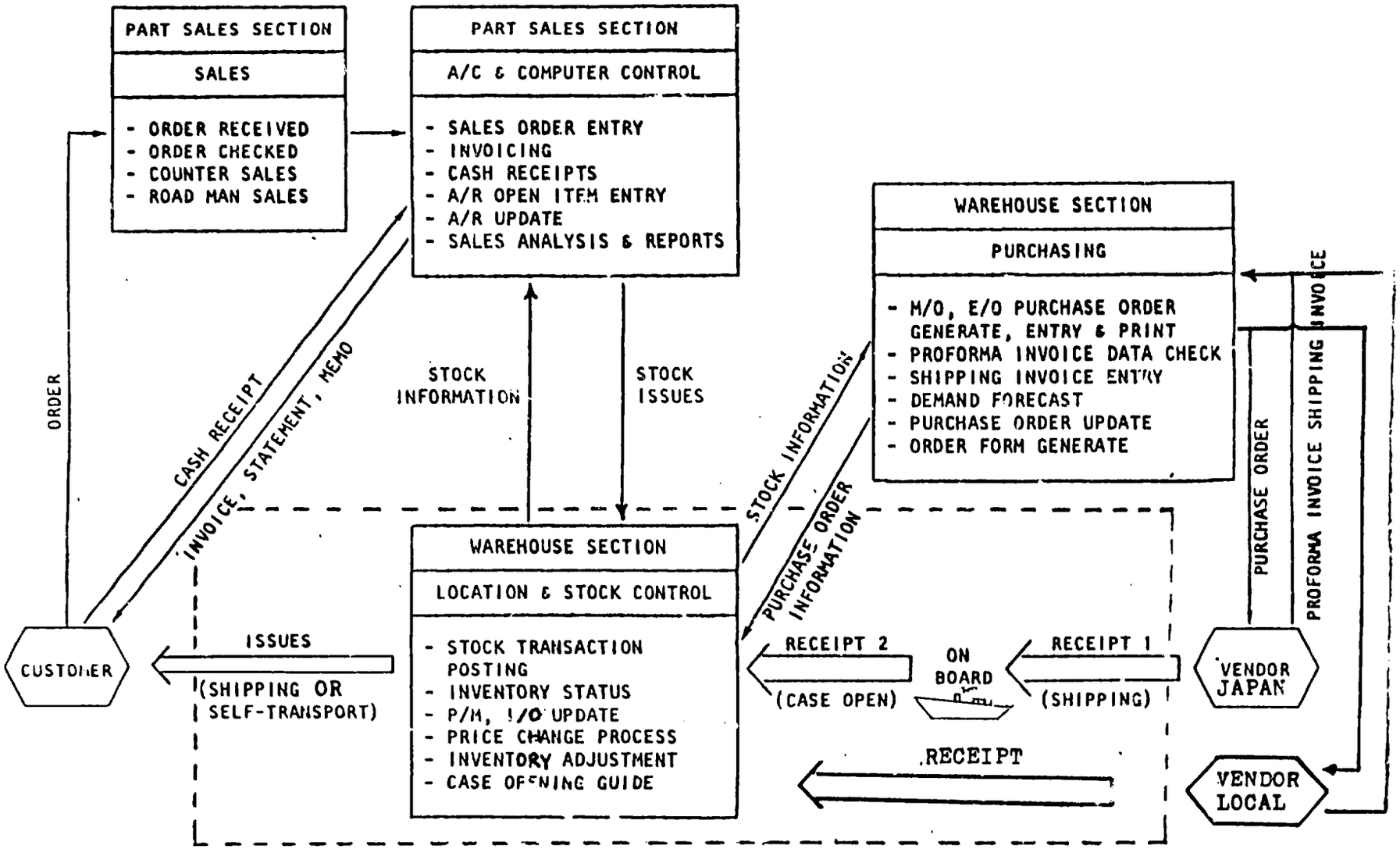


Figure VI. Spare parts department information system

Table 11. Per cent interface of each system to each department of THS by department and system

System	Department						
	Spare parts				CMTA[a]	Accounts	Service
	Warehouse	Purchases	Sales	Accounts			
Inventory Control	100	20	20	20	10	20	10
Purchase	20	100	20	-	-	20	-
Sales	20	20	100	100	-	20	-

a/ Co-ordination, mass transit authority.

Activities and functions of THS spare parts inventory control

Spare part master maintenance and update

New spare parts are introduced from time to time. The spare part master file is updated by erasing, adding or modifying the spare part number, its description and its specifications.

Spare part I/C maintenance and update

There are spare parts which can be substituted for by other spare parts. So it is necessary to have an information file for inter-changeable spare parts.

Spare part shipping invoice entry

As shown in the spare parts inventory control information flow, the spare parts purchased from Hino Motor Ltd. Japan are shipped with an arrival date indicated. This "on-board quantity" is necessary for management decisions. Spare part shipping invoice entry is an activity to register each spare part shipped, based on the shipping invoice.

Spare parts entry

Upon arrival shipped spare parts are unpacked, checked and stored in the warehouse. If the item number is the same as the shipping invoice, then the item number is recorded. Otherwise the difference is recorded on the updating data file. The data is then updated on the stock data file for stock control.

Local spare part entry

Local spare parts are purchased and delivered from local vendor. There is no "on-board" control required for this activity. Spare parts are received, unpacked and stored in spare part warehouse. So the new item or item detail is updated after the spare part receipt data are recorded.

Spare part transaction registration

Spare part transaction registration concerns itself with the quantity receipt, quantity issue, vendor order and quantity adjustment. This function is carried out to satisfy the activities, for example, credit sales, cash sales, transfer sales, part return, part cancellation or modification, purchasing order, spare part receipt and spare part quantity adjustment.

Spare part quantity adjustment

When the actual stock quantity and the on-hand quantity registered in the computer are not equal, then the registered quantity is adjusted to that of the actual stock. Other stock quantities for example on-order, allocated quantity etc. can also be adjusted.

Spare part information

The stock information required by THS spare part inventory control can be classified into three groups:

(a) Spare part master information which involves item number, item description, item price, item cost, various item quantity, item location etc.;

(b) Spare part interchangeability which is concerned with the key spare part, its interchangeability spare part numbers and interchangeability marks:

(c) In/out information which involves item grade, item moving status, and information related to order and location.

Specification of available standard inventory control package

Universal business application (UBA) package

Most computer manufacturers have certain standard software packages available. The package called "Universal Business Application/Floppy Diskette" (UBA) is available from NEC for the NEC100/40 installed at AIT. The four application areas in UBA are: inventory control system, account receivable system, sales analysis system and billing control system.

The information flow of UBA is shown in figure VII. The dotted line rectangular application areas have no standard packages yet. These packages in UBA consist of program ID and program name as shown in figure VIII. The UBA's specifications and activities of inventory control are described in the next two paragraphs.

UBA inventory control specification

The specifications of inventory control package are that the number of items is greater than 32,000; that item transaction through CRT display: receipt, order, issue, transfer, adjust is more than 5,040 times per

month; that the sales order invoice and issue is more than 3000 slips per month. The package must provide a spare parts stock check at least once a month, data file update at any time and a work station. Based on the flow chart in (figure VII) an estimate of the percentage between the different departments of THS is shown in table 12.

Functions of the UBA inventory control package

The UBA inventory control must involve file maintenance activities as well as inventory control activities.

File maintenance and update

The company information file maintenance (FLMCON) is used to create and upgrade warehouse master information such as warehouse identification warehouse descriptions, etc. Warehouse item file maintenance is done by program (FLM020). Item Price File Maintenance (FLM050 is used for creating and updating item price class and pricing details.

The data file of each maintenance file above is reported by a report generating program in the UBA package.

Inventory control system

The inventory control system of UBA can be functionally classified into seven groups.

Stock transaction and report

Ihe posting of all stock receipts, stock issues, stock transfers, orders to vendors and cost changes are done by this program. It also records a variety of stock adjustments, including adjustments to the stock on-hand, allocated, on-order and back-order. All registered transactions are printed. The program also indicates the value of inventory and updates inventory valuation for individual stock transaction.

Stock status report

This program prints out in a report covering all stock item information. This report allows a monthly check over the allocations of available cash to specific stock purchases.

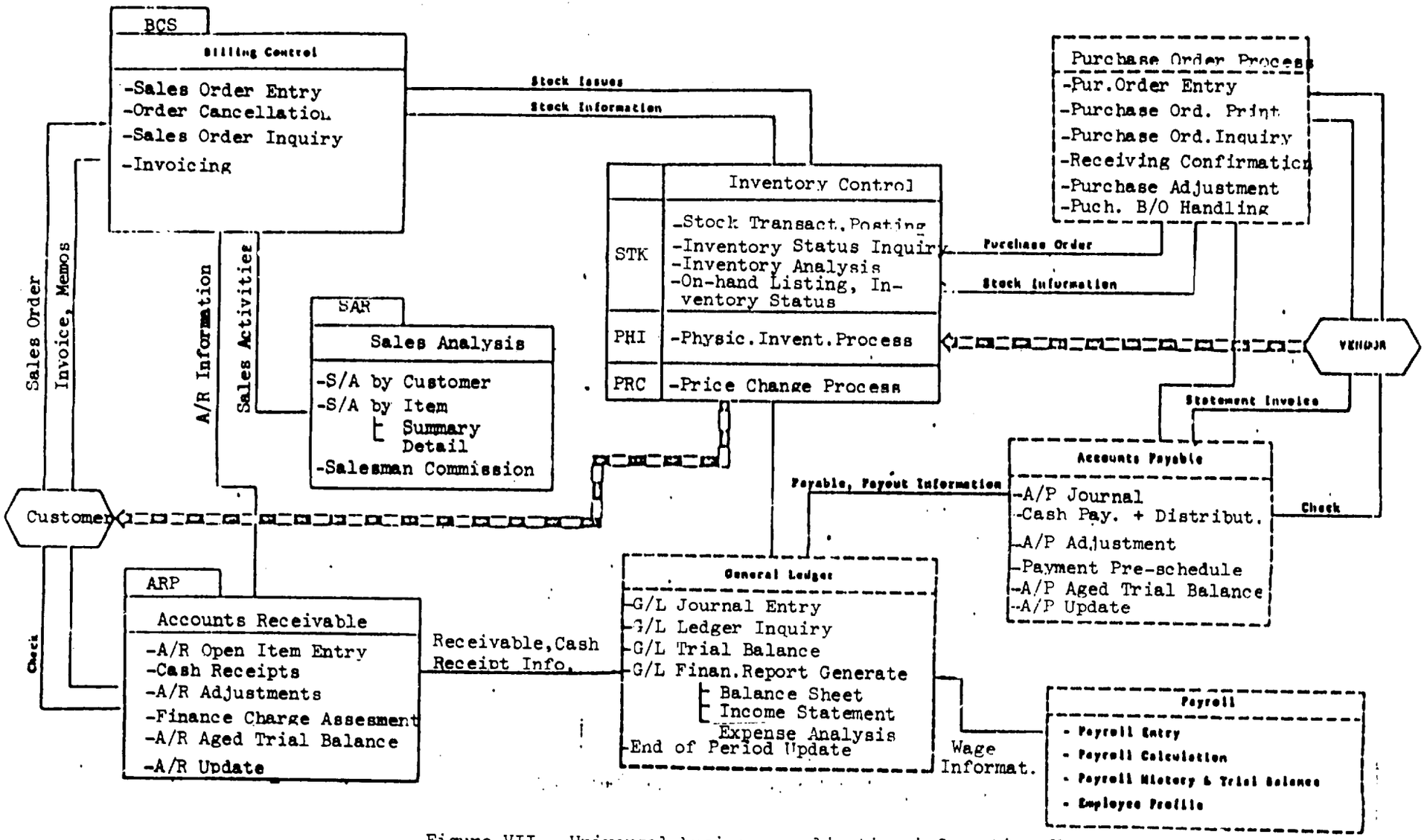


Figure VII. Universal business application information flow

Figure VIII. Program ID. Number and program name of UBA Package

Subsystem.	Progr.ID	Program Name	Remarks
SAR Sales Analysis	SAR010	Sales Analysis by Salesman/Customer	
	020	Sales Analysis by Item Detail	
	030	Sales Analysis by Customer	
	040	Sales Analysis by Item (Summary)	
	050	Sales Commission Report	
ESP End of Process	EOP 010	Customer History Update	
	020	Inventory History Update	
	040	Sales Tax Master Update	
	GMP 010	Good Morning Process	
	GMP 010	Good Night Process	
FLM File	FLMCON	Company Information File Maintenance	
	FLM010	Customer + Related Files Maintenance	
	FLM020	Item W/H Item Files Maintenance	
	FLM030	Salesman File Maintenance	
	FLM040	Sales Tax File Maintenance	
	FLM050	Item Price File Maintenance	
	FLM060	Warehouse Master File Maintenance	
Subsystem	Progr.ID	Program Name	Remarks
FLM File Maintenance	REPCUM	Customer Master Report	SMART
	LSTCUM	Customer Master List	SMAT
	REPCUS	Customer Special Message Report	
	REPCUA	Customer Skip-To Address Rep	SMAT
	LSTCUA	Customer Alphabetical Pointer File Report - SMART	
	REPITM	Item Master Report	SMART
	REPWHI	Warehouse Item Report	SMART
	LSTS	Salesman Master Report	SMART
	LSTTAK	Sales Tax Master Report	SMART
	LSTITP	Item Price File Report	SMART
	REPWHM	Warehouse Master Report	SMART

Figure VIII (continued)

Subsystem		Prog.ID	Program Name	Remarks
	BCS Billing Control	BSC010	Order Entry	
		015	Daily Booking Report	
		020	Order Cancellation	
		040	Invoice Print	
		042	Invoice Update	
		050	Sales Order Inquiry by Order	
		070	Sales Order Report	
	ARP Accounts Receivable	ARP010	Acct. Rec. Open Item Entry	
		015	Daily Inv.Register Print	
		020	Cash Receipts/Adjust. Entry	
		025	Cash Receip./Adjust. Journal	
		030	Finance Chge.Assessem.Report	
		035	Customer Statement Print	
		040	Aged Trial Balance	
		050	Sales Tax Report	
		060	Accts. Receivable Update	
		070	Accts. Receiv. Inquiry	
Inventory Control	STK Stock Tran-saction	STK010	Stock Transaction Entry	
		015	Stock Transaction Entry Register Print	
		020	Stock Status Report	
		025	Inventory Status Inquiry	
		030	Inventory Valuation	
		050	Inventory List	
		060	Stock Price Report	
		070	Stock on-hand List	
Inventory Control	PHI Physical Inventory	PHI010	Zero Count Generation	
		020	Physic. Inventory Entry	
		030	Physic.Inven.Card Sequence Check	
		040	Physic.Inven.Update/Report	
	PRC Price -Change	PRC010	Price Change Selection	
		020	Price Change Entry	
		030	Price Change Update	
		040	Price Change Journal	

Table 12. Per cent interface of application system to each department of THS by department and system

System	Department						
	Spare parts				Accounts		
	Warehouse	Purchases	Sales	Accounts	CMTA a/	Accounts	Service
Inventory control	100	20	20	20	10	20	10
Billing control	20	-	100	100	-	20	-
Sales analysis	10	30	100	30	-	-	-
Accounts receivable	-	-	20	100	-	20	-

a/ Coordination, mass transit authority.

Stock information inquiry display

Sometimes just knowing the quantity on-hand is not enough, thus this program permits detailed inquiry about a specific stock item. It indicates the quantity on hand, the quantity received this month, the quantity sold this month, the quantity transferred into or out of a specific warehouse, net adjustments to the stock level, the quantity available to ship, the minimum quantity to guard against stockouts, the quantity order from suppliers this month, and the quantity on the back-order.

Stock inventory valuation

The inventory valuation program displays on the screen **and prints out in hard copy a report that shows the total value of the stock.**

Stock, stock price and stock on-hand list

The stock program compiles and prints out on demand a **complete inventory list including the stock item ID number, description and** stock unit of measure for each item. A price list program indicates a complete up-to-date price list, or a price list for specified indicates a complete up-to-date price list, or a price list for specified items, whereas the stock on-hand list program indicates a list of all items in stock in specified warehouses, or in all warehouses.

Stock adjustment and physical count processing

This program provides updating the registered stock **data in the computer to match with actual stock status.**

Price change processing

This procedure can select inventory items for price changes. The price change can be effective immediately or at some designated future date and a record of the price changes is printed to show old price. new price, and the amount and percentage of change.

THS requirments and the specifications of standard inventory control package

The comparison of THS spare parts (S/P) inventory requirements specifications of the standard inventory control package and their functions

is shown in table 13. The table indicates functions provided by the standard package that cover the THS spare parts (S/P) inventory requirements.

The functions that the standard package cannot offer are:

Spare Part Item Master (needs more detail)
Spare Part I/C Master File (must be created)
Spare Part Location, safety stock, lead time etc. (needs more detail)
On-board information (must be created)
Stock-Status Inquiry Display (needs more detail)
New Spare Part Item Number Check and List
Spare Part Item Master Check and List (must be created)
Data Entry through Diskette

From table 13, it can be seen that most of the requirements of the THS S/P inventory control are satisfied by UBA inventory control package.

Applying the available standard package as is, without any modifications will not meet the requirements of THS. A second alternative, is that of partially modifying the standard UBA inventory control package to meet the most important functions and performance of the THS S/P inventory requirements and thus provide 80% of the THS requirements. The last alternative is to completely modify the standard UBA inventory package and tailor-make the requirements and functions required by THS S/P inventory control system. This will provide 100 per cent of the THS requirements.

The comparison between these alternatives are summarized in figure IX and table 14. These comparisons are based upon:

Performance of inventory control functions
Degree of automation of inventory control system

Time for program development or modification
Total expenses for program development or modification
Hardware requirements and support availability
Software requirements and support availability

A decision on the alternatives must be taken with the consideration of overall advantages and disadvantages given previously and the availability of time, budget, and the performance, etc. For this pilot project, based upon the overall consideration of time limitation, degree of performance and man-hour availability, the second alternative of partial modification was chosen.

Table 13. Comparison of THS inventory requirements and activities vs. UBA inventory specification and activities

THS function or specification	UBA function or specification
Quantity: 32,000 items, 13 Characters	32,000 items, 15 characters
Transaction rate: 25 times/month 5,040 items/month	25 times/month 5,040 items/month
S/P order and issue: 3,000 slips/month	3,000 slips/month
S/P stock check	S/P stock check
File update: 23 times/month	23 times/month
Inventory report once per month	Once per month
Work station available	Work station available
Interface to other functions such as purchasing, sales etc.	Interfaces available
S/P master maintenance and update	S/P master maintenance and update
S/P master maintenance and update	S/P
S/P shipping invoice entry	(No On-board)
Entry of S/P purchase from Japan	as for THS
Entry of S/P purchase locally	as for THS
S/P Transaction entry	as for THS
S/P Quantity adjustment	S/P Transaction or physical count
S/P Information display	S/P Status display S/P Price change S/P Price, stock list S/P Inventory valuation

Key: M = Month
* = Must be modified

1) NO MODIFICATION			2) PARTIAL MODIFICATION			3) COMPLETE MODIFICATION		
Step	Time (wk)	Expenses (Baht)	Step	Time (wk)	Expenses (Baht)	Step	Time (wk)	Expenses (Baht)
1) Study the operation system of the small-scale computer, its utilities and programming	3	2×8665×3/4	1) Same as 1.1	3	2×8665×3/4	1) Same as 1.1	3	2×8665×3/4
2) Study the UBA standard package in the following details: - Processes of each package - Input and output of each package including their calculation methods - Sequences and relation of these package	4	2×8665	2) Same as 1.2	4	2×8665	2) Same as 1.2	4	2×8665
3) Realize the THS inventory syst	6	2×8665×6/4	3) Same as 1.3	6	2×8665×6/4	3) Same as 1.3	6	2×8665×6/4
4) Select the UBA package suited for the requirements of THs inventory specification	3	2×8665×3/4	4) Same as 1.4	3	2×8665×3/4	4) Same as 1.4	3	2×8665×3/4
5) Set required and related specification for this inventory system			5) Same as 1.5			5) Same as 1.5		
6) Collect data and test run	1	2×8665×1/4	Modification 6) Modify the stock control system for obtaining S/P location and on-board Q'ty	1	2×8665×1/4	Modification 6) Study BASIC language & create I/C file	4	2×8665
			7) Collect data and test run	1	2×8665×1/4	7) Create on-board q'ty and shipping invoice entry, case opening guide	8	2×8665×2
						8) Change program to obtain invoice no., s/p location, etc.	3	2×8665×3/4
						9) Collect data & test run	11	2×8665×1/4
Total Increment from no modification (%)	17 0	73,652 0		18 1	77,985 4,332 (5.88%)		32 15	138,640 66,807 (90.95%)

Figure IX. Steps, times and expenses comparison among three alternatives of UBA/FD inventory control package

Table 14. Comparisons of alternatives for decision making

Item	Alternative		
	Non Modification	Partial Modification	Complete Modification
Inventory control functions	Not complete, but applicable	Applicable	Complete
Degree of automation	Difficult	Easy	Easy
Time for development	17 weeks	18 weeks	32 weeks
Total expenses	Low	Little higher than non-modification	Twice that of non-modification
Support availability	No need	Only diskette	Software and diskette

Step	Description	Consumed time (wk)	Requirements of the modification	Conclusion of the modification
1	Study the BASIC language used in this UBA package	1	- COBOL & BASIC Programming language. Knowledge of FORTRAN is helpful. - Source programs of UBA/FD package from supplier.	1) The whole modification took three weeks longer the schedule. 2) Modification of modified standard package works as described in results of the modification. 3) The results of the modification satisfied the THS requirements.
2	Modify Item &Warehouse Item File Maintenance (FLM020) for data entry as the following steps:			
	- Study & relate the program with its data files	1		
	- Find out where to modify in the program and data files, then modify them	1		
	- Test & modify the program till it works	2		
3	Modify FLM020 to display item information only	1		
4	Modify Item Price File Maintenance (FLM050) to display price of each item only	1		
5	Modify Stock Status Inquiry(STK025)	1		
6	Modify parameters to generate the report of the modified data files	1	- Application of the utility program 'SMART' of computer	
7	Recompile all the programs consisting the modified data files	1		
8	Prepare and enter the collected data through the data file maintenance program	1		
9	Test run & modify operation	2		
	Total time consumed	13		

Figure X. Procedures, time consumed and requirements for the modification of standard package

The partial modification of the standard package and its results

The procedures of the partial modification of the standard package along with time consumed and requirements are presented in figure X. It can be seen that results of the modified standard package satisfied the requirements of THS.

Some problems were met during the implementation. These problems were problems with the UBA, software problems and hardware problems, each of which are described below:

Even though only the inventory control programs of UBA were modified, because they interact with the other systems such as the billing control system, and the account receivable system, it was therefore necessary to also recompile these other programs, which took extra time.

The standard UBA package consists of 5 main application systems and each application program consists of program listings and data files. The average length of each program is 2,000 lines, making UBA a big program. For compilation, UBA required areas for the compile unit and the load modules. The data files to maintain collected data from THS also required a large area. This package, therefore, occupies most of the limited (32 MB) storage of the fixed disk since each file allocated in storage has a fixed address so there can be free space between files. In order to minimize the use of the storage, the free space had to be eliminated. Then all of the files had to be rearranged and given a new address. This arrangement took extra time.

During compilation of such long programs, the buffer storage of the computer is not enough (only 128 KB). It was therefore necessary to increase the buffer storage of the computer. The buffer storage was increased by about 64 KB.

The BASIC language of the NEC Computer systems is not a standard BASIC but combines COBOL and standard BASIC. Thus, it is a little bit difficult to understand at first. It therefore took time for the inexperienced programmers to start up with the non-standard programming language. During the compilation of the modified programs, there were some errors which were difficult to change by consulting the manual, such as address errors, record length, errors etc.

No BASIC software service was provided from supplier. There was insufficient training support from supplier in software application utility and package.

The compilation rate of the computer is very slow, about 4000 lines per hour. It takes time to compile each programme due to limited computer CPU and the files are easily misplaced.

The modification of the standard package was successful. For the inventory control of THS, the modified standard package can be used instead of the tailor-made package of THS, and their results are compared in figure XI.

The modified standard package can be used instead of the THS tailor-made package; and it provides all of the important information and functions either directly or indirectly. However, for inventory control, modified UBA package needs more CPU time and more steps by the users to operate than THS tailormade software but the UBA package meets the requirements and can be used for inventory control of THS.

To compare the partially modified standard package and the tailor made package, it is worthwhile to compare the time consumed by both alternatives. The time consumed of both alternatives started from program development (program modification or program written) until the system works. The time consumed in man-hours of modified standard package is summarized in table 15. From this table, the total time consumed is 960 man-hours, which is about 6 manmonths (from working time: 8 hours per day, 5 days per week, 4 weeks per month). For tailor made package, there are 39 programs involved in inventory control of THS. The actual time consumed on the tailor-made package of only inventory control cannot be obtained but the time consumed can be estimated by two methods:

(a) The estimated rate of writing of THS is about 1 man/month/programme. Then, the time consumed to develop programs for inventory control is 39 man/months.

(b) The total time consumed to develop the THS S/P management system which are S/P inventory control, S/P purchasing, and the total number of programs of this system is 90. The time consumed to tailor-make the package can be estimated as shown in table 16 at about 28 man/months.

Figure XI. Results of the modified standard package compared to results of tailor made for each activity of inventory control and their conclusions

No.	Activity	Tailor made Package Results	Modified STD package Results	Conclusion of STD compared to Tailor made
1	Cash sales operation	excellent	Good	Applicable
	1) Order receipt & check	Easy	Easy	Excellent
	2) Inquiry:			
	- Stock status	Fast	Fast but	STD required
	- Item master & I/C		complex	time to
	- Item price			operate
	3) Order entry	Very easy	Very easy	Excellent
	4) Daily booking	Fast & easy	Fast & easy for group of order	STD can be used but it wastes paper
	5) Invoice print	Easy for one or more invoices	Efficient for a no. of invoices	Applicable
	6) Invoice update	Fast & automatic	Fast & automatic	Applicable
2	Credit sales operation	Excellent	Good	Applicable
3	Modification & cancellation of order	Excellent	Very good	Very good
4	Interface with the other systems	Excellent	Very good	Very good
5	Local Stock Entry:	Excellent	Good	STD consumed unnecessary CPU
	1) Invoice approbation	Very easy	Very easy	Very good
	2) Check, store & sign	Very easy	Easy	S/P check is difficult due to non case openning guide.
	3) Data entry (orders, receipt,etc.)	Easy & very easy	Easy & fast	STD consumed more CPU time
	4) Report (order, etc.)	Batch at any time	Run after finishing	STD required good scheduling

Figure XI (continued)

No.	Activity	Tailor made Package Results	Modified STD package Results	Conclusion of STD compared to Tailor made
6	Import Stock Entry:	Very good	Fair	STD can be used but slow
	1) Case opening guide report	Very good	Poor	No case-key sorted report
	2) Report of new s/p	Very good	Not available	No such fns. for STD
	3) Item check, store & update stock card	Very good	Good	Slow for STD due to no case openning guide
	4) Report	Fast	Fast	Good
7	On-board or Shipping data entry:	Very good	Fair	Complex for STD
	1) Stock entry	Easy & fast	Slower& easy	STD required more CPU time
	2) Report & check	Easy	Easy	Good
8	On-board Stock Status and report	Excellent	Good	Applicable
	1) On-board list	Excellent	Very good	STD give fewer details
9	Stock Control & Report:	Very good	Very good	Very good
	1) Stock status report	Very good	Very good	Very good
	2) Inventory status inquiry	Very good	Very good	Very good
	3) Inventory valuation	Very good	Very good	Very good
	4) Inventory list	Very good	Very good	Very good
	5) Price list	Very good	Very good	Very good
	6) On-hand list	Very good	Very good	Very good
	7) Physical count	Very good	Very good	Very good
	8) Price change	Very good	Very good	Very good
10	File Maintenance & listing:	Very good	Very good	Very good
	1) Fix company information	-	Very good	Unnecessary for THS
	2) Customer file	Very good	Very good	Very good
	3) Salemans file	-	Very good	unnecessary for both
	4) Tax file	-	Very good	Unnecessary
	5) Warehouse file	-	Very good	Necessary for STD
	6) Item & warehouse file	Very good	Good	Not enough details for STD
	7) Price file	Very good	Good	Same as (6)

Table 15. Time consumed to partially modified standard package

Step	Modified programmes		Time Consumed (Man-hours)
	BASIC	SMART	
Item and warehouse item file maintenance for data entry	1		320
Item and warehouse item file maintenance for inquiry	1		80
Item price file maintenance for inquiry	1		80
Stock status inquiry	1		80
Smart utility for report generation		1	80
Recompile all the programmes consisting modified data files			80
Prepare and entry collected data			80
Test run and modify operation			160
Total	4	1	960

Table 16. Time consumed to tailor made package of the whole spare parts management system of THS

Step	Time Required (months)	Personnel required	Time consumed (Man-months)
Program specification	3	1 Electron data processing 1 Systems engineer 2 Local programmers 2 Non-local programmers	3x6=18
Programme coding	3	As above	3x6=18
Test run	4	1 Electron data processing 1 Systems engineer 2 Local programmers 1 Operator 2 Key punchers	4x7=28
Total	10		64

The total time consumed to develop the spare parts management system (spare parts inventory control, spare parts sales and spare parts purchasing) of THS is 64 man-months. There are 90 programs including 15 programs written by system engineer, 18 programs written by THS and 57 programs written by NEC. As there are only 39 programs involved in inventory control of THS, thus, the time consumed for inventory control program development is (64 man-months), 39/90 of which is about 28 man-months.

Conclusions

In conclusion, analysis of the present spare parts sections of THS using the tailor made software shows that management and the users are satisfied with the performance of the computerized system. The reasons for this are:

(a) The spare parts management is completely successful due to good system analysis by system engineers form Japan with good prior experience, as well as good planning of introducing the computer;

(b) There are very few problems in THS because of good planning. However, it still faced the problems of Electron data processing personnel and the operation of the computer because of the slow speed and not enough time to do programme maintenance;

(c) New applications were introduced with support from Japan;

(d) THS are hiring high salary experienced system engineers from Japan instead of hiring inexperienced personnel with low salary.

For the inventory control of THS:

(a) The inventory control of THS is very well designed, especially the interfacing to the other functions such as the use of diskettes for shipping invoice entry to reduce data entry time;

(b) The inventory control of THS is a specific system and the use in nature of a data entry machine is better than use of the CRT.

The partially modified standard package can be used instead of the tailormade package of THS inventory control. The modified package provides all necessary information either directly or indirectly.

The time consumed to the modified standard package is much less than the time consumed to tailor make a package for THS inventory control. For inventory control it is better for THS to select standard package for their system.

For simple inventory control the standard package with or without modification can be applied.

In order to computerize any system, the steps of program development should be followed, then the best alternative should be selected.

IV. CONSENSUS REACHED AT THE WORKSHOP ON IMPROVED INDUSTRIAL MANAGEMENT THROUGH COMPUTER SUPPORT

The workshop was arranged at the completion of the UNIDO Project US/RAS/78/202, a joint project by Asian Institute of Technology (AIT) and the United Nations Industrial Development Organization (UNIDO). Thirty-seven participants from 9 countries in Asia representing governments and industry were gathered for the five-day workshop at AIT. The programme of the Workshop is given in annex XI. Two of the documentary contributions to the Workshop are reproduced in annexes XII and XIII.

The objectives of the workshop were:

(a) To promote the exchange of ideas and experience between the users of small-scale computers;

(b) To evaluate the project undertaken by AIT/UNIDO;

(c) To reach a consensus on the critical factors for the successful use of small-scale computers in industrial management and to establish recommendations for further work by the governments, by UNIDO and by local institutions in order to meet the needs of the industry in the region.

The Workshop reached conclusions that the area must be analysed with the following priorities in mind:

User needs and requirements

Software, especially application oriented software

Computer vendors, their service and support

Hardware

The Workshop reached a consensus on the following needs for three of these areas:

For users

Qualified training of the user

Qualified personnel

Active top management interest and involvement

Professional documentation from both computer vendor and of in-house developed software

Qualified consulting service offered to user.

For software

Qualified training

Qualified consulting service and support

For computer vendors

Expertise available locally to handle vendor's products

Support from the vendors

Training in the products and their use to be provided by the vendors

Critical conditions

From the above, several common denominators and overlapping needs were found. By combining these common requirement areas the major bottlenecks to the successful use of computers in industrial management in southeast Asia were found to be:

Lack of training

Lack of top management interest and involvement

Lack of available qualified consultants' service

Lack of professional documentation

Recommendations

Based upon the consensus reached on the four major problem areas, the Workshop established the more detailed and specific requirements for each area and concluded in the following recommendations. For training, the categories of personnel are in order of priority:

System analysts

Programmers

Operators

System supervisors, on the operational level and EDP managers and consultant instructors on the management and support level

The following plan for providing this training is recommended:

The system analyst should have a good theoretical background (B.Sc.) and special courses of one year duration must be established at national level to provide the required training.

The system supervisor who is recruited from the experienced operators must have 2 weeks of special training from the computer vendors.

EDP managers and consultants/instructors should be offered special in-depth training through courses of 4-8 months duration on a regional level.

It is strongly recommended that UNIDO take an active part in establishing such programmes. In order to give professional assistance and support to the manufacturing industry in their effort to take computers into use for management support, national Consultancy and Training Centres should be established.

It is recommended that UNIDO should play a key role in establishing such centres in assisting the set up and providing the key experts to get such centres off the ground. Such consultancy and training centres could be established along the following lines:

The centres could be organized on a national basis. They should cover the "total" area of system analysis, establishing user requirements, software development/customizing systems operation and training/installation. (Vertical integration of expertise.)

They may be attached to or be part of established (governmental) institutions experienced in software development, customizing systems analysis.

It is recommended that UNIDO establish such a "Consultancy and Training Centre" jointly with AIT, taking advantage of the work done during the present project, the contacts established and the resources and expertise of AIT in management, computers and software.

AIT could be the focal point in the region, providing the facilities on a regional level, and also serving as a back-up for the national "centres".

Possible "partners" with UNIDO in the other ASEAN countries for setting up Consultancy and Training Centres are:

Indonesia - The Surabaya Institute of Technology, and The Management and Computer Application Education Centre of the University of Indonesia, Jakarta.

Malaysia - Malaysian Institute of Management

Singapore - National Productivity Board or Singapore Institute of Management

Philippines - Technical Resource Centre

The need for better documentation should be eased by specific demands to the computer vendor to provide the needed documentation at the time of purchase and information services about available application software packages to the users should be provided from the Consultancy and Training Centres.

Annex I

TRAINING AND EDUCATION IN COMPUTER APPLICATIONS

AT THE ASIAN INSTITUTE OF TECHNOLOGY

AIT started to use the IBM 1620 computer at Chulalongkorn University in Bangkok in 1965. In 1967 AIT rented an IBM 1130, the successor of 1620, so that students could have more computer time for their research. Ninety per cent of AIT students, use the computer in their course work assignments, special studies, and thesis work. Within six years after the installation of the IBM 1130, the machine was running 24 hours a day, seven days a week, with a turn-around time of five days. AIT solved this problem by installing a CDC 3600 - a gift of the Government of the United States of America - in 1974.

It did not take a long time for AIT to fully load the CDC 3600 with its expanding research works. To help meet its needs for better and more modern computer technology, AIT founded the Regional Computer Centre (RCC) in 1975. The RCC was established as the result of a unique, five year partnership between an educational institution (AIT), a non-profit foundation (the AIT Foundation), a multi-national corporation (IBM World Trade Americas/Far East Corporation (IBM A/FE)) and a government agency (the United States Agency for Internation Development (USAID)).

The building of the RCC, which was provided by USAID, initially housed an IBM System/370 Model 145 running under VM/370. There were 23 terminals, a high speed printer, four magnetic tape drives, a card reader, a card punch, a diskette reader/writer and 1260 million bytes of on-line disk storage.

At the end of 1979 AIT has renewed another five year partnership programme with IBM A/FE. Early 1981 the IBM System 370/145 has been upgraded to IBM System 3031 Model 6.

Another high speed printer and 32 terminals were added to the system while the disk storage was increased to 2,520 million bytes.
RCC also has an off-line Watanabe Plotter which was contributed to AIT by the Government of Japan, a Tektronix 618 graphic terminal, and an NEC 100/40 minicomputer donated by UNIDO.

RCC maintains a large and growing library of software including data base and information retrieval systems, mathematical, statistical and simulation packages, planning aids and applications packages covering many important areas of computer usage.

PCAD training programmes

The main purpose of the RCC is to give the computing services to the students and faculty of AIT and to offer such services to other governmental and international agencies. Knowing that the lack of trained computer personnel is a major problem in this region, the RCC started its training programmes called Programmes in Computer Application Development (PCAD) in 1976. PCAD provides tailor-made, practical instructions in the use of the computer as a tool for the problem-solving process.

PCAD programmes are classified into three different programmes:

Programme A: Training to adapt the use of specific software packages to develop applications that meet particular needs.

Programme B: Training to use advanced application development technolgies to develop specific programmes for use when trainees return to their agency.

Programme C: General training in the development of computer applications.

Programmes A and B can vary in length from several weeks to several months, depending upon the application to be developed. Programme C is of 15 weeks duration with 8-9 weeks of formal instruction and 6-7 weeks practice.

The instruction which forms the core of Programme C is offered three times each year, in early January, May and September in accordance with the start of each of AIT's three academic terms. The content varies according to the needs of the participants registered to the needs of the participants registered in a given term.

Participants in the PCAD come with different levels of computer competence, from no background at all to several years of programming and analysis experience. Table XVII gives sample schedules for instruction. The topics shown would be appropriate for an experienced computer user.

In addition to the basic schedule of instruction, typical lectures of interest to the participants are organized during each term. These may cover specific applications or specific software packages in more depth than is otherwise available in the schedule.

Division of computer applications

As of December 1981, the PCAD has drawn about 200 participants from 13 countries. The immediate success of PCAD pushed AIT to consider the needs of the region for a formal education in computer applications. Recognizing the increasingly significant role that computers are playing in Asia, AIT commenced a graduate programme in the field of computer applications in January 1979. The new Division concentrates on user-oriented education and on applied research, seeking practical ways in which computers can be utilized most effectively in the Asian environment. Research applications already chosen for analysis and design of information systems, or for design and implementation of data bases, or for simulation on small computer systems, demonstrate the interest in Asian solutions to Asian problems (1, 2 and 3).

Curriculum

Students admitted to the Division of Computer Applications have different backgrounds. Some are engineering graduates, some mathematicians, some statisticians, some accountants, some social scientists, etc. Applications are welcomed from all fields of study.

Although the emphasis of the instruction is on the applications and not in the design of a computer, several basic courses are required to lay down strong foundation of computer technology for students. It is not possible for anyone to apply a computer to an organization without knowledge of computer suitability, capability and functions, etc. With this reasoning and functions, etc. With this reasoning, the curriculum of DCA is designed to have two parts. The required courses which all students must take are:

(a) Applied statistics. Basic probability concepts, useful distributions, estimation theory, statistical tests, regression and correlation, analysis of variance, factorial experiments;

(b) Numerical analysis. Errors, Taylor series, non-linear equations, linear algebraic systems, interpolation and calculus, solution of differential

equations, computer implementation of basic algorithms, and use of software packages;

(c) Software concepts. Overview of high level programming languages, introduction to structured programming and stepwise refinement approach to problem solving, PL/I programming basis, structured programming, the flowchart theorem, topdown approach to programme design, coding testing and documentation, programme debugging, operating system-job control and file organization, advanced file processing and PL/I programming techniques;

(d) Information systems analysis and design. Data and information, data processing problem statements, system flowcharts, components of an organizations information system, steps involved in information system design, data acquisition and classification methods, error detecting coding systems, file organization techniques, file access methods, introduction to database management systems, programming language: COBOL;

(e) Mathematical foundation of computing. Mathematical logic, set theory, representation of discrete structures, relations, ordering, functions, natural numbers and recursion, algebraic structures, graph theory, representation, introduction to computability theory;

(f) Discrete and continuous system. Modelling techniques and computer simulation, continuous systems, CSMP and DYNAMO, discrete systems, GPSS, optimization.

The second part of the curriculum includes those courses which are selective based on the student background and future planning. These are:

(a) Software engineering. Software project management, life cycle, specification, design, documentation, maintenance and control. Operating systems, batch processing, time sharing, multiprocessing and interactive processing. Performance and comparative study;

(b) Data structures. Linear Data Structures, arrays, stocks, queues, sequential and linked storage allocation, storage and manipulation of trees, heaps, binary search trees, balanced trees, AVL trees, B-trees, VSAM, trees, tables, stringa, sorting and searching;

(c) Programming languages. High level languages, variables and declarations, data structures, expressions and assignments, sequencing and control, input-output, subroutines and procedures, commonly used languages like COBOL, FORTRAN, PL/I, APL, PASCAL, BASIC, RPG, etc.;

(d) Data management and data base. Data base management, data base concepts and architecture, data models and sub-languages, relational, hierarchial and network data bases, distributed data bases, security and integrity, data base design;

(e) Information storage and retrieval. Characteristics of non-numeric data, standard methods for information retrieval, interactive query systems, bibliographic applications, storage and retrieval design study;

(f) Computer organizations and architecture. Computer system organization, Assembly language, storage hierarchies, virtual machine environment, multi-programming and multi-processing, teleprocessing, computer networks, micro-processors;

(g) Computer centre operations. Functions of a computer centre, computer operations, systems engineering and programming, performance measurement, accounting systems, documentation, personnel management and training, organization;

(h) Social implications of computer technology. Use of computers in Asia and Western countries, the computing industry in Asia and government policy, computer impact on employment and privacy, impact on education, protection of software, people oriented computer technology, philosophical aspects, future developments;

(i) Advanced applied statistics. Multivariate distributions, preliminary data analysis, principal component and factor analysis, multivariate analysis or variance, multidimensional scaling and cluster analysis;

(j) Stochastic processes. Probability and conditional probability, moments and characteristic functions, Bernoulli and Poisson processes, Markov chains, time series analysis, modelling and forecasting.

In addition to the courses offered by the Division, students may take courses offered by other divisions too. Some of these courses are, Introduction to Operations Research, Introduction to Systems Engineering, Instrumentation and Measurement Techniques, Introduction to System Dynamics and Management Concepts and Methods.

Research

Research activities undertaken in the Division are in the form of special studies, master's thesis, doctoral dissertations, and contract research. Current research areas include:

Development of DBMS for small computers
Design and implementation of MIS public utility and government organications (Provincial Water Works Authority in Thailand, Bureau of Mines and Geosciences in the Philippines, for example)
Text Processing for Thai Language
Water Resources Decision Support System
Development of mathematical and statistical software
Computer simulation
Computer applications in universities
Computer graphics
Microprocessor and microcomputer applications
Computer analysis of remotely sensed data

Continuing education

The RCC and DCA are the pioneers in offering the continuing education to the computer staff in the region. Each year about five seminars, short courses, and conferences on various computer technology topics are organized to take place in the campus. These programmes not only keep the practitioners informed of new development but also give them opportunities to meet and exchange ideas in improving the usage of computers in their organizations.

Frequent seminars are:

Information System Analysis and Design

Managing Computer Centres

Data Base Management

Software Engineering

Other seminars are:

Foundation for Data Base Security and Integrity (January 1982)

Mathematical Software (August 1981)

Computer Graphics (To be scheduled)

Data Base Design and Implementation (To be scheduled)

Alumni

To date (January 1982) the DCA has produced only two graduating classes. There are altogether 48 masters as shown below.

Table 17. Sample instructional schedules programmes in computer application development

Topic/Subject	Days of Instruction Schedule[a/]	Schedule[b/]
Computer concepts Introduction to computing and computers	5	
RCC facilities orientation		3
Data collection and preparation Data recording devices and media	2	2
Programming language, chosen from APL, COBOL, FORTRAN, and PL/I	15	15
Software engineering for application Top-down analysis and design of applications programmes, structured programming, testing, maintenance, and documentation	10	10
Project management Techniques for managing application development		5
System design		3

Data organization Files and file organization	2	
Data bases Data models and data base management	5	5
Batch and interactive programming		2
System languages Batch and interactive	5	
Computer centre management		5

a/ Schedule A is appropriate for computer users with relatively little experience with modern computing machinery and programming.

b/ Schedule B is appropriate for more experienced programmers and users.

Graduates of DCA

Countries or areas	Graduates 1980	Graduates 1981
Bangladesh	2	1
India	2	2
Indonesia	-	2
Iran (Islamic Republic of)	1	-
Malaysia	3	1
Nepal	1	-
Pakistan	-	2
Philippines	2	3
Sri Lanka	2	3
Thailand	9	8
Other asia	2	2
Total	24	24

References

1. AIT, Research Summary August 1979 (Bangkok, Division of Computer Applications, August 1980).

2. K. Malaivongs, "Combating staff piracy by continued education", Asian Computer Yearbook 1981-1982 (Hong Kong, Computer Publications, Ltd.).

3. J.A. Jordan, "Computing education for the developing Asian countries", Computer, June 1980.

Annex II

ORIENTATION SEMINAR ON COMPUTER SUPPORTED INDUSTRIAL MANAGEMENT

FIRST DAY - Morning

INFORMATION AND MANAGEMENT

- Information as a Product
- Basic Management Functions
- Role of Information for Decision Making

TRENDS IN COMPUTING

Past, Present and Future of

- Hardware Technology
- Software Technology
- Computer Applications

Afternoon

MANAGEMENT INFORMATION SYSTEMS (MIS)

- Every Organization has Information Systems
- Concept of MIS
- Approaches to MIS Development

DATA PROCESSING CONSIDERATION

- Elements and Techniques of DP
- Data Structures and Relations
- Data Base Systems

SECOND DAY Morning

APPROACHES TO COMPUTERIZATION

- General Systems Design
- Over view of Available Software Packages for Production Control
- Hardware and Software Selection

EDP ORGANIZATION AND STAFFING

- Organization Structure
- Personnel Management

Afternoon

PHASE -IN

- Selection and Sequence of Functions to be Automated
- Scheduled for Phase-in of Computer Support
- Parallel Operations

SECOND DAY — Afternoon (cont.)

EMERGENCY PLANNING

- Restart Operations
- Manual Back-up Operations

THIRD DAY — Morning

CASE STUDY I

- Selected Management Operation, e.g.Material Management in an electronic manufacturing company
- Emergency Operations During Computer Failures; Audits and Traces

Afternoon

DEMONSTRATION

on Minicomputer

FOURTH DAY — Morning

CASE STUDY II

- Example of Information Retrieval

Afternoon

DEMONSTRATION

on Minicomputer
General Discussion Session

FIFTH DAY — FIELD TRIP

Annex III

LIST OF SELECTED COMPANIES

Indonesia (8 companies)

Adiguna Shipyard Pt,
Ancol Baru, Tg. Priok,
Jakarta,

Allbest Pt,
Jl. Rawabali,
11/9 Pulo Gadung,
Jakarta,

Brantas Project,
Jl. Surabaya 2A, Malang, Jawa Timur,

National Institute for Instrumentation Lipi,
Jl. Sangkuriang, Bandung,

Pembangunan Jaya Pt,
Gedung Jaya, Jl. M.H. Thamrin,
Jakarta Pusat,

State Electricity Corporation,
Electric Power Research Centre,
P.O. Box 1, KBYT,
Jakarta Selaton,

Tira Fashion Pt,
Jl. Sunter II, Jakarta, Utara,
P.O. Box 4268 JKT, Jakarta,

Yala Persada Angkasa Pt,
Room 209, 2nd Floor Barito Plaza,
Jl. Melawai Raya 93,
Kebayoran Baru, Jakarta,

Malaysia (11 companies)

Bata (Malaysia) Bhd,
Kapar Road,
P.O. 38 Kelang, Selangor,

Beecham Products (Far East) Sdn. Bhd.,
P.O. Box 15,
Petaling Jaya, Selangor,

Dragon & Phoenix Bhd.,
166A Rifle Range Road, Penang,

Dunlog Malaysian Industries Bhd.,
4 Jalan Tandang,
P.O. Box 66, Petaling,
Jala, Selangor,

Eastern Plantation Agency (Johore) Sdn. Bhd.,
Ulu Tiram Tiram Estate,
Ulu Tiram, Jehore Bahru,

Hume Industires (Malaysia) Bhd.,
Jalan 219, off Federal Highway,
P.O. Box 21, Petaling Jaya, Selangor,

Jabatan Kerju Raya,
Ibu Pejabat Persekutuan, JKR,
Jalan Tun Ismail, Kuala Lumpur,

Johnson Shoes Bhd.,
18th Floor Kompleks Kewangan,
Jalan Raja Chulan,
Kuala Lumpur, Selangor,

Jurukur Perunding Services Sdn. Bhd.,
6.11, 6th Floor, Wisma Central,
Jlan. Ampang, Juala Lumpur,

Malaysian Rubber Development Corporation,
Jalan Kerja Air Lama,
Ulu Kelang, Selangor,

Malaysian Rubber Exchange and Licensing Board,
6th/7th Floors, Bangunan Hong Leong,
P.O. Box 531, Kuala Lumpur,

Philippines (17 companies)

AHS Philippines Inc.,
1 Pioneer Street, Mandaluyong,
Rizal, Manila.

Alfa Integrated Textile Mills Inc.,
5th Floor, SL Building,
Roxas Boulevard, Ermita, Manila,

Allied Thread Co., Inc.,
Maybunga, Pasig, Metro Manila,

Alhambra Industries Inc.,
31 Tayuman Street,
Tondo, Manila,

Benguet Consolidated Inc.,
Pasong Tamo Ext,
Makati, Metro Manila,

Border Machinery and Heavy Equipment Co., Inc.,
Makati, Metro Manila,

Bureau of Coast and Geodetic Survey,
421 Baracca Street, San Nicolars, Manila,

BATELCO, Bataan,

Bayer Philippines Inc.,
3rd Floor Equitable Bank Building,
Ortigas Avenue, Corner Roosevelt Greenhills,
San Juan, Metro Manila,

Izuparts Center,
Rizal Avenue Ext,
Caloocan City,

Jackbilt Concrete Block Co., Inc.,
Calle Industria, Quezon City,
Metro Manila,

Permaline Container Corporation,
111 E. Rodriquez Sr. Boulevard,
Quezon City,

Phil Coconut Producers Federation,
Lorenzo Building, Quezon City,

Squibb E.R. & Sons Philippines Corp.,
Pasong Tamo, Makati, Metro Manila,

Steniel Manufacturing Corporation,
KM. 22, Ortigas Avenue Extension,
Cainta, Rizal,

Stresstek Post-Tensioning Phils Inc.,
Zeta Building, Salcedo Street,
Legaspi Village, Makati, Metro Manila,

Atlas Consolidated Mining & Development Corporation,
Bo. Das, Toledo City, Cebu,

Singapore (3 companies)

ACE (Singapore) Pte Ltd.,
82B Block 4 Boon Keng Road,

ACMA Electrical Industries Ltd.,
No. 9, Gul Circle, Jurong Town,

Cameron Iron Works Pte Ltd.,
2 Gul Circle,

Annex IV

QUESTIONNAIRE

USE OF SMALL-SCALE COMPUTERS IN INDUSTRIAL MANAGEMENT

Project: UNIDO-US/RAS/78/202

UNIDO and Asian Institute of Technology are jointly making a state of the art survey of the use of small-scale computers (micro-mini-midi computers) in industrial management in the ASEAN region.

We would appreciate if you would be kind enough to answer as many of the questions in this questionnaire as possible, and return the questionnaire to:

Mr. Per Hovde,
Regional Computer Center,
Asian Institute of Technology,
P.O. Box 2754,
Bangkok, THAILAND.

1. GENERAL INFORMATION ABOUT YOUR COMPANY

1.1 Name of company:
1.2 Address (in full):
1.3 Telephone:
1.4 Company's type of business:
1.5 Name of contact person:
1.6 Number of employees in total:
1.7 Number of employees in staff function:
1.8 Number of employees in line function:
1.9 Number of employees in computer operations:
1.10 Company sales (turn over) in US$:
In 1979 US$ ..... In 1980 US$ .....

2. SMALL-SCALE COMPUTER AND SOFTWARE

2.1 Type(s) of small-scale computer(s) in your company:

2.2 Name of supplier/vendor:
2.3 Time of computer installation:
2.4 Computer configuration:

2.5 Do you have a maintenance contract

on Hardware?:
on Software?:

3. PRESENT USE OF SMALL-SCALE COMPUTER IN YOUR COMPANY IS IN:
(Please mark as relevant.)

3.1 Administrative Data Processing (ADP)

- Accounting - Budgetting - Personnel
- Payroll - Accounts Receivable - Accounts Payable
- Other (specify)

3.2 Material and Production Systems (MPS)

- Sales Order - Requirements Planning
- Master Production Plan
- Purchasing - Inventory - Other (specify)

3.3 Computer Aided Design (CAD)

- Design/Analysis - Simulation
- Generation of production specifications
- Generation of production drawings
- Other (specify)

3.4 Computer Aided Manufacturing (CAM)

- Process Planning - Operations Planning
- Automated Production - Other (specify)

3.5 Other Use of Small-scale Computer

4. APPLICATION SOFTWARE

4.1 The user (application) software specified under para 3. above are:

- standard packages available from the computer supplier .....
- standard packages available from a software house .....
- specially developed taylor-made packages by .....
- other (specify)

4.2 In what computer language are the application package(s) written?

- Assembly - COBOL - BASIC - FORTRAN - Other (specify)

5. PERFORMANCE

5.1 Have the implementation of the computer system been successful?

5.2 Is the hardware (the computer) operating satisfactorily?

5.3 Is the application software operating satisfactorily?

5.4 Which of your applications of the computer is the best investment?

5.5 Are you planning to increase the use of computer systems in your company in 1981-1982?

5.6 In what area of your business/activities will you then take the computer into use?

6. PROBLEM AREAS

List down the type of problems and shortcomings that you have encountered so far in using computers in your company.
(examples of problems; lack of vendor support, insufficient documentation, etc.)

THANK YOU

COMPANY CODE ASSUMED	NAME OF COMPANY	TOTAL EMPLOYEE	STAFF	LINE	COMPUTER OPERATION	COMPANY SALES 1979 1980
T-1	Atlantic Co., Ltd., [Manufacturer]	300	...	...	2	... ...
T-2	Tanin Industrial Co., Ltd. [Manufacturer]	1,600	...	...	4	$25m $30m
T-3	Lever Brothers (Thailand Ltd. [Manufacturer]	1,400	300	250	6	$65m $81m
T-4	Laemthong Corporation Ltd. [Manufacturer]	770	69	701	9	$55m $78.5m
T-5	American Standard Sanitaryware (Thailand) Ltd. [Manufacturer]	400	115	285	7	$5.7m $7.2m
T-6	Thai Hino Motors Sales Ltd. [Sales and Services]	750 (about)	7	470 (about)	7	... ...
T-7	Warner-Lambert (Thailand) Ltd. [Manufacturing]	249	133	106	3	... ...
T-8	Fedders (Thailand) Ltd. [Manufacturer]	700	...	...	5	$12m $16m
M-1	Bata (Malaysia) Berhad [Manufacturing]	2,093	147	1,946	7	$31.7m $36.5m
M-2	Malaysian Rubber Development Corporation [Rubber Processing]	2,000	300	1,700	10	$120m $100m
M-3	Johnson Shoe Berhad [Manufacturer]	200	18	180	2	$4.9m $5.9m
M-4	Beecham Products (Far East) Sdn. Bhd. [Manufacturing]	300	53	244	3	$25m $30m

COMPANY CODE ASSUMED	NAME OF COMPANY	TOTAL EMPLOYEE	STAFF	LINE	COMPUTER OPERATION	COMPANY SALES 1979 1980
M-5	Public Works Department (Government Department) [Engineering Design and Construction]	...	...	...	11	... ...
M-6	Hume Industries (M) Berhad [Manufacturing]	1,200	...	...	6	$29m $37m
I-1	Tira Fashion Pt. [Manufacturing]	830	...	...	3	... ...
I-2	State Electricity Corporation, Electric Power Research Centre [Electric Power Research]	286	28	27	15	... ...
I-3	Pt. Pembangunan Jaya [Contacting, Real Estate Construction]	850	670	180	8	$28m $42m
I-4	Brantas Project [Government]	5,970	19	17	16	... ...
S-1	A.C.E. (Singapore) Pte. Ltd. [Air Conditioning Contracting and Sales]	...	...	...	3	$1.5m $2.7m
S-2	ACMA Electrical Industries Ltd. [Manufacturing]	1,015	120	895	4	$33m $35m

COMPANY CODE ASSUMED	NAME OF COMPANY	TOTAL EMPLOYEE	STAFF	LINE	COMPUTER OPERATION	COMPANY SALES 1979 1980
S-3	Sampoerna Holding S.E.A. (PTE) Ltd. [Investment Holding]	2,000	50	1,500	13	... ...
S-4	Sanyo Electronics(s) Pte. Ltd. [Manufacturing]	2,255	1,815	440	13	... ...
P-1	E.R. Squibb & Sons Philippines Corporation [Manufacturing]	269	30	239	4	$8.061m $9.12m
P-2	Benguet Corporation [Mining]	10,147	747	9,400	20	$29.64m
P-3	Alhambra Industries Inc. [Manufacturing]	769	15	10	10	... ...
P-4	Bormacheco, Inc. [Rent, Reconditioning, Overhaul]	280			5	... ...
P-5	Permaline Container Corporation [Manufacturing]	599	23	576	2	$5.7m $6.9m
P-6	Steniel Manufacturing Corporation [Manufacturing]	600	200	400	4	$18m $20m
P-7	Johnson & Johnson (Philippines) Incorporated [Manufacturing]	1,100	...	...	...	... ...
P-8	American Hospital Supply/ Philippines Inc. [Manufacturing, Health Products]	500-600	...	...	13	... ...
P-9	Izupartz Center Inc. [Automotive Spare Parts (Import, Wholesale, Retailer)]	31	4	27	3	$1.269m $0.9m
P-10	Atlas Consolidated Mining & Development Corporation [Mining]	11,000	1,400	9,600	70	... ...

COMPANY	TYPE OF COMPUTER	NAME OF SUPPLIER	DATE OF COMPUTER INSTALLATION	COMPUTER CONFIGURATION	MAINTENANCE CONTRACT Hard-ware	Soft-ware
T-1	IBM/System3	IBM	1974	CPU, MFCU PRT, PUNCH CARD	Y	N
T-2	NCR I-8250	Messrs Kian Gwan Thailand Co. Ltd.	1980	128K Bytes Mos, 9.8 MB (4.9 MB fixed & 4.9 MB removable)	Y	Y
T-3	IBM System 3 (Digital, Disk operating System)	IBM Thailand Co. Ltd.	January 1979	32 KB	Y	N
T-4	WANG 2200VS	Kriangpat Co.,Ltd.	1979	128 KB, Disk 10 MB	Y	Y
T-5	IBM System 34	IBM	October 1980	96 KB, 27.1 MB	Y	N
T-6	NEC System 100	Datamat Co., Ltd.	1978	-	Y	N
T-7	IBM System 34	IBM Thailand Co.,	1980	96K, Disk 63.9 MB	Y	N
T-8	IBM System 34	IBM	June 1980	128 K,memory 64 MB Fixed Disk	Y	Y
M-1	IBM System 3 Model 12	IBM	1976	CPU (96K) PRT, Data Sta. DASD, Printer keyboard	Y	N

COMPANY	TYPES OF COMPUTER	NAME OF SUPPLIER	DATE OF COMPUTER INSTALLATION	COMPUTER CONFIGURATION	MAINTENANCE CONTRACT Hard-ware	Soft-ware
M-2	NCR 8200	NCR (Malaysia) Son. BHP	1976	CPU (80K), Printer Disk Drive (5 MB)	Y	N
M-3	Data Point 1500	Oriental Data Systems(M) Son.PHD	January 1981	36 K memory	Y	Y
M-4	IBM System 34	IBM	January 1979	128 K, Disk (fixed) 64 MB, Line Printer one console, 4 VDU	Y	N
M-5	NOVA 840	Data Central	March 1977	176 KB memory Disk pack drive 96 MB, 10 VDU Printer	Y	N
M-6	IBM System 34	IBM	November 1978	64 KB memory 64 MB Disk	Y	Y
I-1	Wang PCS II	Wang	October 1978	32 KB	Y	N
I-2	H.P. 9845A	Berca Indonesia PT	1978		N	N
I-3	Wang 2200	P.T. Metro data Indonesia	1979		Y	N
I-4	Wang 2200	P.T. Metro data Indonesia	1975		Y	N

COMPANY	TYPES OF COMPUTER	NAME OF SUPPLIER	DATE OF COMPUTER INSTALLATION	COMPUTER CONFIGURATION	MAINTENANCE CONTRACT	
					Hard-ware	Soft-ware
S-1	Datapoint 5500	Oriental data Systems (Singapore)	October 1977	5500 CPU, 3 VDU	Y	N
S-2	Datapoint 2200	Oriental Data System	1976	16 K, CPU, 2 VDU	Y	N
S-3	Texas Instrument	Texas Instrument	1977		N	N
S-4	NEC System 100-F	NEC	April 1977		Y	N
P-1	IBM System 34	IBM Philippines	September 1980	64K memory, 3 VDU	Y	N
P-2	ICL 2903/35 ICL 2903/40	FLORO Enterprice Inc.	November 1978		Y	N
P-3	IBM System 34	IBM Philippines	December 1980		Y	Y
P-4	Basic-Four 200	MAI, Philippines Inc.	March 1978	32 K (CPU) Fixed 10 MB, 1 VDU	Y	N
P-5	Wang	Wang	January 1978	8 K (CPU)	Y	N
P-6	DEC PDP 11/44	Decision System Corporation	November 1979	256 K memory, 10 MB Disk drive, 5 CRT Terminal	Y	Y
P-7	IBM System 34	IBM	1972	256 K memory, 256 MB Disk, 5 online terminal	Y	Y

COMPANY	TYPES OF COMPUTER	NAME OF SUPPLIER	DATE OF COMPUTER INSTALLATION	COMPUTER CONFIGURATION	MAINTENANCE CONTRACT	
					Hard-ware	Soft-ware
P-8	Basic/Four System 610	MAI/Philippines Inc.	August 1979	96 KB memory, 35 MB disk pack drive, 7 VDU	Y	N
P-9	ICL System 10	International Computers Ltd.	April 1979	2 disk drive, Processor Line Printer	Y	N
P-10	NOVA 3/D	Dataprep, Philippines.	December 1977	160 KB memory, 192 MB disk, 2 tape drive 2 CRT	Y	N

Y = Yes
N = No

USER SOFTWARE SUPPLY					LANGUAGE				
COMPANY	SPACS*	SPAFSH*	STM*	OTHERS	ASSEMBLY	COBOL	RPG-II	BASIC	FORTRAN
T-1	X(IBM)	...	...	...	...	...	X	...	...
T-2	X	X	...	...	...	X	...	...	...
T-3	No Reply				...	X	...	...	...
T-4	X	...	X	...	...	X	...	X	...
T-5	...	...	...	Developed by company's EDP personnel	...	...	X	...	...
T-6	No Reply				...	X	...	...	...
T-7	...	...	X	Developed locally	...	...	X	...	...
T-8	X(IBM)	...	...	Developed locally	...	...	X	X	...
M-1	...	...	Bata Limited Toronto Canada		...	X	X	...	...
M-2	...	...	...	Locally Developed	...	X	...	...	...
M-3	...	...	O.D.S.(M) SDN BHD	...	...	...	...	X	...
M-4	X	...	...	Locally Developed	...	...	X	...	...
M-5	...	...	X	X	...	...	...	...	X
M-6	...	...	...	Locally Developed	...	...	X	...	...

USER SOFTWARE SUPPLY					LANGUAGE				
COMPANY	SPACES*	SPAFSH*	STM*	OTHERS	ASSEMBLY	CO OL	RPG-II	BASIC	FORTRAN
I-1	...	...	...	Locally Developed	...	...	...	X	...
I-2	...	...	...	Locally Developed	...	...	...	X	...
I-3	...	(SPI)	...	Locally Developed	...	X	...	X	...
I-4	No reply		...		...	...	...	X	X
S-1	...	...	...	Locally Developed	...	DATA	SHARE		
S-2	X	...	O.D.S.	...	...	X	...	...	...
S-3	X	...	...	Locally Developed	...	...	PASCAL		
S-4	...	...	...	Locally Developed	...	X			
P-1	X	...	X	...	...	...	X	...	...
P-2	...	...	...	Locally Developed	...	X	...	...	X
P-3	X	...	X		...	X	X	...	X

USER SOFTWARE SUPPLY					LANGUAGE				
COMPANY	SPACES*	SPAFSH*	STM*	OTHERS	ASSEMBLY	COBOL	RPG-II	BASIC	FORTRAN
P-4	No response				...	...	...	X	...
P-5	...	...	...	Locally Developed	...	...	...	X	...
P-6	...	...	...	Locally Developed	...	...	...	X	X
P-7	X	X	...	Locally Developed	...	...	X	...	...
P-8	...	...	...	Locally Developed	...	...	...	X	...
P-9	X	...	X	...	X	...	...	...	...
P-10	...	...	...	Locally Developed	X	...	...	X	X

SPACS - Standard packages available from the computer supplier.
SPAFSH - Standard packages available from a software house.
STM - Specially developed tailor-made packages.

X = In use
... = Not in use

Annex VIII

PRESENT USE OF SMALL-SCALE COMPUTER

Administrative data processing

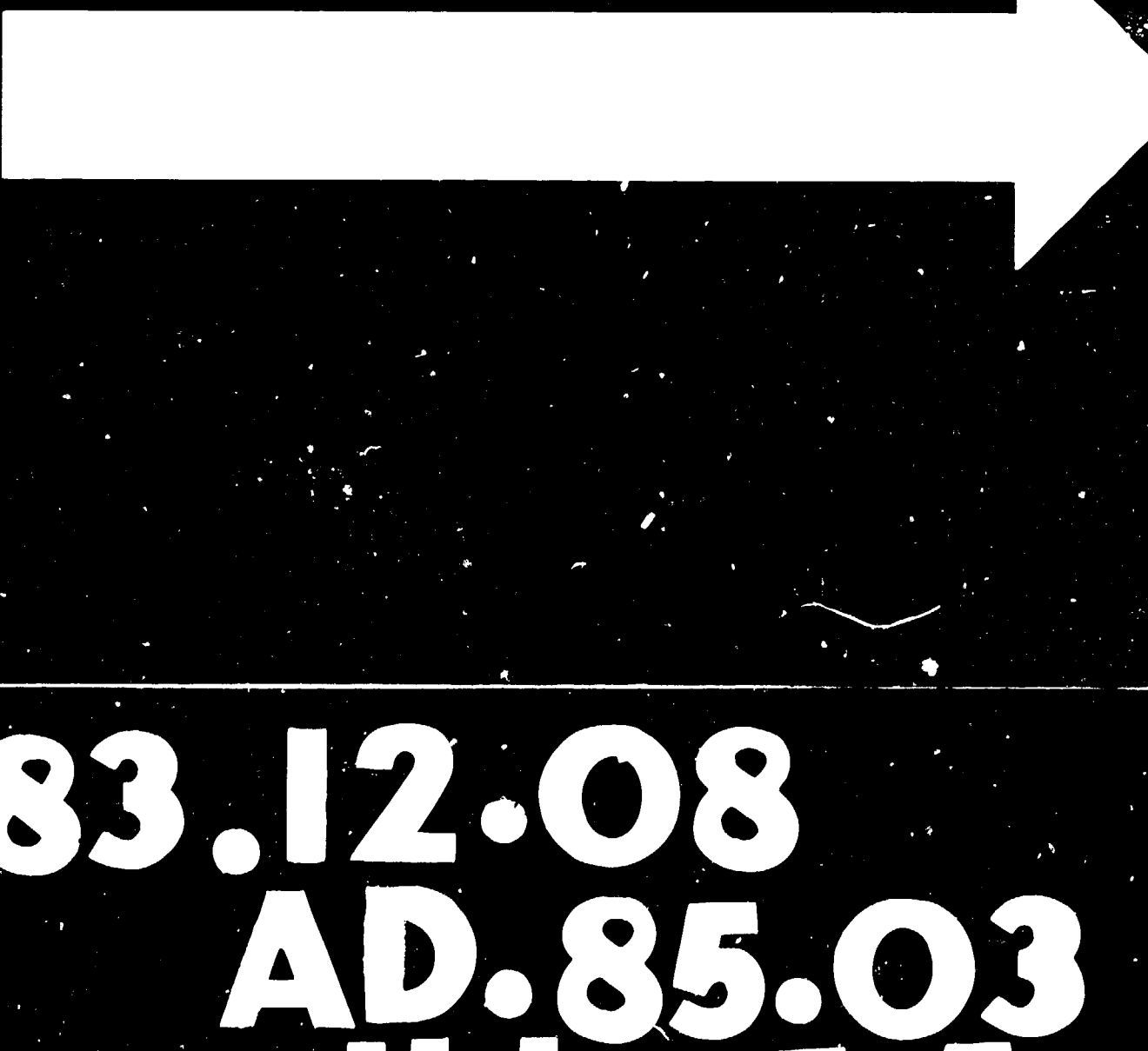
COMPANY	A/C	BUDGET	PERSONNEL	PAYROLL	A/C RECEIVE	A/C PAYABLE	OTHERS
T-1	*	...	...	*	*	*	...
T-2	...	...	...	...	...	...	
T-3	...	...	...	...	*	...	Sales Analysis
T-4	*	...	...	*	*	...	...
T-5	...	...	*	*	*	...	Sales Invoice, Sales Analysis
T-6	...	...	...	*	*	...	...
T-7	...	...	...	...	...	...	Order entry and Billing
T-8	*	*	*	*	*	*	General Ledgers, Sales report, Sales Analysis
M-1	*	...	*	*	...	...	
M-2	*	*	...	*	*	*	...
M-3	*	*	...	...	*	*	Invoicing
M-4	...	...	*	*	*	*	Sales Analysis, Marketing Infor.
M-5	...	...	...	...	...	...	...
M-6	*	*	*	*	*	*	...
I-1	...	...	...	...	...	...	...
I-2	...	...	*	*	...	...	...
I-3	*	*	...	*	...	...	...
I-4	...	...	*	*	...	...	...
S-1	*	...	...	*	*	*	...
S-2	...	...	...	*	*	...	...
S-3	*	...	...	*	*	*	...
S-4	...	...	...	*	*	...	...
P-1	*	...	...	...	*	...	Billing, Invoicing
P-2	*	*	*	...	*	*	...
P-3	*	...	...	*	*	*	General Ledger
P-4	...	...	...	...	...	...	...
P-5	*	...	*	*	...	...	Invoicing
P-6	*	...	...	*	*	*	General Ledger, Fixed assets, Sales Analysis
P-7	*	...	...	*	*	*	...
P-8	*	*	...	...	*	*	...
P-9	...	...	...	...	*	...	...
P-10	...	...	...	...	...	...	...

Material and production systems

COMPANY	SALES ORDER	REQUIRED PLANNING	MASTER PRODUCTION PLAN	PURCHASING	INVENTORY	OTHTERS
T-1	*	...	...	...	*	...
T-2	*	*	*	*	*	...
T-3	...	...	...	...	*	...
T-4	*	...	...	...	*	...
T-5	*	...	...	...	*	...
T-6	...	...	...	...	*	...
T-7	...	...	...	...	...	...
T-8	*	...	...	*	*	Costing, Bill of Materials
M-1	*	*	*	...	...	...
M-2	...	...	...	...	*	...
M-3	...	...	...	...	*	...
M-4	...	...	...	...	*	...
M-5	...	...	...	...	...	...
M-6	*	...	...	...	*	...
I-1	*	...	...	...	*	...
I-2	...	...	...	...	...	...
I-3	...	...	...	...	...	...
I-4	...	...	...	...	*	...
S-1	*	...	...	...	*	...
S-2	...	...	...	...	*	...
S-3	...	...	...	...	*	...
S-4	...	...	...	...	*	...
P-1	*	*	...	...	*	...
P-2	...	...	...	...	*	...
P-3	*	*	...	*	*	...
P-4	...	...	...	...	*	...
P-5	*	...	...	...	...	...
P-6	...	...	...	...	*	...
P-7	*	...	...	...	*	...
P-8	*	...	...	*	*	...
P-9	*	...	...	*	*	...
P-10	...	*	...	...	*	...

* = In use
... = Not in use

COMPANY	IMPLEMENTATION SUCCESSFUL	HARDWARE OPERATION SATISFACTORY	APPLICATION SOFTWARE SATISFACTORY	WHAT APPLICATION BEST INVESTMENT	PLAN INCREASE IN 1981-82	WHAT AREA
T-1	Y	Y	Y	Accounting, Inventory	NO	...
T-2	NO (only 9 months)	NO (slow operation)	NO (slow operation)	Production Planning Inventory Control	Y	Production Planning Inventory Control
T-3	Y	Y	Y	Account Receivable Sales Analysis	Y	Product Costing Inventories
T-4	Y	NO Frequent Failure	Y	Payroll, Billing & Sales Analysis	Y	A/C, Inventory Production Control, Feed Formulation
T-5	Y	Y	Y	Work in Process & Finished Good Production	Y	Accounting
T-6	Y	Y	Y	Inventory	Y	Accounting
T-7	Y	Y	Y	Inventory Control & Requirement Planning		Personnel Department
T-8	Y	NO (Overloading, not fast enough)	Y	MAPICS	Y	Master Production And Material Requirement Planning
M-1	Y	Y	Y	Retail System	Y	Purchasing Inventory Control
M-2	Y	Y	Y	Budgeting, Accounting	NO	...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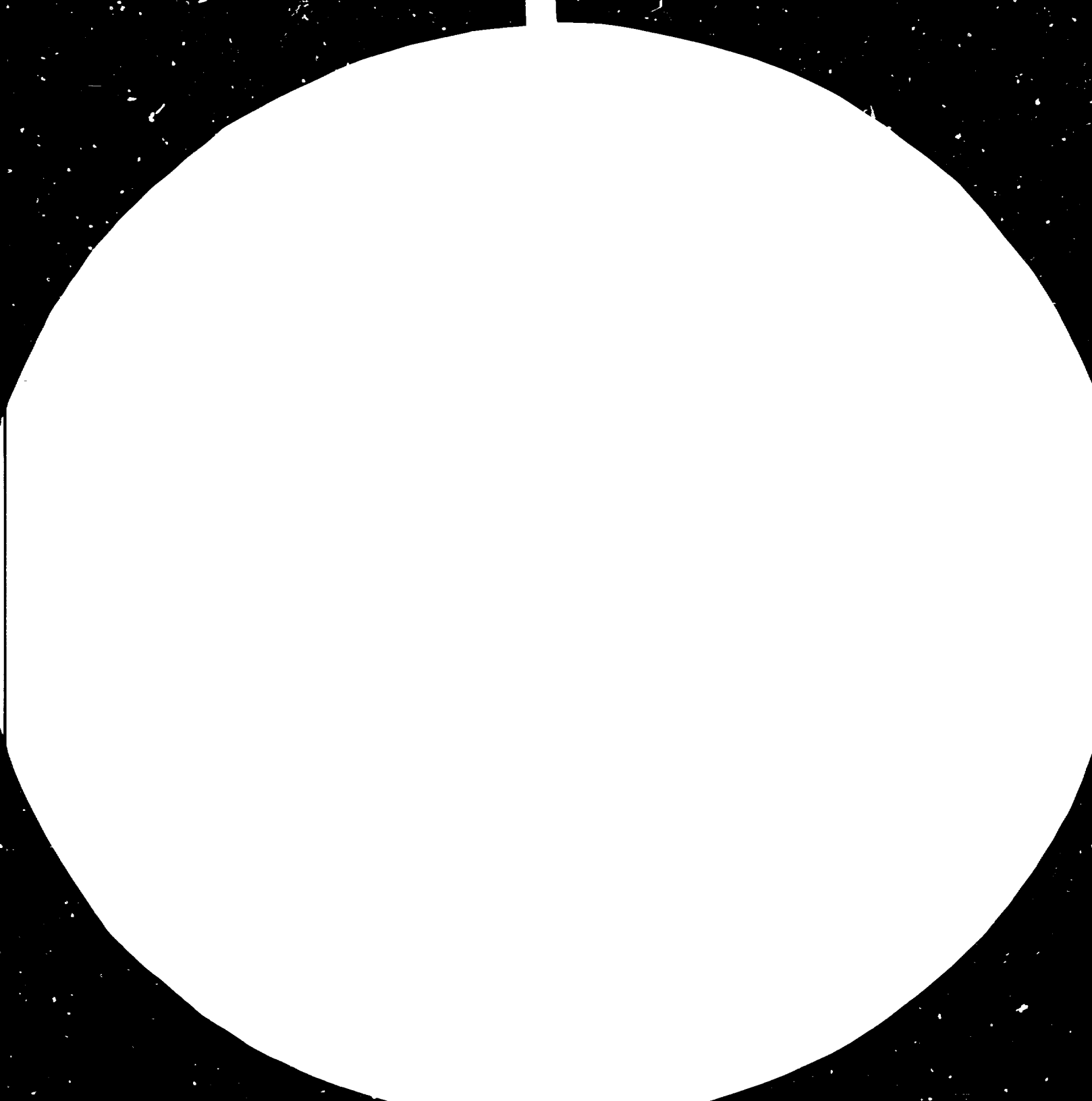

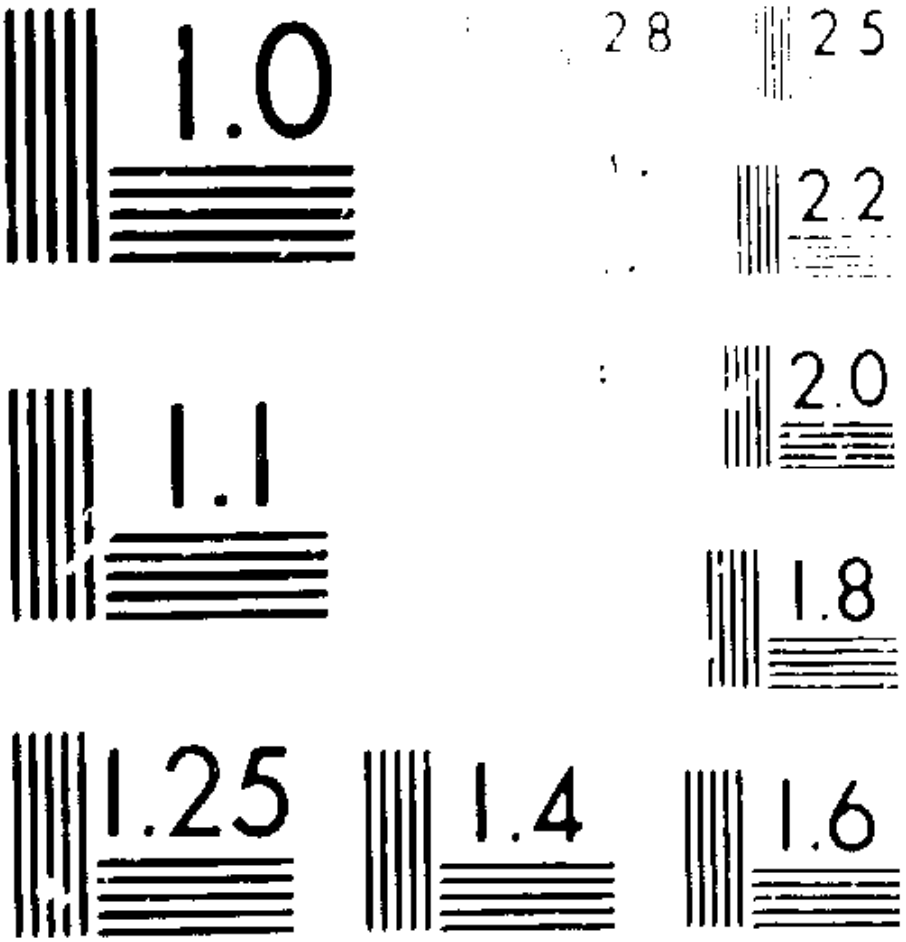
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2.8
2.5
2.2
1.1
2.0
1.8
1.25
1.4
1.6

COMPANY	IMPLEMENTATION SUCCESSFUL	HARDWARE OPERATION SATISFACTORY	APPLICATION SOFTWARE SATISFACTORY	WHAT APPLICATION BEST INVESTMENT	PLAN INCREASE IN 1981-82	WHAT AREA
M-3	Y	Y	Still on parallel run	...	...	...
M-4	Y	Y	Y	A/C Receivable	Y	Factory System
M-5	Y	Y	Y	...	Y	Project Control & Contract Admin.
M-6	Y	Y	Y	Sales and A/C Receivable	Y	Sales, A/C receivable, Inventory Planning
I-1	Y	Y	Y	Finished Goods Control	Y	Production Load
I-2	Y	Fair	Y	Technical Use	Y	Information System
I-3	NO	Y	Y	...	Y	MIS/Contract Control System Accounting System
I-4	Y	Y	Y	Personnel and Payroll	Y	Budgeting
S-1	Y	NO	Y	Inventory	NO	...
S-2	Y	Fair	Y	All	Y	Manufacturing Sys.
S-3	Y	Y	Y	ADP	Y	All Areas of Bus.
S-4	Y	Y	Y	Payroll and Invoicing	Y	Production Control
P-1	Y	Y	Y	All applications are equally good	Y	Raw Material Inventory, Requirement Planning

COMPANY	IMPLEMENTATION SUCCESSFUL	HARDWARE OPERATION SATISFACTORY	APPLICATION SOFTWARE SATISFACTORY	WHAT APPLICATION BEST INVESTMENT	PLAN INCREASE IN 1981-82	WHAT AREA
P-2	Y	Y	Y	Inventory Control	Y	Engg., Accounting and Administrative
P-3	Y	Y	Y	General Ledger, A/C Receivable	Y	Manufacturing Processing
P-4	Y	Y	Y	Inventory Control & A/C Receivable	Y	A/C Payable, Payroll, Age Analysis
P-5	Y	Y	Y	Payroll	Y	As much as possible A/C & Production
P-6	Y	Y	Y	Inventory and Accounting	Y	Production
P-7	Y	Y	Y	Inventory, A/C Payable, A/C Receivable	Y	Forecasting, Requirement & Production Planning
P-8	Y	Y	Y	On Line Sales Order Entry, A/C Receivable	Y	Production Planning, Personnel Records, Payroll
P-9	Y	Y	Y	Inventory	Y	A/C Payable, Payroll, General Ledger
P-10	Y	Y	Y	Inventory Control	Y	Preventive Maintenance

Y = Yes

Annex X

PROBLEM AREAS

COMPANY	PROBLEM
T-1	No response
T-2	Data are collected uncompletely and in difficulty
T-3	None
T-4	Lack of vendor support in both hardware and software
	Recruitment of qualified personnel
	Training takes very long
	Lack of documentation from vendor and they are not easy to read
	Managing staff retention
	Few software packages can be used with real applications creating long period of system development
T-5	Personnel problem
	Source data came late
	Vendor price increases
	Underestimation of size and training of projects
T-6	Memory size of computer too small
T-7	None
T-8	Lack of technical support in MAPICS application from IBM
	Limited resources (hardware & software) in that littel choice available locally other than IBM

COMPANY	PROBLEM
	Limited understanding, particularly in manufacturing application, by end uses as to required disciplines necessary and potential benefits available.
M-1	Insufficient documentation
	Lack of key personnel involvement in systems study and design
M-2	Lack of Telecommunication facilities
	Lack of Documentation
	Lack of Good personnel
M-3	Fluctuation of Electricity
M-4	Insufficient disk space
	Insufficient vendor software support
M-5	Difficulty in Recruiting and retaining suitable staff for systems and programming work at the computer centre.
M-6	Lack of Documentation in most system
	Application system being developed long time ago need to review most system to follow the current trend of information processing.
	Lack of vendor support in application system software.
I-1	No response
I-2	Very poor maintenance from the vendor
I-3	Lack of management support
	Problem of human factor - attitute, discipline
	Lack of documentation
	Lack of project plan
	Lack of communication between user and project team

COMPANY	PROBLEM
	Lack of experience.
I-4	Lack of vendor support on software
	Upgrade hardware & software operating crew
S-1	Lack of vendor support in upgrading software
	Poor hardware maintenance by vendor
S-2	Lack of user support
	Insufficient documentation
	Lack of hardware(?) support
S-3	Lack of computer personnel
S-4	Insufficient man-power to follow-up documentation upgrading documents.
P-1	Insufficient vendor support on application packages. In some cases, the vendors themselves are not so familiar with the packages
P-2	Lack of vendor software support
P-3	Insufficient documentation
P-4	Need to upgrade system for most file space 10 MB to 14 MB.
P-5	Limited memory
	Lack of regular vendor support in terms of advanced computer education
	Insufficient documentation
	Limited diskette capacity
P-6	Lack of trained and experienced programmers
	Lack of technical expertise on the system, both hardware and software

COMPANY	PROBLEM
P-7	Insufficient documentation
	High mobility of computer personnel
P-8	
P-9	Power interruption
	Packaged programs not completely suited to our needs
	Lack of vendor support
	Lack of competent EDP staff
P-10	Lack of vendor support
	Insufficient documentation
	Insufficient storage capacity

Annex XI

PROGRAMME OF UNIDO/AIT WORKSHOP ON IMPROVED INDUSTRIAL MANAGEMENT THROUGH COMPUTER SUPPORT

TIME: February 1 - 5 1982

PLACE: Asian Institute of Technology, Bangkok, Thailand

Monday 1 February:

Opening Ceremony:

Welcome	AIT Representative
The UNIDO/AIT Project	Project Leader
Introduction to Seminar	Project Leader

Findings from UNIDO/AIT Project:

State of the art in the Use of Small-Scale Computers in Industrial Management in Southeast Asia. Findings from project survey	Project Team Member
Experience from Consulting Service offered to industry in Southeast Asia Pilot Project at AIT. The use of a Small-Scale Computer for Industrial Management	Project Team Member

Tuesday 2 February:

USER EXPERIENCE:

How to get started on M.I.S.	1-2 Speakers from Industry
Back up procedures and systems	1-2 Speakers from Industry
How to expand the M.I.S. within your company	1-2 Speakers from Industry

PANEL DISCUSSION I:

On user experience

Wednesday, 3 February 1982:

COMPUTER COMPANIES/VENDORS:

Representatives from 3-5 companies

on computers and M.I.S. presently available to industry in southeast Asia

what can the computer companies and vendors offer the industry in southeast Asia in the future

Thursday, 4 February 1982:

PANEL DISCUSSION II:

Representatives from industry and from computer companies on success factors for improved M.I.S. in industry

ASIAN INSTITUTE OF TECHNOLOGY AND INDUSTRIAL MANAGEMENT THROUGH SMALL-SCALE COMPUTER SUPPORT:

A.I.T. post graduate studies in industrial Management and Computer Applications	AIT Representative
A.I.T. training/services set up especially to meet industries need	AIT Representative

Friday, 5 February 1982:

PANEL DISCUSSION III:

Representatives from Industry, AIT, UNIDO

On evaluation of the UNIDO/AIT project and ideas for future work to improve the industrial management in southeast Asia through the support of small-scale computers.

INDUSTRIAL MANAGEMENT AND SMALL-SCALE COMPUTERS:

Guest Speaker

CLOSE

Annex XII

SEVEN HINTS FOR EFFECTIVE USE OF SMALL BUSINESS COMPUTER

by

S. FURUMI
Nippon Electric Co. Ltd.

Prepared for the UNIDO/AIT Workshop on Improved Industrial Management through Computer Support,
1-5 February 1982

I. Seven Hints for Introduction

1. To define the introduction purpose
2. To examine the software
3. To select the flexible computer
4. To observe, touch and check it
5. To reconfirm the budget
6. Not to try to start with the month full
7. To select the reliable supplier

II. Seven Hints for System Design

1. To re-examine the current procedure
2. To aim to improve the bottle-neck
3. To compare with the ideal procedure
4. To put the right computer in the right place
5. To build the human oriented procedure
6. To keep good relationship with the system designer
7. To set up the evaluation criterion

III. Seven Hints for Operation

1. To make P.R. of the new system to all concerned
2. To appoint the person in charge
3. Totrain all concerned to operationable
4. To put the computer to the suitable place
5. To control the consumables perfectly
6. To make the operation schedule
7. To inform correctly in document

IV. Seven Hints for Profit Making

1. To be evaluated by the top manager
2. To confirm the purpose periodically
3. To apply one's own criterion for performance evaluation
4. To evaluate from all-round aspects
5. To pursue the quality improvement
6. To perform the timely evaluation
7. To evaluate with documentation

Annex XIII

INDUSTRIAL ENGINEERING AND MANAGEMENT PROGRAMME AT THE ASIAN INSTITUTE OF TECHNOLOGY

This paper was prepared for presentation at a workshop held at the Asian Institute of Technology during February 1-5, 1982 as part of the Project on "Improved Industrial Management Through Computer Support" jointly sponsored and undertaken by the United Nations Industrial Development Organization and the Asian Institute of technology. Participants to the conference came from Bangladesh, China, Indonesia, Japan, Malaysia, the Philippines, Singapore, Thailand as well as from Hong Kong and from AIT and UNIDO. The paper is aimed at informing the participants on what the Industrial Engineering and Management Programme at AIT can offer to industries in the region in order to improve their industrial management.

Ideas and opinions expressed in this paper are not necessarily the official views of the Division of Industrial Engineering and Management of the Asian Institute of Technology.

Background

The autonomous, international postgraduate technological institute — the Asian Institute of Technology (AIT) -- introduced the Industrial Engineering and Management (IE and M) programme in 1970 in response to the growing needs of Asian developing countries for proficient professionals to engineer and manage industries in the region. Industries have been concerned with the evolving complexity in the design, installation and management of integrated systems involving men, materials and machines in a highly competitive environment. Knowledge and skill in the mathematical, physical, social, economic and management sciences, together with the principles and methods of engineering analysis are all needed in order to timely specify, predict and evaluate the behaviour of industrial systems.

Due to the increasing demand of IE and M graduates in the region, the IE and M programme as a field of study expanded to become a Division in the later part of 1973.

The faculty in the Division are drawn internationally — currently from Asia, Europe and Australia. Student in the diploma, master's and doctoral levels are admitted mainly from the Asian region, most of them from the developing countries of the region.

Curriculum thrust

The emphasis of the IE and M programme at AIT has been the application of advanced techniques to the industrial process in the areas of operations research, management science, systems engineering, socio-economic science, and behavioural science. This requires attention to the materials and tools of manufacture, to the economics and management aspects of the processes, and to the interrelation of man and machine in the manufacturing system. The programme deals with industrialisation problems at the different levels: factory, industry, and the industrial system of the nation.

In the development of modern systems technologies, the pacing fact is management. To maintain technological viability, all resources must

be utilised where possible. While the student of industrial engineering and management must appreciate this, he must also be prepared to deal with specific problems. The various approaches to management and their relevance to Asia are examined, including the empirical or case history approach, the management theory approach, the management science approach, and the system dynamics approach.

The curriculum of IE and M is dynamic in nature in order to be responsive to the needs of changing times. It is continually being revised according to the changing needs of Asia.

Courses offered to students in the programme include the following:

1. Management concepts and methods

Overview of the management process; traditional theories; structural theories; corporate processes; organizational processes; management problems and issues; managing change in organizations; selected topics.

2. Organizational management

Organizations and their characteristics; management theories and their critical evaluation; individual behaviour; inter-personal interaction; organization as systems; role playing in organizations; power and authority; coercion; conflict and its resolution; effectiveness; change; selected topics.

3. Managerial economics

Decision making in engineering and management; costs; evaluation of alternatives; capital management; cost and profit determination; elements of economic analysis; enterprise cost and profit relationships; issues relating to managerial economics.

4. Marketing management

Understanding the corportate mission; scanning the marketing

environment; market opportunity analysis leading to selection of market targets; design, implementation, and control of the marketing programme.

5. Linear programming and extensions

An overview of Operations Research; phases of application of Operation Research in Decision making; a comprehensive treatment of linear programming - formulation; solution procedures, simplex and variations; duality theory and sensitivity analysis; special types of linear programming, transportation, assignment, transshipment, etc.; extension to integer programming, goal programming, separable programming; case studies and application of MPSX package.

6. Stochastic models in operations research

Review of probability theory; Markov chains; exponential distribution and Poisson process; birth and death process; queuing theory; Markov decision process.

7. Combinatorial optimization

Integer programming formulation; explicit and implicit enumeration; the branch and bound method of Dakin; computer package MIP/370; heuristic methods; NP - completeness; location and layout problems; sequencingand scheduling; applied network optimisation.

8. Advanced topics in operations research

Nonlinear programming theories (convex analysis, optimality conditions, duality) and algorithms (gradient and penalty methods); multicriterion optimisation theories (conflict of objectives, efficient solutions, and preference, priority, utility and trade-off theories) and algorithms (aggregation, progressive, interactive, nondominated solution generation methods); deterministic and probabilistic dynamic programming.

9. Introduction to economics

The economic problem; utility theory and consumption decisions; theory of the firm; market and multi-market equilibrium; imperfect competition; welfare economics; dynamic optimisation; linear economic models.

10. International economics

International trade and specialisation; the basis of trading relationship between countries and regions; international organization: problems of economic development and underdevelopment; the international agencies and their tasks; international economic relations: the world monetary system; the terms of trade and the balance of payments; investment, indebtedness, and aid.

11. Development economics

Growth and development in Asia - definitions, history and characteristics; development theory, production functions, rates of return; development strategies; international economic relations; case studies of different development countries; technological development and transfer; nature of relations between industry and agriculture.

12. Econometric methods and applications

The econometric approach; simple regression; violation of basic assumptions; multiple regression; applications to demand analysis; applications to firms; simultaneous equation systems.

13. Introduction to system dynamics

Open and closed systems; causality and feedback dynamics; behaviour of various classes of systems; policy insensitivity of systems; structural elements of systems; non-linearities and delays; gain and amplification introduction to systems modeling; designing effective policies for managing systems.

14. Corporate system analysis

Firm as a system; subsystem of a firm, their functions and interrelationships: marketing, production planning, material ordering, capital acquisition, labour hiring, pricing, and financial management; selected topics on management.

15. Technological planning and control

An overview of the process of technological change: technology - society - environment - development interaction; importance of technology management in developing countries: appropriate technology, technology development, transfer, and assessment; technology planning: implications and challenges; technological forecasting: exploratory, normative and dynamic approaches; technological substitution: single, multilevel and causal models; technology control: assessment methodology; determinants, issues and models of technology transfer.

16. Production management

Classification of production systems; forecasting of production requirements; economic evaluation of production system alternatives; production resource scheduling; materials management - inventory, materials handling, material requirements planning; machines and maintenance - replacement, sequencing, loading, line balancing, preventive and group maintenance; methods and measurement - time and method study, work measurement, job evaluation and wage payments; production system cases; plant visits.

17. Product quality management

Basic concepts; measurement and analysis of quality costs; organization for quality; statistical aids for quality control; statistical aids in design; manufacturing planning for quality; process control; quality control of finished goods; product quality during customer usage; vendor development; product and process

reliability; human factors in quality control, reliability and maintainability; total quality control.

18. Selected topics

Courses on current topics and recent developments in selected fields of study. Materials are selected on the basis of student requirements and faculty interests. Details of these courses are announced as they become available.

19. Special studies

Individual studies requiring a comprehensive investigation, submitted in report form, on a topic of relevance.

Research activities

Research in industrial engineering and management involves the utilisation and consideration of the following: (a) methodology, (b) tools and techniques, and (c) areas of application. The idea in this research philipsophy is to teach AIT's graduates in industrial engineering and management how to apply a modern approach to the down-to-earth and complex problems facing the developing countries of the region.

Research activities undertaken in the form of special studies, master's thesis, doctoral dissertations, and contract researches. Contract researches are mostly funded externally -- by governments, industries and foundations.

Current research areas in industrial engineering and management include:

- National industrial planning
- Production management modeling in various industries (e.g., garment, oil refinery, chemical, electrical and electronics, automobile assembly, jute milling, cement, sugar, rubber product, battery, rice milling)

- Technology management
- Energy management in industry
- Management information systems
- Product quality management
- Modeling of service industries such as airlines and hospitals
- System dynamics
- Modeling of economic systems
- ASEAN economic cooperation (including ASEAN industrial complementation, and Intra-Extra ASEAN trade)

Continuing education

The IE and M Division's commitment to the region is not only in the production of graduates with degrees of master, doctor or diploma, it is also carrying out tasks in the continuing education type such as seminars, short courses, and even international conferences. These programmes are designed to keep practitioners in the field be continually abreast of the growing development of their professional field of endeavour. This offering of the Division is an area whereby industries can very well avail of.

Laboratory facilities

The Division has received cooperation from the management of many firms in the Bangkok metropolitan area and in other parts of Thailand permitting students to make plant visits and in many instances to conduct research work at those plants. The Institute's IBM 3031 computer enables students to analyse their research work more effectively, particularly in such work as modeling. In addition, a number of application packages are available to students for training and research, including management gaming, general purpose systems simulator, and DYNAMO. A micro processor is also available for students.

Alumni

To date there theve been about 200 masters, 10 diploma and 9 doctoral graduates in industrial engineering and management from AIT. They represent 17 countries or areas and all of these graduates are professionally employed. The majority of them are working with private firms, both local and multinational, in Asia. Many of them work with public enterprises or with government agencies which are responsible for the promotion of industrialisation and improvement of productivity (.e.g., the Board of Investment and the National Productivity Centre). Some are pursuing doctoral degree studies at AIT or at leading universities in the United States and Australia. With the exception of those working on doctoral degrees abroad, all IE and M graduates have remained in Asia. It is expected that, with the kind of training they have received, job opportunities will emerge in other non-manufacturing activities such as hospitals, hotels, postal and public health services. This expectation is based upon past experience in many industrialisednations.