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SOME ASPECTS OF COMPUTER APPLICATION FOR INDUSTRIAL MANAGEMENT IN DEVELOPING COUNTRIES

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This report has not been cleared with the United Nations Industrial Development Organization which does not, therefore, necessarily share the views presented.

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1 INTRODUCTION

Due to the fast development of industry in developing countries the requirements and needs of information, especially in enterprises, training institutes, governmental and private organisations are growing significantly. This has created an urgent need of industrial information services combined with electronic data processing. In order to organize an exact data and information processing and to activate the necessary flow of information for supporting the management in their decision making process the introduction and ordering of managerial capacities of computers with all consequences for developing countries has become necessary.

The practical circumstances of computerization in developing countries should be taken into consideration when a developing country plans to computerize its industry. This relates to technological, economic and administrative processes.

Some of the positive effects of computerization are:

1) Good organisation of information and data flow means a fast structured data transmission and a short response time for required informations.

2) Through collection and elaboration of data the necessary informations for planning strategies are always available.

3) Effective financial resource planning and control.

4) Reduction in production costs and as a direct result the diminuation of sales prices for goods and thus following reasons:

In the future a requirement for developing country is to [illegible]

This is is ver. difficult undertaking but at the same time it is a big challenge, not only for developing countries but also for the industrialized world, in order to stabilize the world economy and to provide a constant growth in the social wealth to all countries.

As it has been shown in a vast and intensive study, made by some organizations (such as OECD, ECLA, e.r.) and according to the experience achieved by my company ITALTEL over the past years, one important factor for the effectiveness of a solid socio-economic and industrial development is the planned intensive computerization of all industrial branches also of the public administration in developing countries. Computerization means to introduce the microelectronics in order to support the administrative and the technological process. Computerization has to be a planned and integrative factor of industrial development. Industrial investment planning has to include the costs of computerization.

The components of computerization costs are:

Hardware

Software

Personnel

Plants e.g. Controlling Use

Organization of the system

Training and following

The meaning is to help the medium and small scale industry in developing countries to find the appropriate computer equipment with the adequate software programmes for managerial applications. The appendix will provide an outlook of future development in microelectronics and computer application.

This report should be understood as an introduction and as a basic guide line for the selection of hardware and software systems. It should be applied in first priority areas of management in developing countries. But it has to be pointed out that the effectiveness of computerization also depends very much on the availability of specially trained personnel. According to the local conditions, a computerization of small and medium scale industries can only be successful after the definition of the management needs and the creation of the necessary organization for the selected management areas. Before introducing a computer system, an exact time and work plan has to be established by experienced personnel.

The suitability of the work to be carried out includes also a consultant, experienced in computer training and -application.

A success can be more or less assured when the planning and the implementation process for computerization has been accepted and approved by the responsible working-members and the top management.

To underline the importance of a fast development of a computer aided support (hard- and software) for managers in developing countries, a summary of an article which was published in 1987 by Prof. P.O.I. GODONATILAKE (Univ. of Ilorin, Nigeria) will show the problems of production management. The summary is representative for all other management areas because production management is considered as one of the most critical and crucial industrial management areas. This article is still valid in 1988 because in the most developing countries any substancial changes have been taken place until now, and it expresses also our experience gained as consultants for the governmental and privat industrial sector of some developing countries.

The headline is:

'Production management - the forgotten factor in the industrialization policy in developing countries'

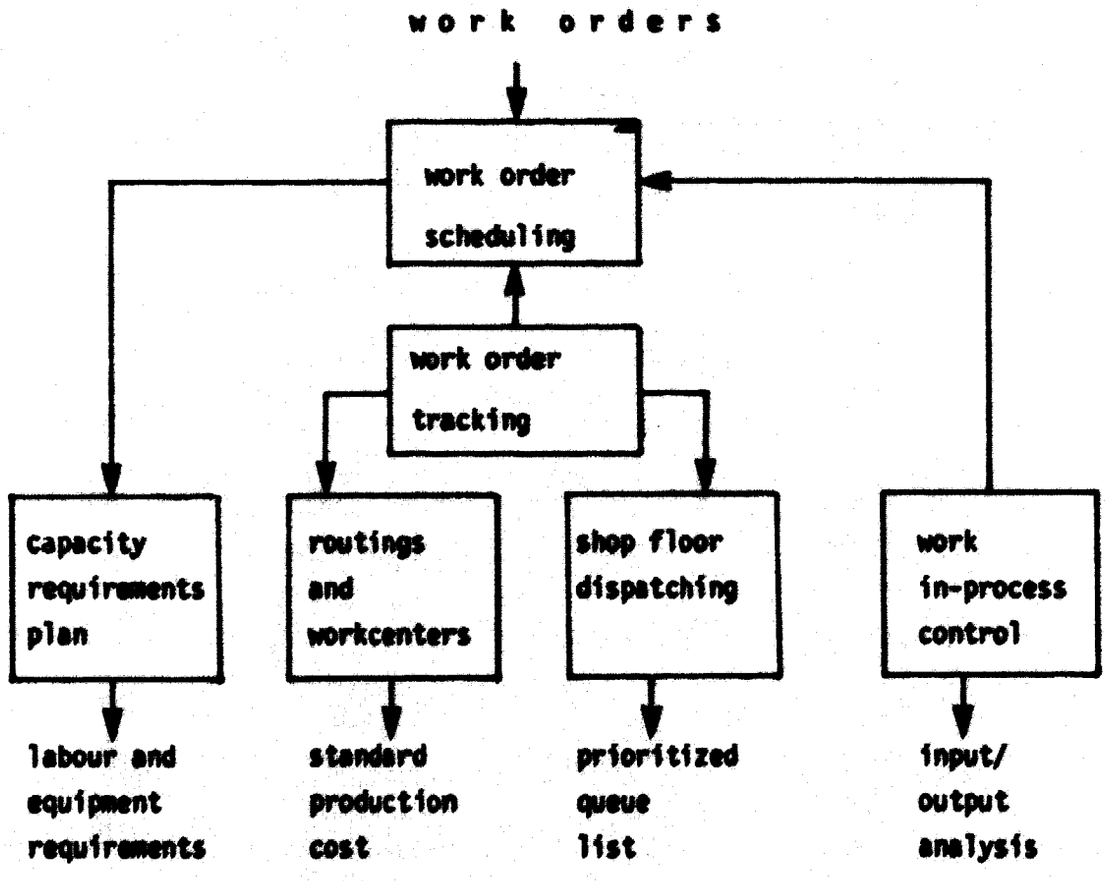
The failure or the slow progress of industrialization programms in developing countries is often attributed to the reluctance of developed countries to "transfer technology" to them. It is indeed true that in many cases developed countries are reluctant to part with the technological know-how gained over the years to a potential competitor; however, it would be unfair to blame lack of transfer of technology totally for the failure of industrialization efforts of developing countries. In most cases the types of technology employed in developing countries are well established. However, the performance of these industries falls well below expectations, even though the technological know-how is fully available. The success of any industry once the technology has been acquired depends largely on efficient production [illegible]. Most attempts to solve production [illegible] the [illegible]

2.1. Production management should have first priority when a factory decides to reorganize the technical and/or managerial process for computerization.

Production management:

- Workcenter and routings
- Capacity requirements planning
- Control of work in process
- Shop floor dispatching
- Work order scheduling
- Work order tracking

Respective flow chart:



1.1. Standard product costing system (determination of product costs by computer):

- Material costs
- Labour costs
- Overhead costs
- Control parameters:
- Process code selection
  - Level code selection
  - Accepted percent of difference
  - Number of accepted errors
  - Effective datas
  - General informations

Part selection criteria:

- Part number
- Account number
- Product line
- Work center

The standard product costing input/output:

- Cost edit report
- Costed bill of material
- Product cost sheet (per product group or single product)

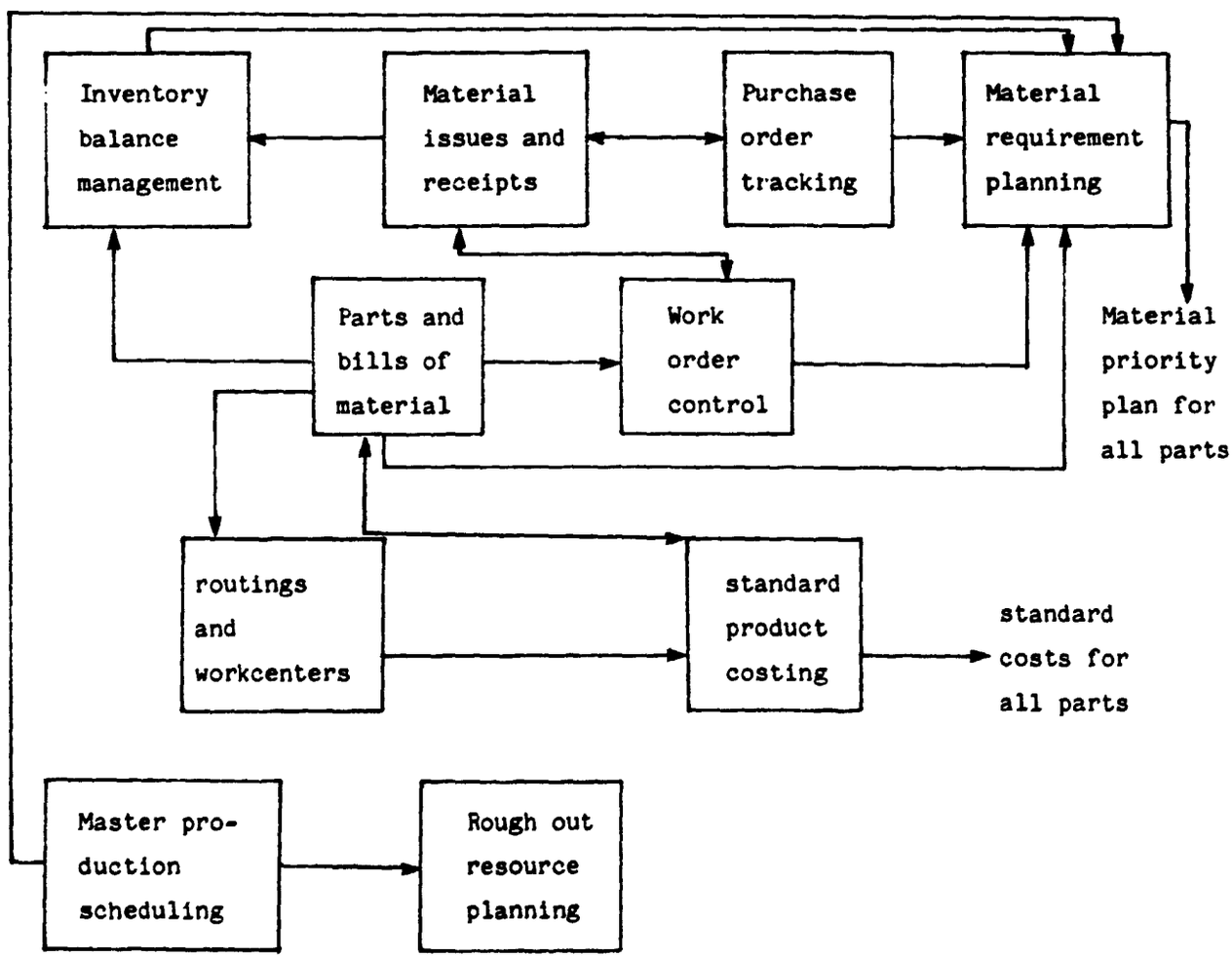
2.3. MATERIAL MANAGEMENT/ INVENTORY CONTROL

Stock control:

- Stock planning
- Stock recording
- Inventory
- Stock inquiry
- Stock valuation
- Statistics for stock

General ledger integration

Information flow chart:



4. Maintenance and repair management

The software package should be a user-customizable, interactive system for the management and control of all maintainance and repair operations.

The benefits and repair software packages should be:

- Improved planning and execution of orders through better coordination with production the costs for both maintainance and production can be reduced and the profits increased.

- Increasing machine availability achieved by regularly performed scheduled preventive maintainance the product quality and the available machine capacity can be increased. This yields lower costs and increased profits.

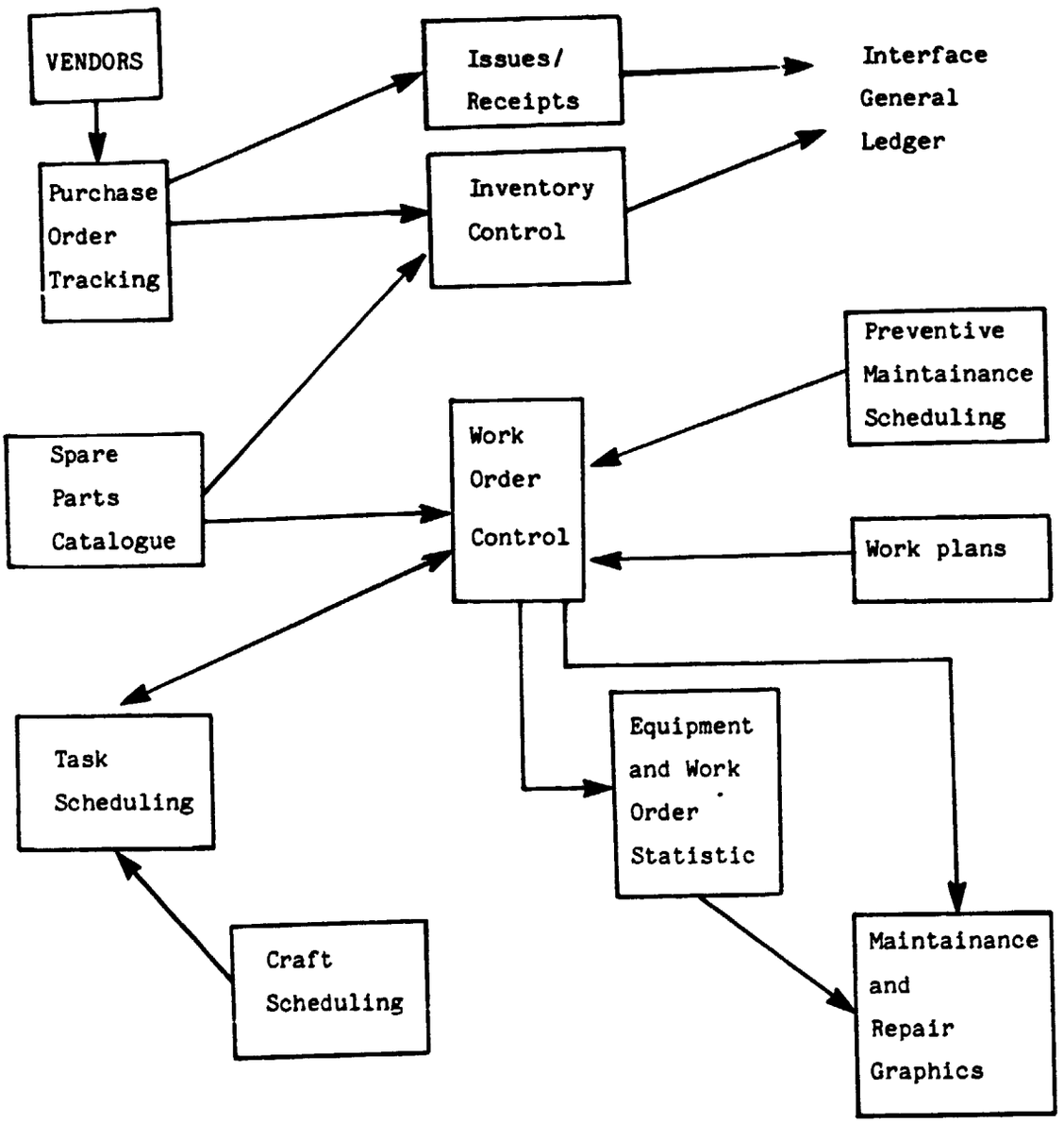
- Spare parts inventory can be reduced, floor space requirement is reduced, also a reduction in material handling costs can be achieved through a well managed inventory. This means that cash can be used for more profitable purposes.

- Efficient planning for turnarounds and shutdowns.
  In reducing the amount of time required for a plant shutdown or for service turnarounds a lot of money can be saved for the company.

- Fast response time to emergency work
  A quick response in case of an emergency repair work means a faster availability of machines. Technicians have more time for preventive jobs.

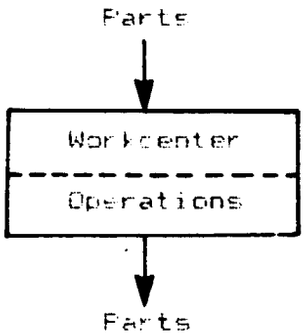
- Demanded features for maintainance and repair:
  - Work order control
  - Preventive maintainance (PM) scheduling
  - Equipment and work orders (statistics)
  - Task and draft scheduling
  - Parts catalog
  - Issues/receipts (input/output)
    Material purchasing and requisitions
  - Vendors (information)
  - Purchase order tracking and inventory control for maintenance and repair works and spare parts

DATA FLOW CHART OF MAINTAINANCE AND REPAIR



1.5. Quality management:

Production model:



Many parts are going through the workcenters and different operations are performed on the parts.

For each combination of workcenters the part number, the operation and the data collection has to be identified as:

. Process common data (to all parts)

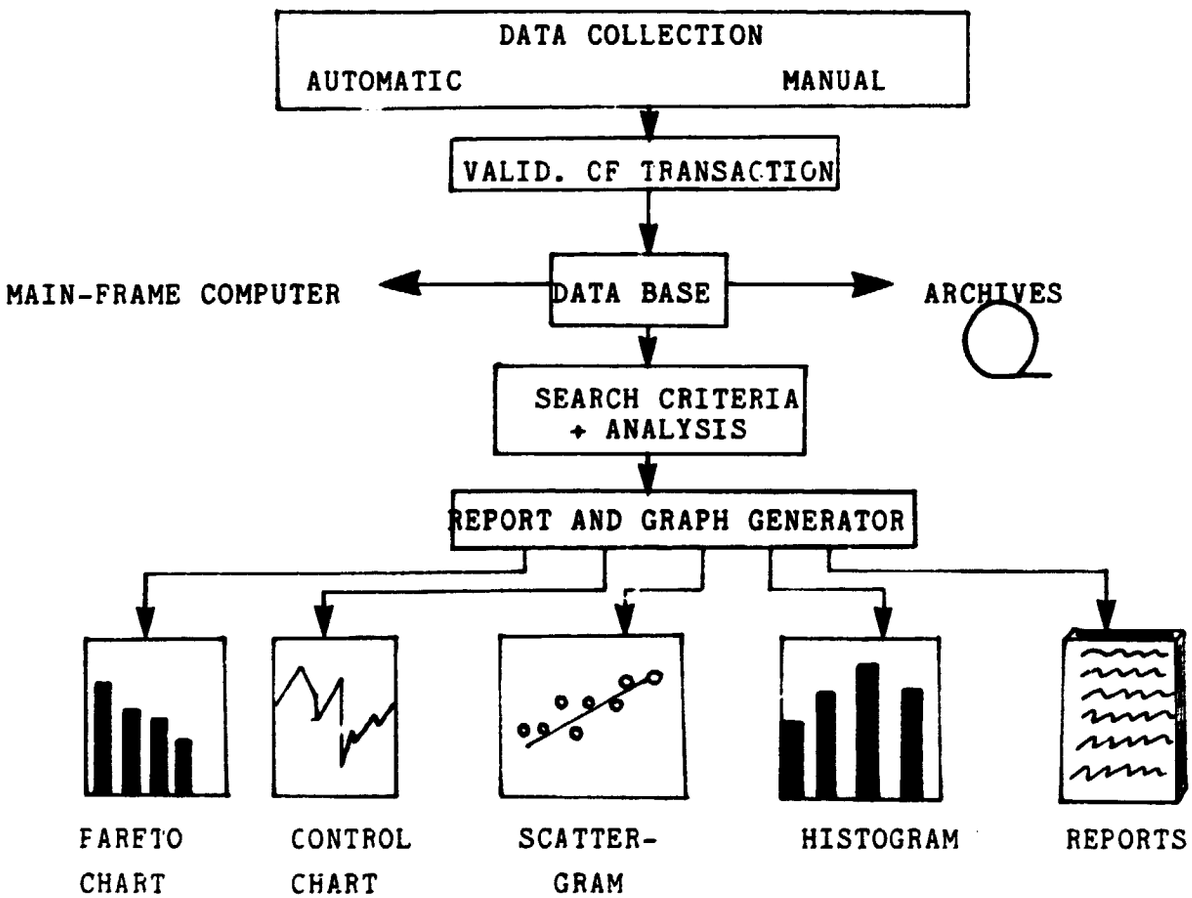
. Transaction data (who, what, where)

. Unit specific data (specific to an individual part)

Demanded features for quality management:

- Menu or prompt/response driven user interface for easy configuration, modification and system use by non programmers.
- Access via password assignments.
- Pre-defined data collection for system design.
- User-defined data collection for system customization to specific application requirements.
- Powerful graph printer for selection and analysis of collected data
- Data collection supported from microelectronic device or from any other source which can transfer a formed file to the computer.
- Color graphic output

Chart for quality management:



Description of Quality Application Areas, Features and Benefits:

Application Area	Features	Benefits
Incoming Inspection	Displays inspection instructions, generates vendor rating reports, control charts of defect rates, vendor quality.	Prioritize vendors, reduce number of vendors, and increase vendor responsiveness to your quality demands.
Product Test: Electronic, Electro-mechanical, final, in-process, component	Manual and automatic on-line data collection, test procedure display. Provides statistical monitoring of defect levels and decision support graphics and reports.	▪ Optimize test process, schedule calibrations, determine minimum number of readings necessary, identify tester vs product defects. ▪ Reaction to statistically significant defect rates. ▪ Production defect data available for correlation to manufacturing process data, identification of causes of quality problems.
History Tracking/Audit Trail	On-line data collection of pertinent traceability facts, archived but available for recall to satisfy regulatory requirements.	▪ Respond to regulatory requirements
Statistical process/product monitoring	On-line data collection from incoming inspection, manufacturing process, and test areas. Statistical graphs/reports to monitor manufacturing process quality and product defect rates. Correlation between product defect data and defect cause data allows identification of specific defect causes: ▪ poor workmanship ▪ faulty material ▪ weak manufacturing process execution ▪ wrong manufacturing process definition ▪ faulty product design	▪ High, predictable yields ▪ Lower production costs ▪ Reduced rework costs ▪ Lower scrap levels ▪ Reduced labor content ▪ Accurate vendor quality feedback/correlation. ▪ Reduced cycle times and inventory levels

1.6. Other important management areas for computerization are:

- Controlling and planning systems for short and medium term investments
- Resources management
- Financial planning and controlling with bookkeeping
- Cash management

Note: The above mentioned areas are very special, taking into consideration the legal aspects of each country. In this case it will be more difficult to find standard ready to use software. Before creating a software for these areas it will be necessary to check carefully, if a standard software is available and ready to buy, if it is adjustable to the local needs and what will be the costs.

- Last but not least, the creation of a modern and functional documentation- and reporting system for managers. This system has to provide the responsible management only with useful and necessary information for their management area.

  Such a software program can be designed and created for the needs of the requesting industry or a standard with the possibility of statistical output (ex. framework or lotus etc.) for more details see chapter IV. Software can be adapted modified to the requested information needs.

III. INTRODUCTION AND SELECTION CRITERIAS OF HARDWARE

Before a company decides to computerize, many factors should be analysed in order to get an idea of the hardware capacity needed. A detailed analysis of the "information" is required.

Before ordering a computer system the initial work should always be a quasi pre-feasibility-study: in this case it has to start with an information-profile: what information is needed at what time, and then the respective information-flow chart has to be established.

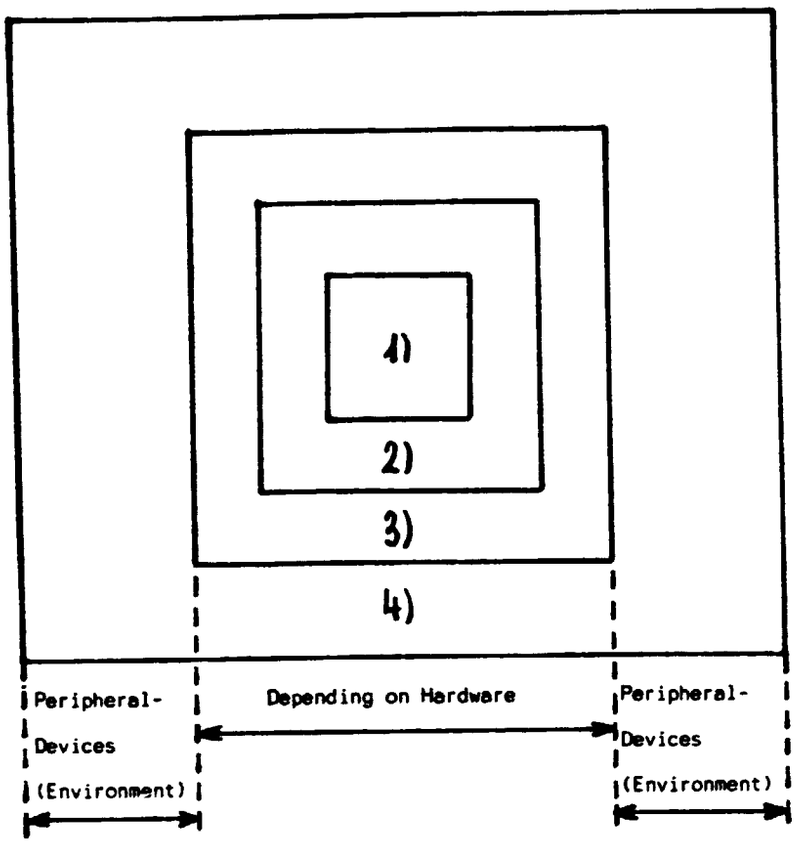
The computer with the appropriate user-software programmes has to assist management in the different levels of the "decision making process". The computer technology has always to make its contribution towards a better management of primary resources and should always be matched to the requirements and needs of industries.

Further it has to be decided if only one or more workstations will be needed. For networking with PC's only 2 - 4 workstations are recommended at the moment, where micro-computers can support up to 64 workstations.

On the market there are many software-programmes available but they have to fit to the hardware which means that the operating system has to support the user software: they have to be "compatible".

As to our knowledge at the moment not each computer software and hardware are 100% compatible. Full or 100% compatibility means that a software program e.g. written for IBM-PC/AT can be used without an additional adaptation work on Hewlett-Packard. PC or the other way can communicate with HP-multi-terminal hardware [illegible].

General computer model



1) Hardware: all material (electrical and mechanical parts of the computer: this is the nucleus of the system "computer", but without specific software completely useless

2) Operating system: Programme package which controls, coordinates and "manages" the different functions of the computer

3) Assembler, compiler (or interpreter), loader, editor.

4) User programmes: Specific written software

The system software can be also called "internal software" which means that the operating system (OS) has been standardized. This standard will be UNIX (S) or XENIX-IBM - standard which is a further development of UNIX time sharing systems with more functions.

XENIX can be used for the IBM-PC/AT but not for IBM-PC/XT. UNIX/XENIX is a "multi-user, multi-tasking" system, it supports one or more workstations.

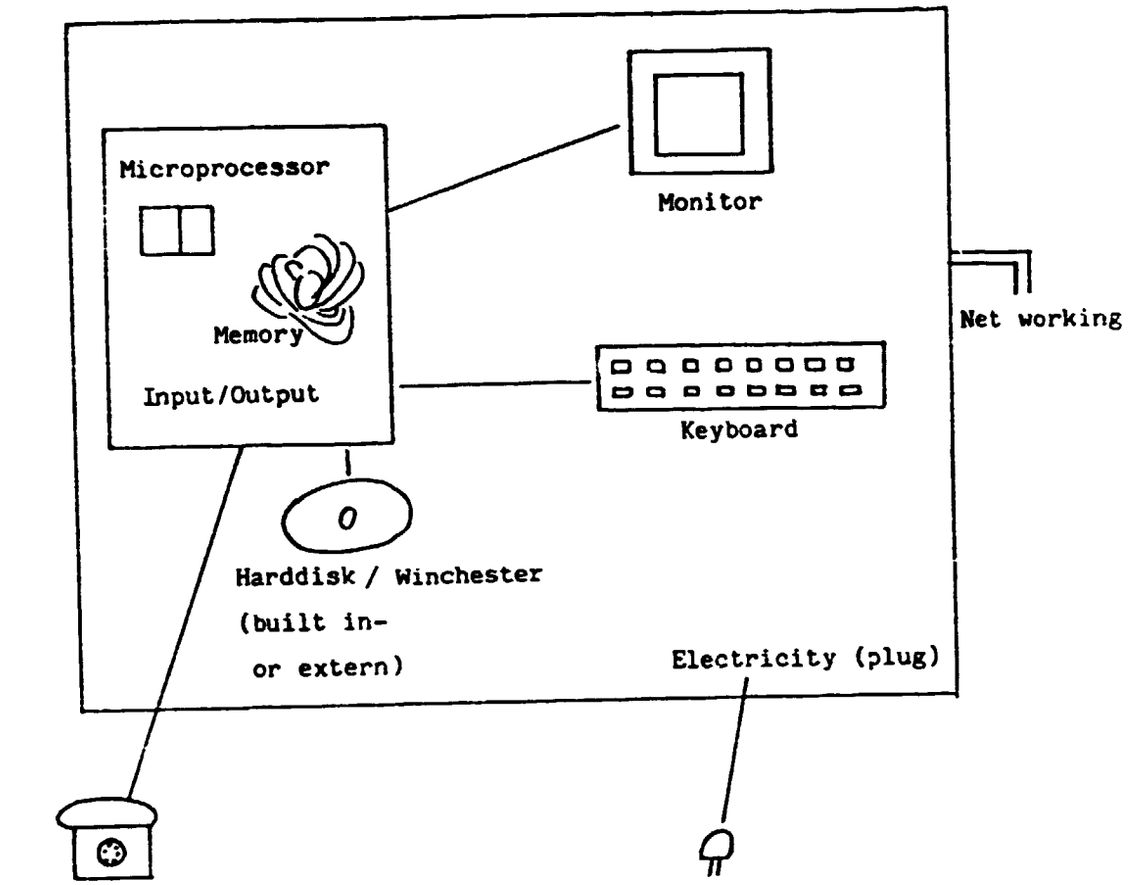
On the market are other UNIX-systems available but these systems are not compatible with others, which means the software programme from other software producers cannot be used any more. The other thing is that before the decision to buy a computer is made, it should be made sure that the operating system (in the most cases MS DOS) now can be changed, if nececessary, by means of an additional investment into the operating system UNIX (S).

This problem has to be taken strongly into consideration because the major producers of hardware (PC's) have already agreed to use in the future the standard "UNIX S". There is only one exception IBM has not agreed till now because they are using XENIX which is similar to UNIX. The UNIX system software is easy to use but not without a proper training. But up to this moment no sufficient software is available, therefore the recommendation can only be to buy computers with MS-DOS operating systems.

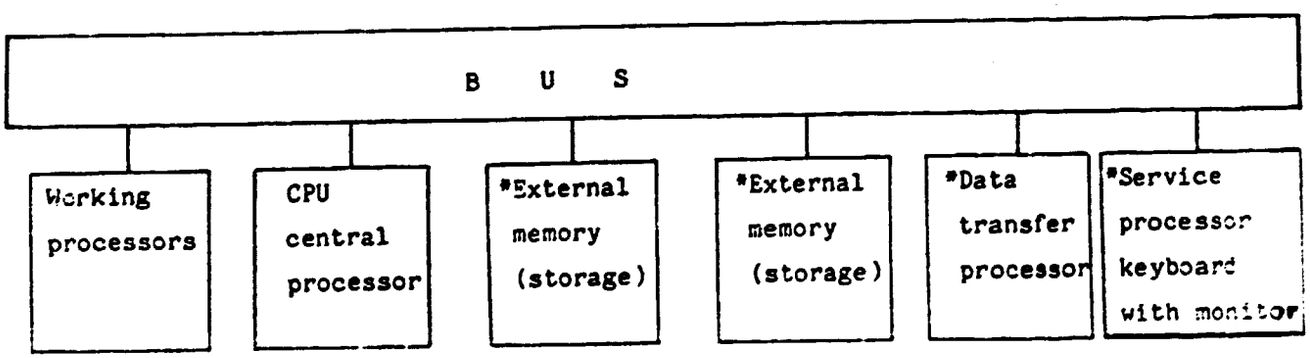
Minimum hardware configuration for UNIX or XENIX operating system:

- 512 KB for Main Memory
- 20 MB Hard Disk
- 1.2 MB Disk Drive
- Monochrome or color monitor with adapter

WORKSTATION MICRO- OR PERSONAL COMPUTER (PC):

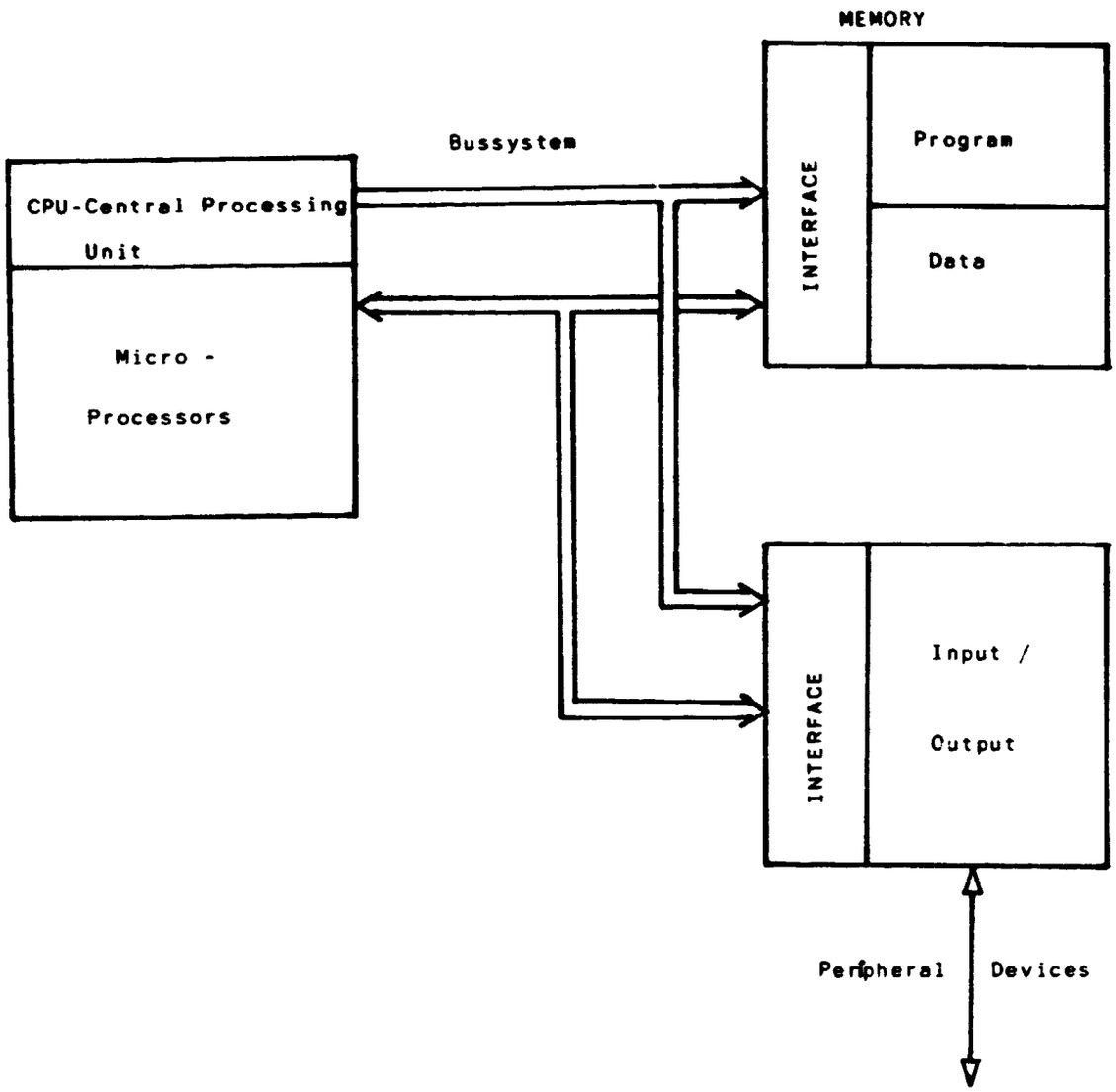


Example of architecture of microcomputer/PCs (busconcept-connections with plugs):



(* Peripheral processors)

COMPUTER ARCHITECTURE :



The minimum hardware configuration for industrial application should be:

CPU - (Central processing unit) from

512 KB (Kilo byte) to 3 MB (Mega byte) RAM

Memory

1 x 20 or 40 MB hard disk drive (Winchester) and

3½" KB floppy disk drive (640 KB RAM) or

1.2 MB floppy disk drive (max 2)

Monitor (monochrom or color screen)

Printer - nearly letter quality type

- or letter quality type

7.1. Personal Computer - PC

Until now there are PC computers which have 16/8 bit microprocessors (Intel 8088), or the 16 bit microprocessor (CMOS 8086), 40 KB ROM (fixed memory), 64 KB RAM (work memory); the most used programming language for PCs and Micros is definitely Basic. The floppy disk standard is 5.25 inches, the new floppy disks have 3.5 inches.

Since 1985 the 32 bit microprocessor is available but there is almost any software on the market; these computers should be taken into consideration in the future (after 4-5 years) because of their larger capacity and velocity in data processing. In any case a PC, intended for industrial application should have 640 KB or if possible over 1 MB floppy disk as a minimum configuration and one hard disk (Winchester) drive with 10 or 20 MB.

A complete, workable PC system including the PC itself with keyboard and monitor, a decent printer, two diskette drives, the operating system and some extras will cost US$ 5 000.- in any case and if there is a hard disk instead of diskettes required which is necessary for integrated software, the investment will approach US$ 7 500.-.

The new development of multiuser PCs will probably be on the cost [illegible] US$ 10 000.- when they become available. This are cost estimations without application software packages.

Another cost has to be taken into consideration: the cost for training of the various systems users. With the availability of user-friendly, menue-driven software the training time has certainly decreased, but still it takes at least 2 and more days to 3 weeks to learn working with a PC. For more complex applications [illegible]

[illegible] of time to provide the ability to handle CAD/CAM and also more sophisticated systems. Until now sophisticated software packages are only applicable to micro- and mainframe computers.

Before ordering a computer system the purchasers in developing countries have to be aware that for certain computers, which have built in microchips from the new generation (like IBM-AT etc.), each supplier must have an export license and a user certificate. To get such a license it can take between 2 months and 1 year. Due to embargo the selling of certain computer equipments to some countries is forbidden. This depends on the type/model of computers.

The most important selection and comparison criterias of personal computers - PCs and micro computers are :

1) Hardware (technical data)
2) Software availability
3) Practical application (not only demonstration of PCs but also practical application in industry such as: research time in dialog-processing, etc.)
4) Producer (standards, etc.) reliability
5) After sales service and maintainance
6) Costs
7) Benefits

Note: PCs and micro-computers should always provide the possibility of growing with the need of information. "modular system". An example: PC - version with two floppy disk drives is not sufficient and more so in this case an extern or build in hard disk drive can be installed without any technical problem. also the same software can be used. etc.

The basic costs of PCs normally start (for industrial application, not for "home-computers") from about US $ 2000.- up to US $ 6000.-. user software-standard user software excluded.

According to our experience of computer application in small and medium scale industry the following computers (hardware) have been selected among several producers:

1 IBM PC-AT

IBM PC AT only the new version from 1986 can be recommended. IBM PCs have the advantage of large software availability and last but not least of software compatibility with other computer companies. The IBM policy is to install the user-software in the new model or in other IBM-PCs.

2 HP - Hewlett Packard 150 II

From the technical view it is one of the most advanced PCs on the market with a lot of attributes for a personal configuration. Software packages are available. IBM compatible, but not 100%. need. for telecommunication.

3 Commodore PC10

Commodore PC20

[illegible] relatively IBM compatible, the [illegible]

availability is provided.

Modular system, ready for telecommunication.

4) Digital Rainbow 100B

Rainbow 100 +

Application mainly for research and scientific programmes. IBM compatibles.

5) Apple III (McIntosh)

PC for business, middle price range, software available but limited, compatibility also limited.

The journals for the above mentioned hardware are available over request from manufacturers or dealers.

7.2. Microcomputer

There are many micro-computers offered but it is always a question of reliability. therefore it is recommendable to buy a very well known make. In this report a selection within several makes are made. This selection was made according to the available software packages, training possibilities and after sales service

7.2.1. as first user system IBM 3x Family for interactive dataprocessing. the 36 system is also called 'compact model"

example: IBM 5364

min. 2 processors: DOS Release 2

CPU 256 K or 512 KByte

Hard-Disk cap.: 40 M or 80 MByte

Diskette cap.: 1.2 MByte 5 1/4 inch

or up to 64 remote workstations connexion possible

monitor

connexion with IBM/PC etc. possible.

IBM newest model IBM 6150

32 bit microprocessor. based on the RISC-reduced instruction set computer technology

new operation system AIX based on UNIX System V.

co-processor PC/AT. PC-compatible. up to 17 workstations-connexion possible.

Large IBM- and other user-software for technical and managerial applications available.

7.2.1. HP-Hewlett Packard:

HP-3000 system:

Basic version

CPU 512 KB (Kilo Byte)

Hard-Disk: 55 MB (Mega Byte)

up to 28 workstations connexion possible monitor

HP - user software for technical and managerial applications available. Example: the HP Manufacturers Productivity Network etc.

7.2.3. Olivetti:

The Olivetti-micro-computers and also the PCs were selected because of the connexion with AT & T - (American Telephone & Telegraph Company-Bell Company (25% Olivetti shares were both from AT & T in 1983: AT & T is also the inventor from UNIX System). Olivetti will become most likely one of the biggest computer manufacturies in the world.

Micro-hardware: L1 (Lines 1) family is made up of M30, M40 and M60 which are avaiable in the following models

. M30, M34

. M40, M44

. M60, M60/2, M60/3

All the models are fully hard- and software compatible. They are differing only in configuration procedures and processing power.

Basic version M30, M34:

4 MB main memory

power supply/input, output drives

diagnostic consoles

[illegible] for magnetic storage units

[illegible]

or one 14/30 MB hard disk drive plus

1 MB 5 1/4 inch back up diskette

maximum 4/6 workstations can be connected

Software for technical and managerial applications available.

3.2.4. Nixdorf:

8870 System Family first user system 8870 Micro 7

(or 8870 M45/55/M65/M75)

This computers are manufacured in West-Germany with a high quality standard. Own Nixdorf Software Programmes are available mainly for business and managerial application (example: user software package COMET).

Basic version 8870 Micro 7

CPU 512 KB main memory

Hard disk drive 10 or 20 MB

or floppy disk drive 800 KB

Monitor Nixdorf

c. Feasibility Report and evaluation criteria:

The Feasibility Report should contain:

1) detailed documentation of the areas specified, showing: programmes, data inputs, data sources, real times, real volumes, complexities of computations, constraints, options, data files, output reports and distribution, including guide for working paper;

2) routine and exceptional transactions to be considered;

3) cost and efficiency of current procedures; and

4) assessment of their success in meeting existing organizational goals and objectives;

5) re-examination of organization policies, if considered necessary;

6) impact of proposed computer processing on organizational structure;

7) anticipated growth of data processing requirements over the next 5 - 10 years, lead time of the computer plus its normal life span, say four years;

8) a broad outline of proposed computer operations and related activities in source and user departments (including general flow charts);

9) types of computer facilities required (hard disc 2 - 40 MB etc.);

10) estimated costs of preparation of standards manuals, etc., conversion costs, staff costs, structural alterations, out-of-pocket expenses for training, projected requisitions, design, etc., supplies, procured by:

a) [illegible]

b. post-installation costs (including major items such as computer, file, program maintenance and software support). Consideration may also be given to the common costs of new application areas.

11. estimated computer usage required to perform the operations outlined in the study;

12. feasibility and estimated cost of performing all operations at an outside facility;

13. feasibility and estimated cost of performing some operations 'in-house' and the remainder at an outside facility.

14. recommendations:

- to introduce computer processing or not,
- choice of "in-house" equipment, data centre or combination of these two modes,
- general equipment characteristics;

15. summary of ranges of costs, savings, profit improvement and other benefits broken down by application area.

The report need not specify which make or specific configuration of equipment be obtained even though the recommendation to introduce computer processing methods may have been made. It should contain all the information required to enable management to decide whether the introduction of computer processing methods should proceed or desirable.

[illegible] study places the emphasis on a management approach rather than one which is equipment oriented.

- [illegible] equipment selection criteria should be established and [illegible] defined and made available to potential suppliers.

As a result of the Feasibility Study, management will know the [illegible] of this [illegible]. The [illegible]

approximate breakdown of costs, savings and benefits. Most computer manufacturers have equipment available which is capable of performing almost all normal commercial data processing operations, but selection of a supplier should be based on many more factors than merely hardware costs and delivery schedules.

- Selection criteria should be utilized in the evaluation of suppliers proposals.

Effective control over the selection of suitable facilities and services can only be attained if all factors affecting selection such as hardware, software, equipment maintenance, staff training and test facilities.

- A list of appropriate selection criteria should be prepared and given to each potential supplier.

The list and a copy of the Feasibility Study Report will provide a standard basis for the preparation of all suppliers proposals, without which an adequate evaluation of proposals is virtually impossible.

- The selection criteria should be set out in the form of a chart on which the evaluation of suppliers proposals should be entered. Setting out the selection criteria on a chart, provides a ready means for comparing all suppliers responses against each item. It should be noted that, while the chart appears to give an artificial precision to hardware and software evaluation, these criteria should be the subject of an intense examination and only the final summary entered on the selection chart.

- Contractual arrangements should be carefully reviewed prior to making the final equipment selection and signing the contract.

After a thorough review of the evaluation chart and comparing

contract, the purchaser should insist that all special circumstances and offers of technical assistance and support as well as equipment maintenance are incorporated in it. Similarly, if the successful supplier has promised additional support in post-installation phases, this should also be carefully defined and included.

- Pre-installation tasks or activities should be identified and defined.

The identification of these activities will facilitate the preparation of a reliable plan to which subsequent progress can compared.

- All tasks or activities should be incorporated into a pre-installation plan.

The length of the pre-installation period is subject to manufacturers delivery schedules, essentially a function of the tasks to be completed and the manpower available for their completion. The pre-installation activities can be effectively controlled only if all the tasks, the interrelationships between tasks, and time estimates for the completion of each task can be incorporated and clearly depicted in a pre-installation plan or schedule to which subsequent progress can be compared.

- Pre-installation tasks or activities should be identified and defined.

A listing of all activities or tasks and their dependencies should be prepared.

The [illegible] activities which must be completed prior to the introduction of a new computer system is likely to be appreciable and the dependencies [illegible]

there is a precedence or other items. reference should be made to those items. Examples of the activities which should be included in a pre-installation planning list are:

a) completion of initial equipment specifications

b) completion of final equipment specifications

c) determination of staff requirements

d) recruitment of staff

e) training of staff

f) completion of site design and requirements

g) completion of site preparation

h) preparation of programs to be run on the computer

i) delivery of the computer

- All tasks or activities should be incorporated into a pre-installation plan.

The tasks or activities should be represented in a form which shows their interdependence and a time relationship.

Probably the simplest and most economical form is the network diagram in which each event can be depicted and its relationship to the others expressed.

Tasks and activities may also be depicted by means of various types of charts and visual display boards on which planned, revised and actual completion dates can be shown.

Table for Hardware evaluation (example):

EVALUATION CRITERIA	Supplier A	Supplier B	Supplier C	Supplier D	RATING			
					A	B	C	D
. Equipment type								
. Equipment cost								
- lease								
- purchase								
- other								
. Required staff								
. Delivery date								
. Software support								
. Available language								
. Supplier support in days								
-system								
-programming								
. Sales office location								
. Maintenance possibilities								
. Test facilities								
. Test time in hours (free)								
. Training facilities								
. Local conditions								
- Climat / heat								
- humidity								
- dust								
etc.								

Summary of major technical aspects for hardware evaluation:

1) Operating system - Machine language for elaboration and processing of datas and communication

2) RAM - Random Access Memory - internal storage capacity (memory) of the computer

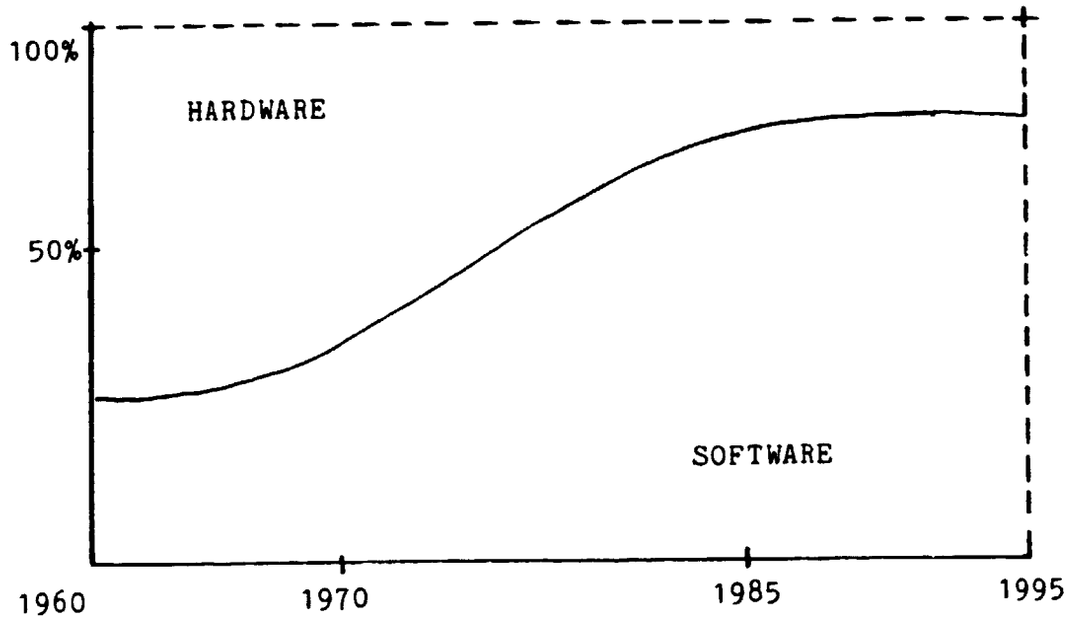
3) Floppy disk drive/hard disk drive (Winchester drive)
The storage capacity and capability of the memory for application programmes and files

4) Monitor - the capacity and intelligence of the display screen

5) Interface (bus system) - the possibility and method of transmitting and receiving information from and to devices (such as printer, monitor, external memory systems, external databases, etc.)

6) Network system - the computer availability for a multiuser - multitasking system

3.4. Relation between hardware/software for EDP (estimation):



As shown above the costs of software reach almost the costs of hardware, or the costs of the hardware between 1984 and 1986 will be 20% and for software 80%, which stresses the importance of software.

This trend can only be sopped when a 100% compatibility between several EDP products has been achieved. The pre-supposition is an agreement between the EDP producers on the standard of the installation of microprocessors and the operating system (see "UNIX/XENIX").

COMPARISON PCs - MICROS - MINIS

	PERSONAL	MICRO
Hardware:		
Memory:	64 to 256 K (to 1 MB)	128 - 512 K;
Storage:	Diskette: up to 1 MB, Disk: 10/20 MB to 40 MB	Disk: 10- 40 + MB Diskette back up
Input:	1 CRT; soon 3	1 - 4 CRTs, 8 max.
Printer	1 30 - 60cps	120cps - 300 lines/min.
Service:	Contract, on site seldom avail. by serv. comp.	Contract; on site usually avail. by serv. comp.
Expandability:	Limited	Expandable
Usage:	One fuction at a time; soon multiple	Several simultaneous functions
Software:	Numerous simple pakkages; but proven documented?	Far too expensive packages usually documented/proven; update serv.?
Support service:	Manuals and training solve your own problem	On site installation + later support
Cost: (hardware)	US$ 2.000,- 6.000,-	US$ 6.000,- 25.000,-

	MINI
Hardware:	
Memory:	128 K - 1 MB and up
Storage:	Disk 40 - Disk/tape back up
Input:	4 to dozens
Printer:	300 - 1200 lines/min.
Service:	Contract, on site by manufact. or serv. comp.
Expandability:	Very expandable
Usage:	Simultaneous multiple functions
Software:	Numerous comprehensive, proven, documented packages, with update service
Support service:	Extensive on site installations and full later support
Cost: (hardware)	US$ 25.000,- and up

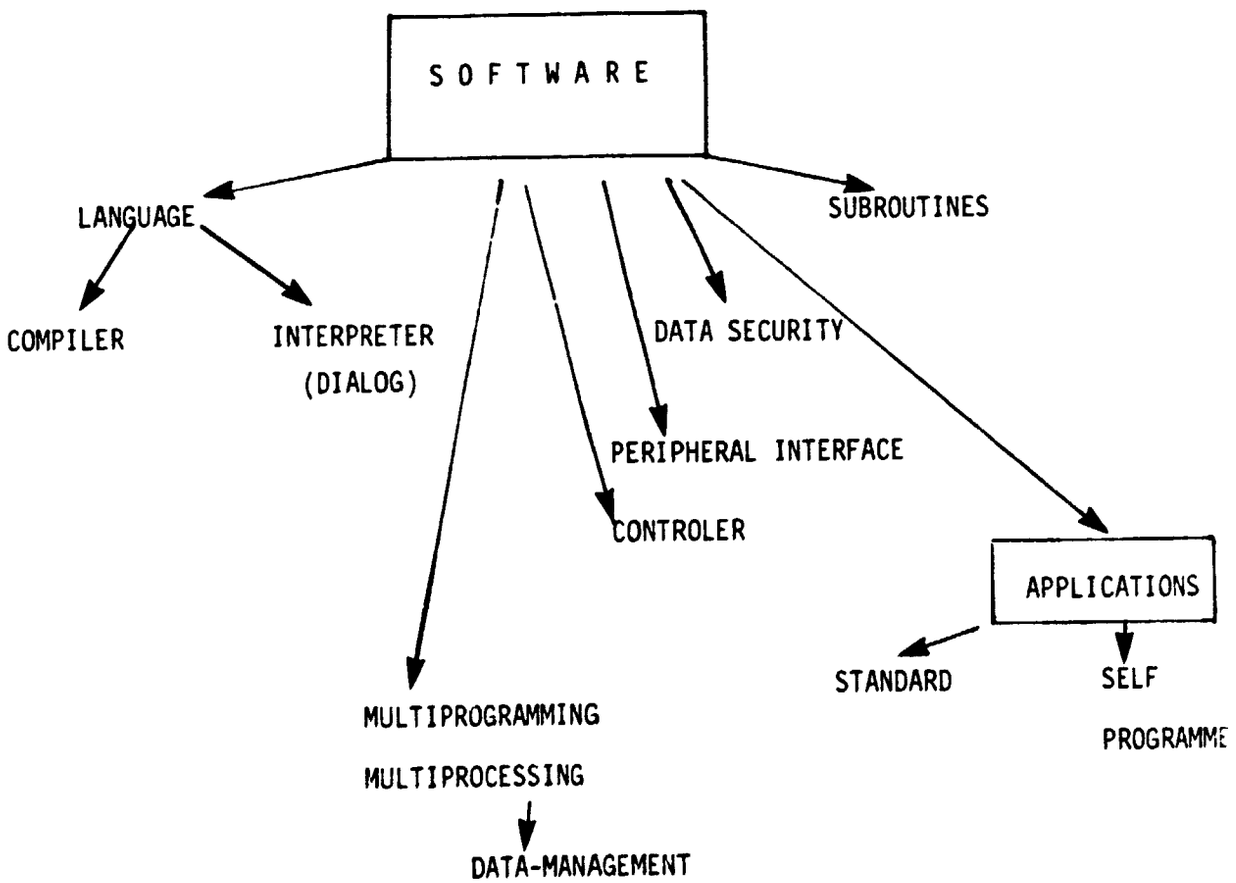
IV. SOFTWARE

4.1. Definition and introduction to software

OPERATING SYSTEM + USER PROGRAMME = SOFTWARE

PROGRAMME - PACKAGE

(SUPERVISOR, JOB AND DATA-MANAGEMENT, ETC.) ► MAKES THE OPERATION OF USER PROGRAMMES POSSIBLE



SOFTWARE MEANS THE TOTALITY OF ALL COMPUTER PROGRAMMES.

[illegible] the [illegible] of [illegible] a software [illegible] is the customization [illegible] capability: this means that the [illegible] allows the [illegible] of application, without the necessity of new programming work in order to target the established requirements of a given manufacturing environment with no additional hidden costs.

The software must [illegible] to guarantee the following customization capabilities:

- Extended customizing capabilities (advanced customization)
- Customizing the operating environment (general customization)
- Validation data, records and software code (customization)

Different [illegible] for advanced and [illegible]:

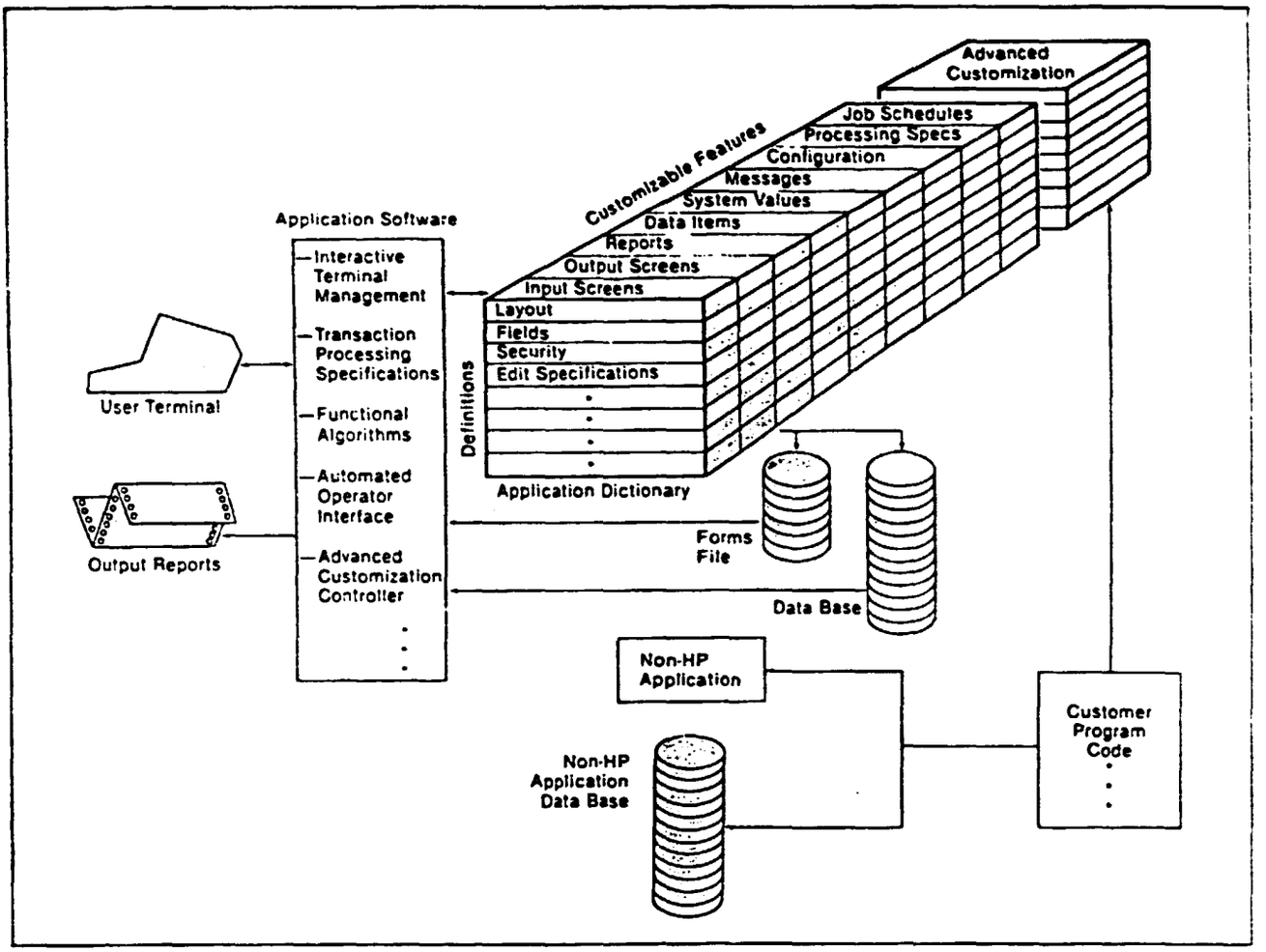


Diagram1.

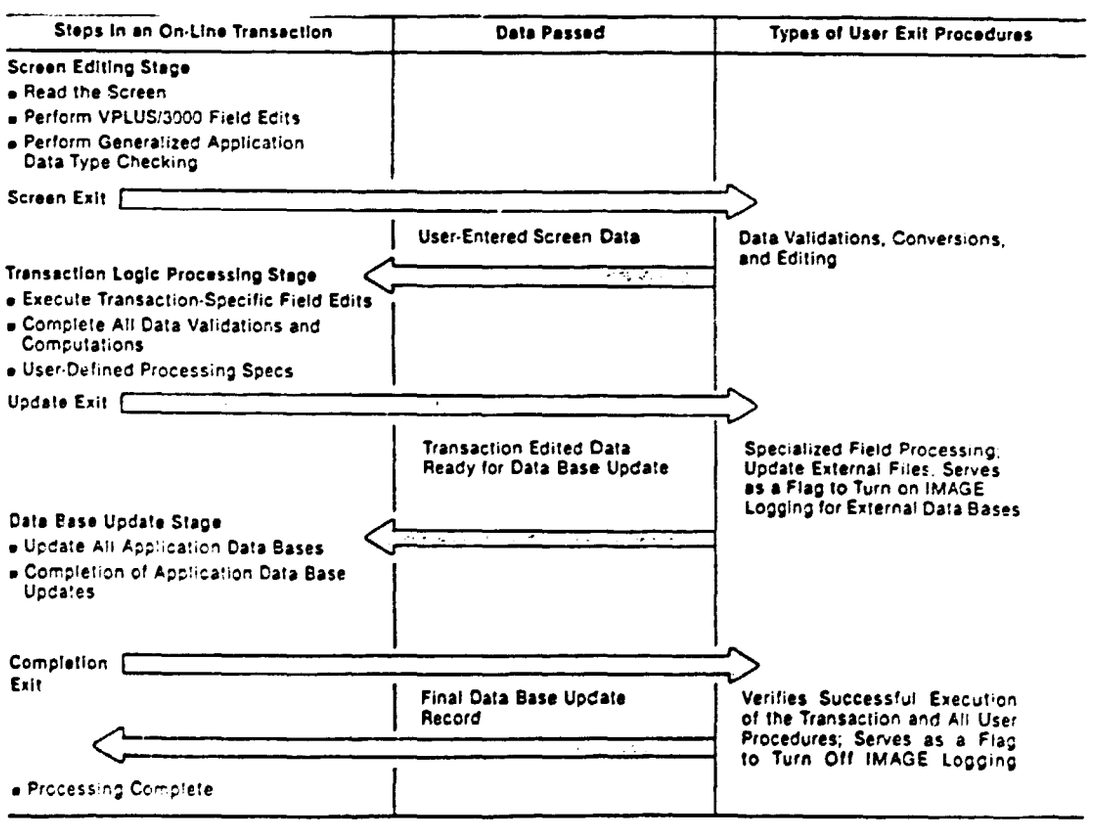


Diagram 2.

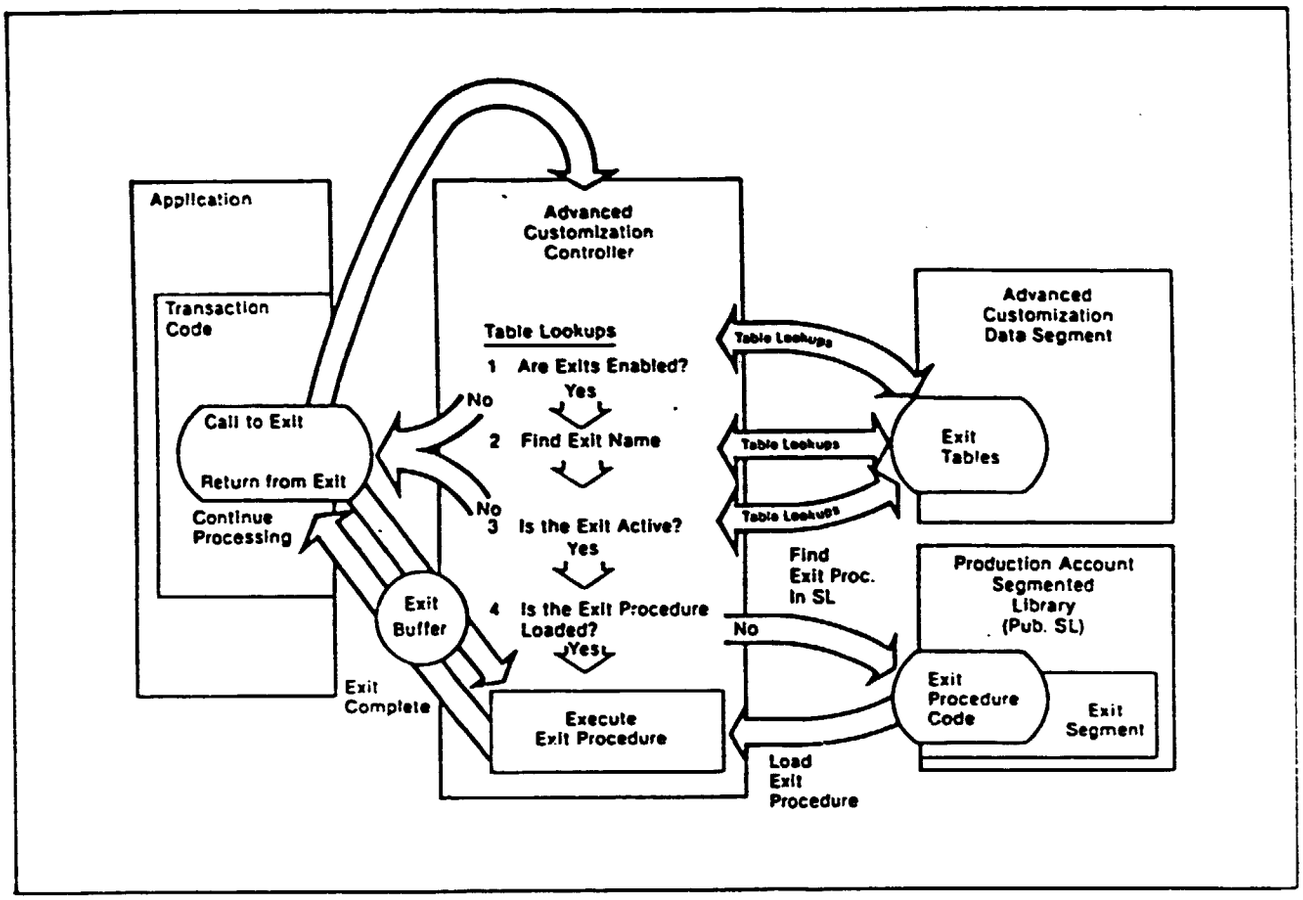

Application
Transaction Code
Call to Exit
Return from Exit
Continue Processing
Exit Buffer
Exit Complete
Advanced Customization Controller
Table Lookups
1 Are Exits Enabled?
Yes
No
2 Find Exit Name
No
3 Is the Exit Active?
Yes
4 Is the Exit Procedure Loaded?
Yes
Execute Exit Procedure
Table Lookups
Table Lookups
Table Lookups
Advanced Customization Data Segment
Exit Tables
Find Exit Proc. In SL
No
Production Account Segmented Library (Pub. SL)
Exit Procedure Code
Exit Segment
Load Exit Procedure

Diagram 3.

The application of computers in industry, especially for managerial purposes, can be defined as an introduction of "microelectronics" in all manufacturing and administrative management areas (incl. office automation).

4.1. Management Network System (MNS)

In the last years much attention was focussed on modular computerized production systems such as:

CAD - Computer Aided Design

CAM - Computer Aided Manufacturing

CAE - Computer Aided Engineering =

CAM-systems are composed of:

- .Industrial planning and control
- .Automatic warehouse (storage system)
- .Automated monitoring and reporting systems
- .Automated manufacturing systems
- .Numerical control of machines (NC)
- .Industrial robots

Of course this would be a very large application of a modular software package which sometimes needs a backup from a mainframe hardware and a very well established input-output organisation. For establishing and handling such complex programmes specially trained and experienced personnel in this area will have to be available.

In the past years it has become a necessity for developing countries to provide adequate people for a practical training in this management areas. The initial and also the update training should take place in experienced industries or training [illegible]

system the single models are combined and a Management Network System (MNS) can be created.

A Management Network System (MNS) should be composed of:

MARKETING NETWORK

- Order entry
- Warehouse management
- Service
- Transportation

ADMINISTRATION NETWORK

- General accounting
- Cost accounting
- Personnel
- Payroll

ENGINEERING NETWORK

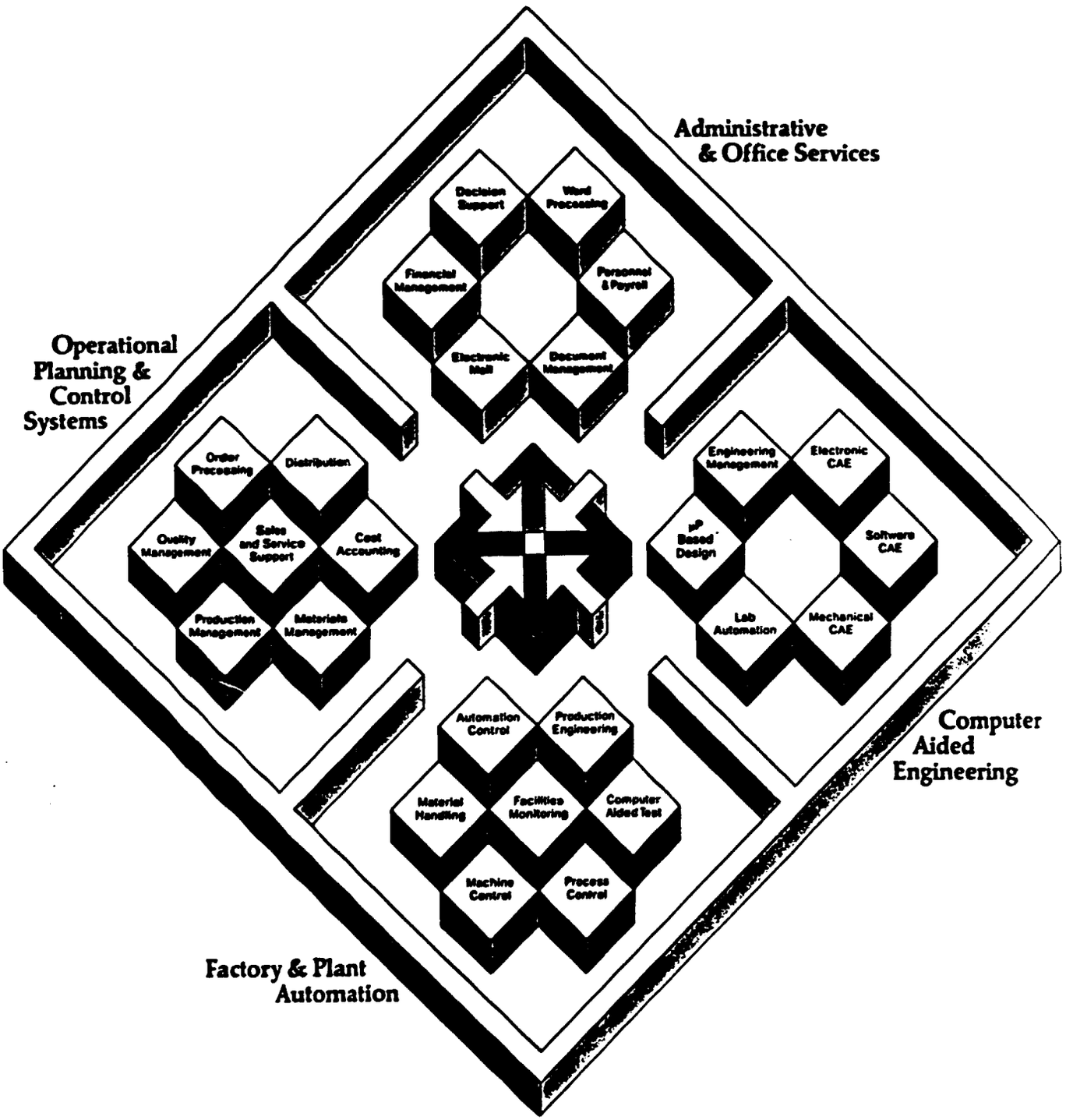
- Mechanical CAE
- Electronic CAE
- Software development, application and updating

FACTORY NETWORK

- Production control
- Material management
- Quality management
- Process control and monitoring
- Facility control and monitoring

EXAMPLE OF INTEGRATED MNS

(SOURCE HEWLETT-PACKARD)



4.3. Software evaluation

Before a software package is ordered an evaluation for selecting the most appropriate software has to be made. The primary factors for software evluation are:

- Does the software package meet the user requirements
- Is the software easy to understand and is it easy to be followed by the staff
- Is the software easy to test
- Is the software architecture modular to facilitate modifications and maintainance
- What would be the cost of eventual modification
- Does the software have appropriate documentation
- What type and what quality of training is offered by the vendor system features for evaluation:
- Documentation quality
- On-line capability
- User friendness
- Password security
- Menu driven
- Help functions
- Automatic restart recovery procedures

Costs:

- Direct cost
- Maintainence charges
- Additional costs
- Future enhancements

Advantages and disadvantages of self developed software and standard ready to buy software for management and manufacturing application:

Self developed software:

- Advantages:
  - Specifically designed for the user
  - Customization is easier
  - Acceptance of data processing
- Disadvantages:
  - Lead time is much longer
  - The time, when the software is ready to use is difficult to predict
  - The cost for the software development is difficult to estimate
  - Risk of a poor performance

Standard ready to buy software:

- Advantages:
  - Capability is proven
  - Flexibility and versatility
  - The cost is much lower and specified
  - Good documentation
  - In the most cases the vendor offers training and maintenance
- Disadvantages:
  - Customization is sometimes not easy
  - Some is not suitable
  - Sometimes poor processing capitation

4.4. Software programmer selection

The software market offers a wide variety of mind software programmers in the languages:

. English

. German

. French

. Spanish

Each of these software programmers are written from independent software houses for the most important computer brand names like IBM, Microsoft, Digital, Philips, Apple, Macintosh, etc. These software houses are according to our experience also up to a certain extend willing to adapt their software to the needs of the user sometimes with a free charge, sometimes not. But the point is that the software houses should get an exact information from the user beforehand:

- what information is needed?
- how should the selection procedure be?
- how should the questionnaire be?
- etc.

It is also up to the expanded software to local needs and to improve it to the most reasonable economic solution. Still a new software has to be discussed carefully with the user because it is very important to know the kind of knowledge which is implemented in the software programmer. Also the experience of the software programmer is important.

Below I will mention the most important, world wide

- Labour Development Corps.
- [illegible] Personnel.
- Supernumerary Labour Corps.
- [illegible] Tete
- [illegible]

[illegible] PCs and Micro-computer application some programmes have been developed in order to create an individual software. Such programmes are now available for the most important computer models at even a reasonable price. The purpose of this software of the second generation is to give the possibility to non-specialists in programming to generate an individual function and programme for industrial applications.

[illegible] some initial training how to handle the software is necessary.

Selected software programmes for PCs and micro-computers:

- open access
- d Base III
- Framework
- Lotus 1-2-3
- Multiplan
- Wordstar

Some application of the most important software programmes for PCs and micro-computers: open access and Lotus 1-2-3 are selected programmes representative for many others of the second generation.

Open access is an universal micro-computer software of the second generation. It is an integrated management system which [illegible] Data base. This concept open access with which we have [illegible] private international [illegible] function [illegible] can also be translated in all known languages. But to give the full power it can also be used as a tool for [illegible]

Application of the six integrated functions is as follows:

[illegible]

for data entered.

It includes up to five files simultaneously. Retrieved information may be listed, updated, completed, deleted, copied, printed and used for mailing.

Screen or print masks are equally defined through user dialog with open access, including - according to the individual needs - virtual fields, fields joined or range checking.

2. PROJECTIONS, MODELLING, CALCULATION

It includes a next generation spreadsheet program. Virtual memory allows applications with extremely large models. Up to four different models may be combined and viewed simultaneously on the screen within different windows. Many mathematical and business functions and additional goal seeking calculates variables from predefined results. Seven models with up to 30 submodels can be consolidated. The models are entered in a problem oriented way, adapted to individual working habits.

3. WORD PROCESSING

When entering the text it can move quickly from word to word, sentence to sentence, paragraph to paragraph. Words to be printed out underlined, bold or italicized are displayed in different colour settings on the screen. For printouts, it is possible to create header and footer parts, have pages automatically numbered and include graphic files.

4. PRESENTATIONAL GRAPHICS

The data from another module is easily transformed into synthetic [illegible] graphics, [illegible]

various types of graphic displays. Graphs can be displayed in either 2D or 3D views on the screen and printed out.

5) TIME MANAGEMENT

The electronic calendar helps to plan the time efficiently and reliably. For each month an on-screen calendar is available, providing a daily schedule to enter the appointments.

Confidential appointments are displayed on the screen and accepted only at command. Appointments can be retrieved easily by date, subject or name. At any time a personal adress file can be viewed and scanned. Schedules and personal appointments may be organized and maintained for several users. For example, at the push of a button a hardcopy of information about the daily appointment list can be displayed or printed.

4. COMMUNICATIONS

Through open access communication the personal computer becomes a link between you and remote computer systems. These may be other microcomputers, a network - or even mainframe computers. Phone numbers can be stored and retrieved by the system to make connections. Received data are displayed on the screen and may, if desired, also be stored in disk files.

The above described programme is one of the most powerful PC or Microcomputer software, it is a mulit-user/multi-tasking system.

Demanded hardware:

- Central Memory: minimum 192 KB (kilobyte)
- two 360 KB floppy disk-drives or one hard disk-drive (Winchester) and one 360 KB
- Monochrom or colour monitor (screen)
- Operating system DOS from version 2.0 and newer
- Graphic printer
- 1 x communication adapter for personal computers
- Lotus Symphony:

  It is a complete business software system and as such a multi-dimensional business tool for managers and other professionals in production and administration. Lotus Symphony was developed out of Lotus 1.2.3 from the Lotus Development GmbH.

The modules are:

- Word Processing
- Spreadsheet
- Database
- Communication

-Software Systems Listing:

1. Wordperfect

- Complete professional word processing
- Intuitive, easy-to-use commands. Full use of function keys, help
  screens, and tutorials
- Works with database to provide mailmerge capabilities and
  complete report generation
- Works with communications to send or receive electronic mail
  (word-processor ability to create, edit documents received via
  communications)
- Works with spreadsheet to provide dynamic word processing
  create documents containing and spreadsheet tables as spreadsheets
  change, report is updated automatically and instantly
- Interfaces with graphics

2. dBase

- [illegible] DBase capabilities
- [illegible] create and update database structures, entries and
  filter cells
- Easy-to-use command set or full use of function keys
- Full screen cursor control, closely with other parts of
  [illegible] with database to provide comprehensive capabilities
  [illegible] with [illegible] structure [illegible] word
  processor to provide mailmerge word processing with [illegible]
  [illegible] with [illegible] to provide easy capture & analysis
  [illegible] with [illegible] with graphics [illegible]
  [illegible] graphics

Communications

- Full-featured asynchronous communications package
- Capture data directly onto a spreadsheet or document, in usable form
- Auto dial and logon to remote databases; auto-answer
- Ability to instantly suspend session, analyze data and immediately return to communications
- Can store commonly used setups for fast, easy recall
- Works with word processor to provide electronic mail capabilities
- Fully programmable: can send or receive unattended
- Setting sheets provide full user control of communication parameters like baudrate, word length and stop-bits, tone & tone dialing, half or full-duplex and timeout periods for dialing and answering

Database

- Full-featured database generation
- Form-oriented data entry, edit and query
- Powerful forms oriented report generator
- Stores records over 32K fields (within memory constraints)
- Uses all memory to advantage to provide fast manipulation and sorting of large files
- Provides fast access to several files within a single worksheet and an unlimited number of entry, query and report forms per database
- Uses all of the full functions

- Two floppy disk drives a 360 kB or one floppy disk drive and one hard disk drive optional
- Monitor (monochrom or color) and peripherals
- Operating system (MS) DOS 2.0 or later revisions
- d Base III: ... a relational database system. It was developed by Ashton-Tate Software for the application on 16 bit-computers. The programme was created for the easy and fast handling of large volumes of data and for the creation of powerful application software programmes.

Demanded hardware:

- Central memory min 256 kB
- Two 360 kB floppy-disk drives or optional one hard-disk drive (winchester) and one 360 kB floppy-disk drive
- Monochrom or color monitor required
- Operating system DOS 2.0
- Printer optional

[illegible] software from [illegible] generation for universal Micro and PC applications. The modern frame-window-technique provides a three-dimensional powerful flexible information processing for all IBM compatible micro-PCs.

The module are:

- Word processing
- Outlining-Planning
- Database administration (compatible with dBase-software)
- Spreadsheet-Matrix
- Graphics (charts for business
- Data-access (for other PC/DOS oriented software (dBase III, Framework))

Hardware requirements:

IBM - PC, XT or other compatible systems

- 256 KB-RAM min. main memory
- two floppy disk drives a 5¼ HD or one hard disk drive (recommended drive capacity)
- Hercules or CGA monitor or color
- Operating system MS/PC DOS 2.0 or later versions

[illegible] of [illegible] other standard software packages, also if used with hard disk [illegible]

Application:

Management, auditing or [illegible] IBM-PC/XT, Olivetti M24 [illegible] Data Vision [illegible]

Prices from DM 500.- to 1.500.-

[illegible] reliability, billing and inventory control:

Price: from US$ 1.000.- to 1.500.-

- Advanced Space Graphics

Function: CAD/CAM

Microcomputer application: IBM-PC/XT, Olivetti M24 and 100% compatibles; MS-DOS

Price: from US$ 1.500.-

- Autocad

Function: CAD CAM

Microcomputer application

MS-DOS

Price: from US$ 1.000.- to 1.500.-

This programme is a two-dimensional, drafting- and design system for low-cost microcomputers. As multi-disciplin system it is suitable for a wide variety of applications such a architectural and landscape drawing, drafting for electri cal, chemical, mechanical and civil engineering. It is eas to learn and to use and it requires almost no [illegible] knowledge.

- Base Material Requirements Planning

Micro and Multi computer application

UNIX based, XENIX

Price: from US$ 1.000.- to 5.000.-

- Bill of Material System

Microcomputer application

MS-DOS, UNIX, TURBO-DOS

Price: from US$ 500.- to 1.500.-

- CAM

Multi-purpose planning and scheduling [illegible]

IBASOS, MS-DOS

Price: from US$ [illegible] to [illegible].-

- Comprehensive Maintenance Management System (CMM)

Function: energy and facility management, preventive maintenance

Microcomputer application IBM-PC/XT

Price: US$ 5.000.-

- Computer Integrated Manufacturing Software

Function: CAD-CAM, manufacturing machinery control

Mini- and Microcomputer application

Price: on request

Manufacturing cell organizational control for machine tool systems with custom design cell management, sequencing planning, including interface for other CIM system software.

- DNM

Function: manufacturing machinery control, process control

Microcomputer application (DeM-PC system

Price: PC-IBM

Price: US$ 1.500.-

- Energy Control System

Function: energy and facility management

Microcomputer application

Price: from US$ 1.000.-

- Fire Detectors and Installations

For furniture and electronics

microcomputer application

Price: US$ 500.-

- Personal Computer

MS-I-S

Price: US$ 800.- to 1.400.-

- M-Make

For manufacturing planning and scheduling, inventory control and material requirements planning

Microcomputer application

MS-D.S. UNIX

Price: US$ 2.400.- to 4.100.-

- The-Manufacturing Inventory Control System

Microcomputer application

MS-DOS

Price: US$ 2.600.-

- Job Cost Work in process

Microcomputer application

MS-DOS 2.0

Price: US$ 800.-

- Job Costing

For furniture, electronics and metal fabrication

Microcomputer application

MS-DOS

Price: US$ 1.200.-

- Maintenance Management System (MMS) or Industrial Maintenance

Microcomputer application

UCSD 1.4

Price: US$ 1.750.-

This software performs the main maintenance management functions such as preventive maintenance, work order, inventory, equipment history

DOS 2.0

Price: US$ 400.-

This software produces time scaled network diagrams

- Microbee Stock Control

Microcomputer application

MS-DOS

Price: US$ 1.400.-

This software performs a record of stock in and out move ent
and a status of all stock items or stores.

- Mvte Multi General Ledger

Microcomputer application

Ms-DOS, UNIX

Price: US$ 1.200.-

This software performs a balance sheet with a cost allo
profit and loss out in detail or consolidated on various
reports

- Multi User Order Entry/Billing

Microcomputer application

MS-DOS, UNIX

Price: US$ 1.500.-

- Multi User Manpower Planning

Microcomputer application

MS-DOS, UNIX

Price: US$ [illegible]

This software lists labour requirements by time period and
shows the route for scheduling and budgeting

- Multi User Manufacturing Standard Cost

Microcomputer application

[illegible]

- Pipe Flow (The Piping Design Data Base)

  CAD/CAM, maintenance for food industries, lumber and wood products

  Microcomputer application

  MS-DOS

  Price: US$ 600.-

- Quality alert

  for Process Control

  Microcomputer application

  DOS 2.0

  Price: US$ 900.-

  This software computes statistical quality control activities, analysis of the process capability, determination of quality specifications.

- Sales Order Entry

  Microcomputer application

  MS-DOS 2.0

  Price: US$ 750.-

  [illegible]

  For pre-feasibility study, developed by UNIDO-Vienna

There are also complete software-packages for many industrial branches covering the most important management areas. These software-packages should be studied carefully one by one. If they match the needs of the requesting tenderer in developing countries (see also chapter "Recommendations").

Software-packages are available for the following [illegible] environment:

[illegible]

Piping Plant and Machinery

[illegible]

- [illegible] pharmaceutical industry

- Furniture manufacturing

- Textile industry (spinning, weaving, dyeing etc.)

[illegible]

[illegible] number of networks and communications for digital equipment [illegible] said in 1984 that networking is a survival [illegible] in 1986 [illegible] are becoming more and [illegible] developing countries. The two key elements of [illegible] communication [illegible]:

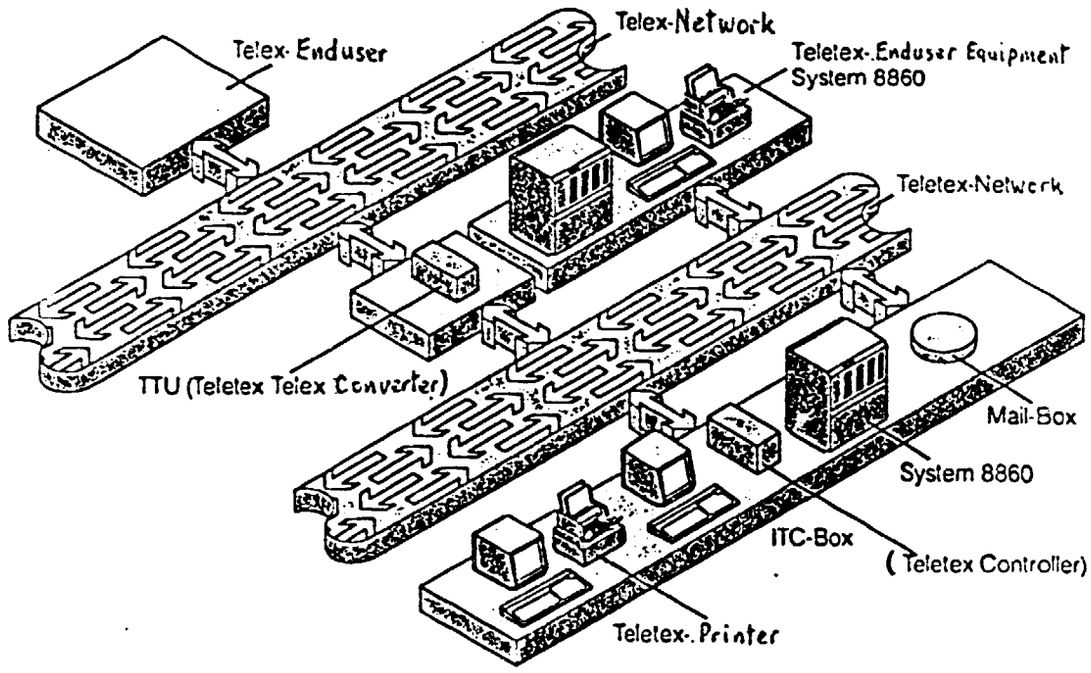
1. [illegible] computer systems, PCs or micros with the necessary software, connected with mainframes.
2. Long distance services, such as electronic mail, teletex, telefax etc.
3. [illegible] with the required speed (300, 1200 [illegible]) etc.

[illegible]

[illegible] stage of networking.

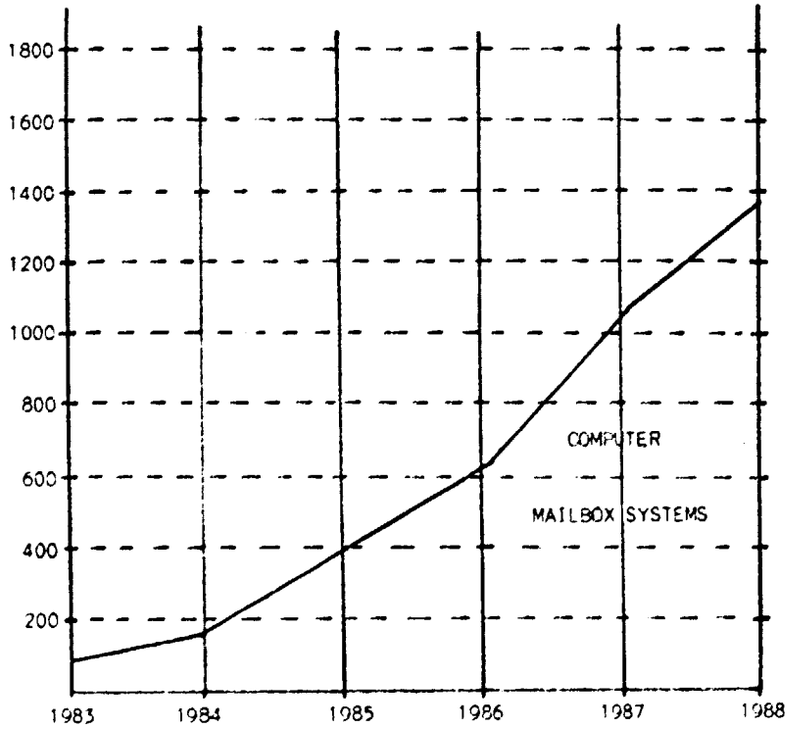
[illegible] Terminological Data Bases [illegible] future [illegible] the "electronic mail" service. This electronic mailbox system works like a telex service. With the [illegible] that a telex machine is not necessary, only a PC or [illegible] and a telephone modem have to be installed. [illegible] electronic mail can be [illegible]

Example of a TELE-COMMUNICATION NETWORK (source Nixdorf-Computer AG.) :



This Network System provides the user a fast electronic transfer of original documents between TELETEX and TELEX SYSTEMS.

THE PUBLIC ELECTRONIC MAIL AND ITS DEVELOPMENT :



Source : International Data Cooperation

4. Recommendations:

5.1. Due to the growing demands e.g. from industrial managers in developing countries for strengthening their management capacities and supporting the decision making process through computer applications, it has become necessary for UNIDO to establish a software library for management software packages. This library should provide to users: catalogues, printouts, newspapers, publications on soft- and hardware etc., and specially some selected software programmes. But this software can only be useful to developing countries if these programmes can be tested and shown to interested people in connection with hardware systems. UNIDO should have in the future a demonstration unit that can visit and at a training center. At the same time a library [illegible] hardware systems must be established. To consider this there would require a feasibility or preinvestment [illegible] [illegible] in the context of the [illegible]

- which suitable software programmes can be used in what manner;
- what hardware configuration can be recommended for the required information (case study with pre-feasibility study) and how can it be financed;
- how the organization for the data input and output should be established.

For the execution of this demanding work and for the efficient administration of the software library it is necessary to [illegible] up to four microelectronic/informatic specialists, which are maybe available in UNIDO but not in the factory establishment and management until now.

[illegible]

hardware and software manufacturing and application. It cannot help anybody if informatics and training centers are not aware of the shortcomings and the necessary updatings of information or programmes cannot be made in time. This would create the effect of "back to the future". This means speaking today of already outdated informations and using the results of new investments which are already obsolete. The industrial managers in developing countries should always be well informed of the trends and shortcomings in hard- and software systems, otherwise the pay-back period of the often quite high investments for the computerization of industries will get too long, and the hard- and software cannot be utilized. The establishment of this kind of software [illegible] should provide the possibility of testing several [illegible] support software programs before buying a particular one and [illegible] developing countries has to take into consideration the compatibility of hardware + software, etc.

[illegible] offers for the computerization of industry.

Managers should be aware that no computer system can solve problems existing in their factory. A computer is only a tool to support management decisions and functions, but the efficiency of the support depends on the state of organization.

This consulting group for computerization of flexible managerial decision support system has to fulfill the following tasks:

- Diagnosis of enterprises
- Identification of critical areas
- Planning and executing of computerization
- Selecting (consulting) on hard and software applications
- Control of establishment and introduction of computer system
- Project documentation and follow up

operation of installations

- Initial training and coordination
- Workshops and follow-up-training
- Establishing and maintaining cooperations with hard- and software manufacturers
- Publication and transfer of information to users
- Maintaining the constant dialogue with the users.
- Exchange and documentation of informations on hard- and software systems
- Sensibilisation of responsible managers for possibly arising social problems such as dislocation etc., caused by the fact of too fast, uncontrolled computerization.

The size of the necessary demonstrationsmodel must be measured according to the real installations. It can be envisaged as [illegible] AT and an M. The installation should include:

[illegible] systems (IBM and HP or Olivetti)

[illegible] PC, Olivetti, Toshiba, IBM.

The hardware installation can be changed from time to time according to the requirements given. The needs of customers and the availability of software. These computer installations have to provide the possibility of networking and through connexion to the IBM mainframe computer installed in Vienna International Center. Another computer capacity can be utilized and demonstrated to UNIDO customers. Also short demonstrations of hard- and software during workshops and visits of delegations can be made with stand-alone systems, or simulating more than one workstation. Pedagogically it is necessary that people see how software programmes can be used. The advantages of computer application in the management process and the efficiency of the installed software programmes can be shown through a printout or

[illegible] short this is not [illegible] and additional entities the work of an established software center. Another [illegible] trade is the future establishment of a direct logical connection with information data bases. Then a wide field of informations is available and these informations can be processed on the own or [illegible] equipment (software interprocessing) and then transmitted to the users in developing countries (see chapter on telecommunication and integrated networking).

As the initial investment in such a software library and training center is presumably high, other alternatives than buying should be taken into consideration.

One possibility is to 'lease' hardware systems.

[illegible] leasing is a special form of renting equipment and training to a certain timeframe. Leasing usually does not include the person who uses it.

It is small, even 'first on lease' for him and he has to get more [illegible] in business. To lease equipments is very common in [illegible] activities. The term of the leasing contract usually is that the 'lease' 'tenant' has the right to buy the equipment after the last leasing rate is paid. The leasing contract defines the 'buying amount'.

This 'buying amount' varies usually between one or two monthly leasing rates, this depends fully on the leasing contract terms.

Example: Intermediate Loss no 65

Duration observed period:

(all in)	24 months	36 months	43 months
	4.16% month	2.77% month	2.33% month
	of equipment	of equipment	of equipment
	value	value	value

to buy the equipment the remaining value is one month rent

example: 24 months equipment value	100 000.-
4 760.-/month - total 24 months	114 240.-
	4 760.-
	114 000.-

5.2. To get hardware systems installed at the UNIDO Software [illegible] relations should be made with hardware manufacturers and/or [illegible].

In the negotiation with the companies such as IBM, Olivetti, etc., the promotional factor of exhibiting their products in an United Nation Software Center should be strongly underlined. Manufacturers should get the feeling that in consequence of this exhibition the possibilities of introducing their products, or of increasing sales in developing countries are very high. It should also make possible to promote a direct contact between the experts of the permanent missions or those from developing countries, who are visiting UNIDO, and computer manufacturers or [illegible]. In order to establish a good cooperation for [illegible] and hardware development, to get help for training of staff [illegible] for promotion of industrial

developing countries.

It will become important to work together with computer-specialists because of their experience in application of computers and modification of software-programmes for industrial management purpose. When a computerization project starts, the local conditions are a given fact. In this case it is necessary to adopt the project to these local conditions. But in many cases there is no possibility to change this local conditions and to create new and more favourable concitions for computerization in developing countries. The possibilities of adopting local conditions to the requirements and needs of the project can only be evaluated after an analysis of the possibility study, made for computerization of a particular project (see also chapter 4.1) and work out how to design together with multi-country center staff and professionals from the manufacturers side.

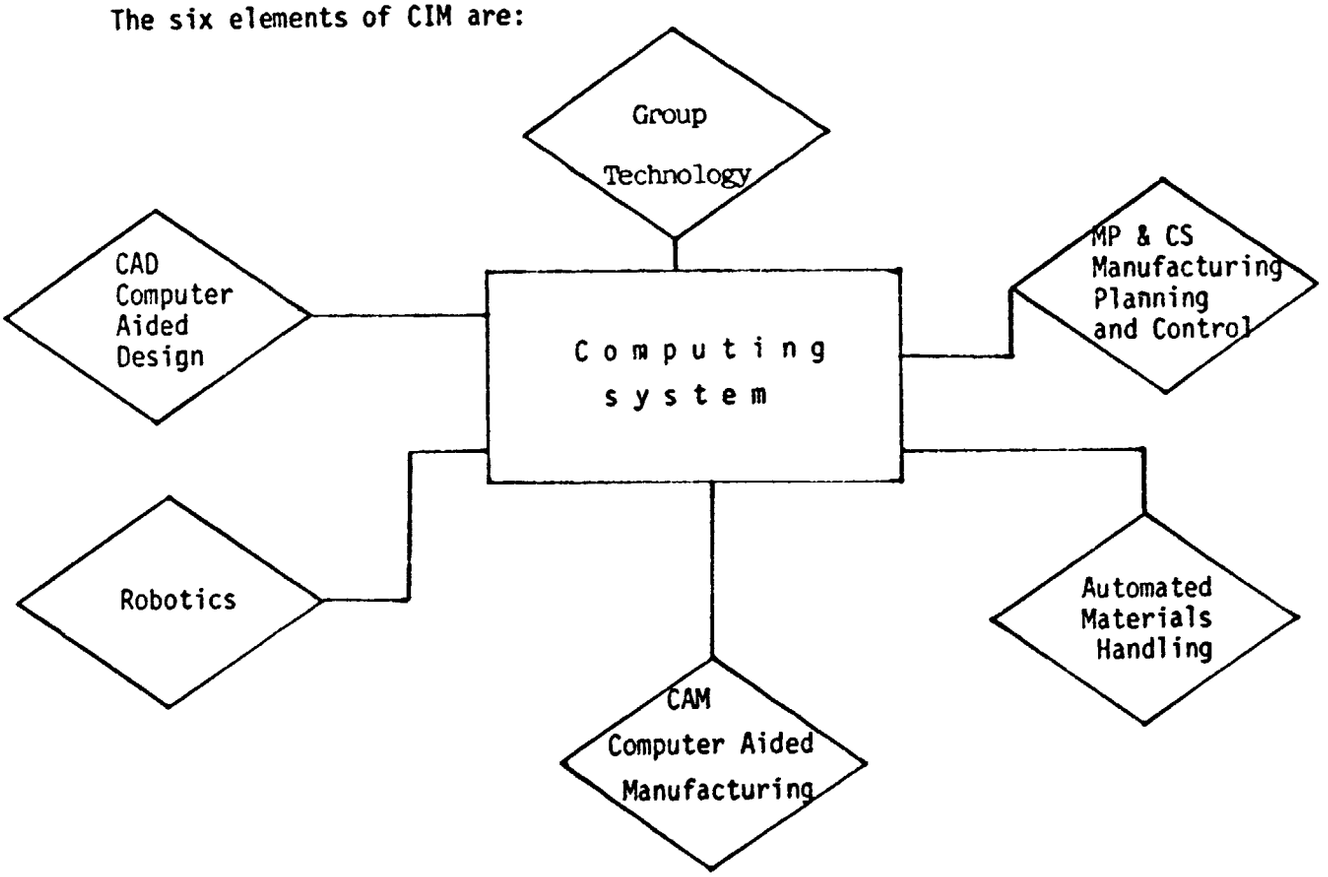
VI. Annex

The following pages will give an overall information of one of the most important future integrated software packages called - CIM - Computer Integrated Manufacturing.

Note: CIM should never be a loos colleciton of datas and technologies but as system that integrates them all. The integration of datas is the key to realize the great benefits of CIM.

CIM - description:

The six elements of CIM are:



C I M terminology:

CAD: Computer aided design, the wide application of computer graphics to design.

CAE: Computer aided engineering, the wide application of computer systems and computer graphics to engineering analysis.

CAM: Computer aided manufacturing, the use of computer system in the manufacturing process. analysis

CAPP: Computer aided process planning, a system which enables the planner to create, simulate and modify interactively the process plans.

CNC: Computer numerical control, the use of electronic processors / computers for the control of machines.

DNC: Distributed numerical control, the use of electronic processors / computers for the distribution of programmes and for the controlling of machine groups.

DRP: Distribution resource planning, a system for planning the most effective use of all resources involved in th production process and product distribution.

DSS: Decision support system, the application of computer technology in supporting all managerial decisions making process.

FMS: Flexible manufacturing system, work cells without human labour.

GT: Group technology, coding and joining parts into part-families based on similarities in their production process.

JIT: Just in time production system, for tre minimization of inventory required for production.

MP and CS: Manufacturing planning and control system, a computer supported manufacturing information system, providing plans and also control functions.

MRP: Manufacturing resource planning, an efficient system for planning all resources integrated in the manufacturing process.

PROCESS CONTROL: A system providing automation for continous operations or processes.

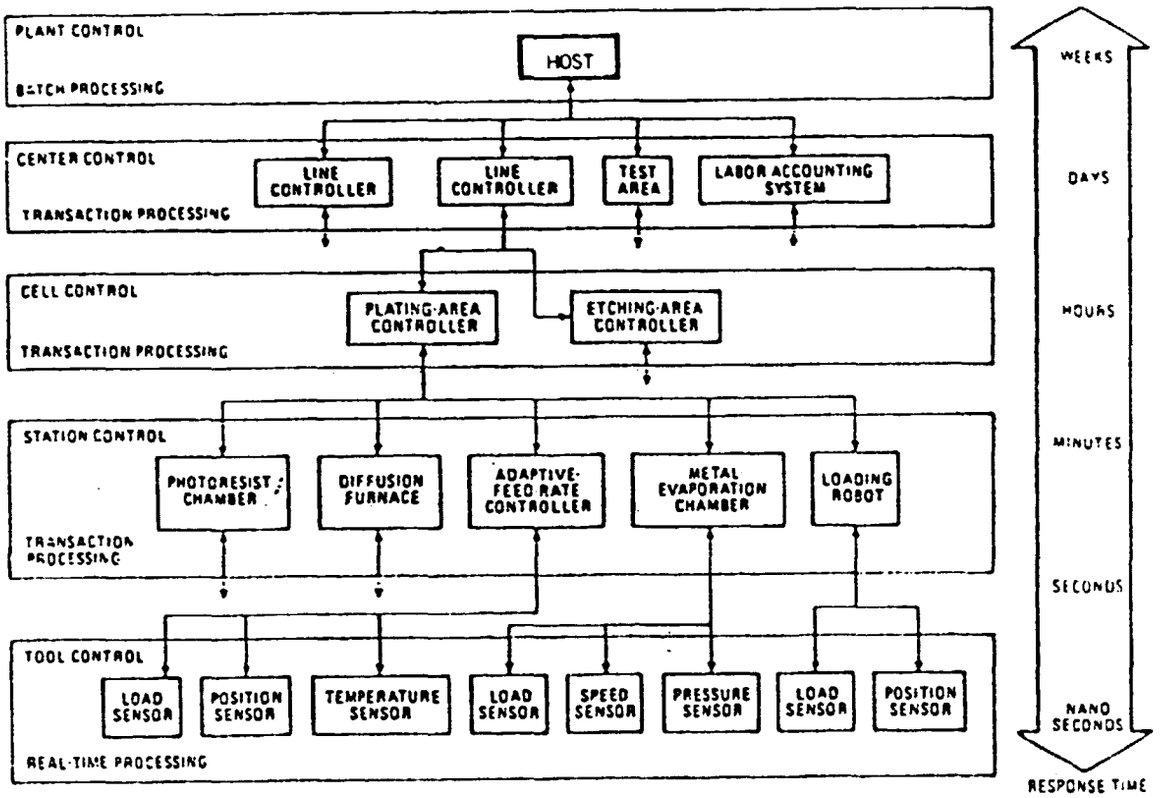
QMC: Quick mold change.

WCDP: Work cell device programming, design, coding/monitoring and test of programmes for the electronic/computer-controlled machines in work cells.

WORK CELL: An individual defined production center, consisting of one or more machines (group of machines) and persons.

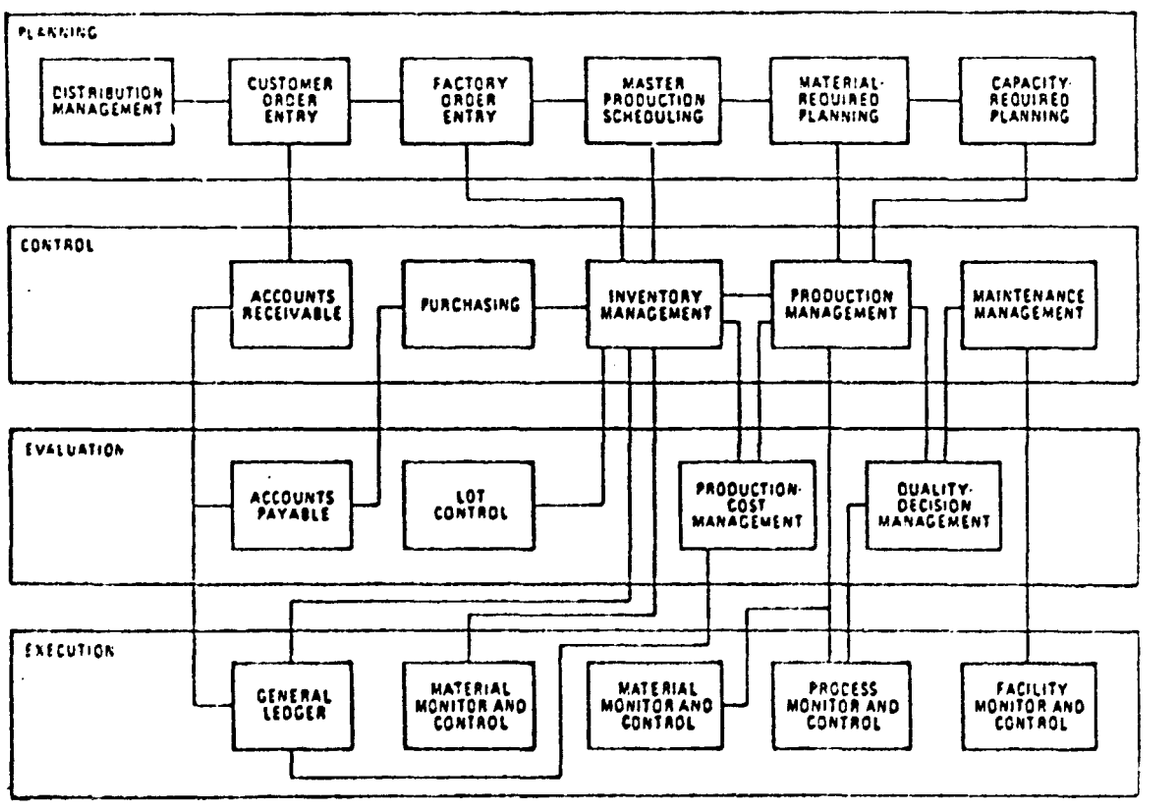
CIM - ARCHITECTURE AND DATA BASE: (source Hewlett-Packard Co.)

1.



1.Computer Control: Hierarchical and distributed control architecture is required for all Computer-Integrated-Manufacturing Systems. This architecture increases both computing and control efficiency, eases fault-finding, and makes the system easy to modify.

2.

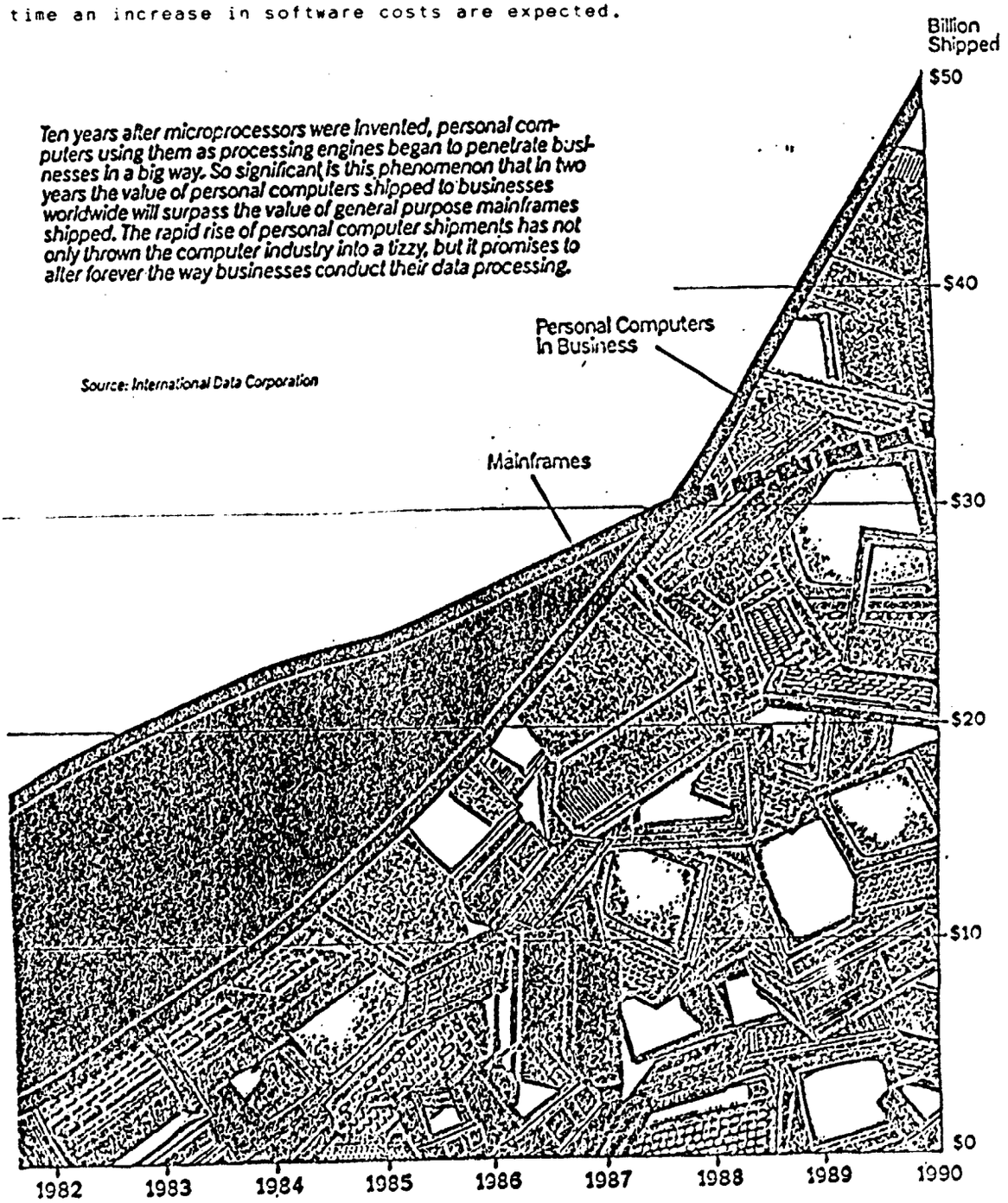


2. CIM-Data Base: Design, production, management and accounting data feeds the manufacturing data base for a real-time electronic mode of the CIM environment. Application software for each of these functions provides the data control and processing tool.

The following pages showing the future developments of software packages and hardware systems. The future aim is to produce for computer application the next generation of:

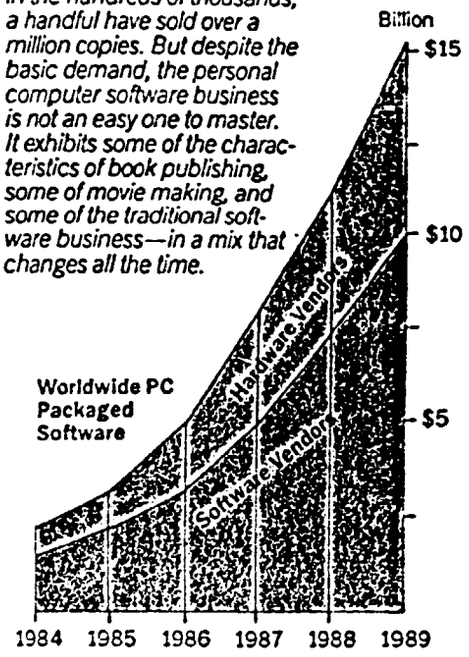
- circuits (micro-chips) which are much smaller then those are used in computers of today.
- increasing the memory capacity of todays systems(laser-disk based memory etc.).

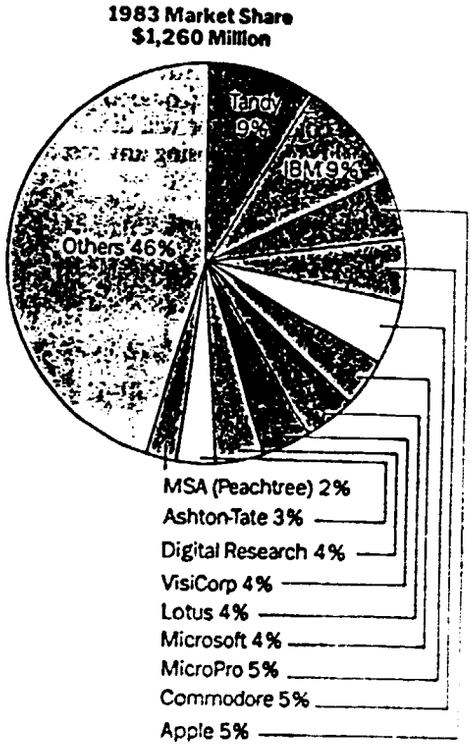
This will conduct a decrease in hardware sales price, but at the same time an increase in software costs are expected.



SOFTWARE DEVELOPMENT FOR PERSONAL COMPUTERS

The proliferation of personal computers has permitted great economies of scale in software development; dozens of programs have sold in the hundreds of thousands, a handful have sold over a million copies. But despite the basic demand, the personal computer software business is not an easy one to master. It exhibits some of the characteristics of book publishing, some of movie making, and some of the traditional software business—in a mix that changes all the time.





Figures below showing the budgeted investment for research and development of the new so called "Supercomputer"in the USA.

Five year budgets (1985-1990), million of dollars (US$):

	National sience Foundation	Univers.+ States	Corporate contribut*	Total
Cornell	$ 22	$ 12	$ 95	$ 129
Univers. of Illinois	44	22	50	116
Princetown	70	31	23	124
Univers.of California/ San Diego	60	25	15	100
	$ 196	$ 90	$ 183	$ 469

Data: Participating institutions

*Figures represent each center's goal for cooperate contributions, including the value of equipment and personnel donated by computer vendors.