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By

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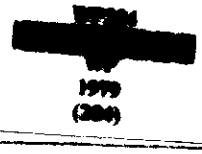

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ABSTRACT

The use of computers in Management has ranged from Processing of Operational Data to Development of Corporate decision models. Planning of Information Processing System as a Part of the Management Information Systems in organisation, is essential for deriving the benefits of computers for generation of information for planning, control and decision making. In this paper, some of the problems which are being faced in implementing information processing systems are discussed. An approach for implementation of such systems based on information analysis and choice of technology has been evolved. Availability of various range of computers and their impact on the information processing systems is also discussed.

1.0.0 INTRODUCTION

1.1.0 Since the last about two decades, computers are being used in India for information processing for Management. Presently, there are about 450 computers in India. Table-I shows the increase in number of computers over the years in various sectors. In addition to the computers, there are more than thousand unit record machines being used by various organisations for data processing purposes. The use of computers is widely spread in India. Many medium and large organisations who do not have computers are buying computer time from larger computer centres.

TABLE - I

Year	Education, Research & Development	Public Sector	Private Sector	Total
1960	1	-	-	1
1965	14	9	5	28
1970	30	49	42	121
1975	63	126	92	281
1978	93	183	108	384
*.	16	34	14	64
Total in 1978	109	217	122	448

* Date of installation not available

Source: Electronics, Information & Planning, December, 1978

1.2.0 The use of computers in management has ranged from processing operational data to development of corporate decision models. However, a major part of the use of computers in management is used for financial accounting. Other significant applications being in the areas of inventory control, sales analysis and pay roll. Though computers are beimg used to a certain extent in generating information for decision making, they have not been used on a wide scale for planning and decision making in various functional areas and corporate levels in organisation. Some attempts have been made in developing computer based information systems for operational decision making and for management control.

1.3.0 The impact of information processing system is yet to influence most of the decision making processes at senior functional level managers as well as at the corporate level. It was observed that managers from various departments such as, production, marketing, purchasing, etc., did not feel the advantage of computers even if the computer has been in use for a number of years. However, in the same organisations, the top management seems to be happy with the computer use because of the possibility of faster processing of financial information, share accounting, pay roll, invoicing, etc. In this paper we are discussing some of the problems which have been faced in implementing information processing systems and suggesting an approach for implementation of such systems in view of the developments in information systems design and technology.

2.0.0 PROBLEMS IN IMPLEMENTATION

2.1.0 The choice of computer applications and the lack of involvement of major user departments in planning of information processing systems and in the information systems design, has been one of the major problems in the development of computer use for decision making. As the computer systems have not been integrated fully as essential parts of the over all management information systems of an organisation their interface with the user, has not taken place. Computer applications have been developed as and when a problem related to data processing has been identified. System planning of developing information systems is not being done as an important task for management of information in the organisations. The involvement of user departments in determining the information needs and in the system design, is important for designing effective information systems. As the functional managers are the users of final information outputs of the computer, lack of their involvement in the system design will some times result in generating reports which may not ultimately be useful.

2.2.0 Lack of effective involvement of the system designers in understanding the users' need has also affected the design of information processing system. In order to understand the information needs at various levels and the nature of computer based analysis and processing the system designer would have to involve themselves in

understanding company's operations and decision making processes at various levels.

2.3.0 The involvement of top management in increasing the interface between the users and systems designers in developing effective information systems, their support in creating such interaction would help in improving the quality of information systems in an organisation. Top management in many organisations have not laid importance in the development of formal information systems for planning and decision making.

2.4.0 The location of computer services in the organisation, plays a very important role in developing information systems. There has not been a uniform pattern in the level of head of the computer services/management services in the organisational structure. Many data processing departments form a part of the finance department which some times restricts the development of applications in other departments.

2.5.0 Non-availability of trainned manpower for designing computer based information systems has been one of the important constraints in designing such systems. System designers at the initial stages have been drawn from various disciplines such as accounting, statistics, production, etc., and trainned mostly through the short term programmes organised by the manufacturers. These trainning programmes do not however, develop skills which are needed to develop organisation-vide information systems.

2.6.0 Another major problem in designing information processing systems has been in the area of data flow, procedures and systems used while converting manual systems to the computer based systems. While computerising a particular application in an organisation, it is necessary to study the collection and flow of data and also modify procedures and methods of systems to match the requirements of the computer based systems for deriving maximum benefit in generating timely information for decision making. For example, while designing material information system, one commonly observes that use of inputs relating to updating of inventory level on the basis of supplier's bills results in considerable delays in generation of information. In case information is processed before the receipt of the bill, it results in incorrect information including reporting of negative inventories. Therefore, for processing of information in time for decision making relating consumption of materials and for determining the stock levels, it would be necessary to change the procedure of generation of inputs and updating of inventories on the basis of purchase order prices already available at that time. Matching of manual systems and procedures to take the advantage of the computer forms an important part in the information processing system.

2.7.0 Computer technology being used for last few years, has been another major factor in limiting the use of computers for decision making applications. The second generation technology which was available to the commercial users could not be always used for developing computer based information systems for planning and decision making. Availability of appropriate information technology and its matching with the information processing requirements of an organisation is essential in the design of information processing systems.

2.8.0 Some of the problems discussed above have restricted the growth of computer applications in organisations for planning, decision making and control. However, the developments in computer technology and the greater appreciation of the computer use by the management, is helping now in the development of effective information processing systems for decision making.

3.0.0 DEVELOPMENTS INFLUENCING INFORMATION PROCESSING

3.1.0 The developments in information processing systems have been influenced by the developments in the areas of management planning and control systems, systems analysis and information technology.

3.1.1 The process of planning and control systems in an organisation which includes developing of targets, preparation of budgets, fixing performance levels, monthly review of performance, etc., have had an impact on the design of information processing

systems. The designers of management planning control systems have affected the information processing development through the demands on the analysis to be performed and through the design of reporting systems.

3.1.2 At the same time, Analysts have been evolving different techniques and approaches in studying an organisation as a "system", developing integrated information systems and developing models for the decision making and planning. These have had an effect on the design of information processing system over the past few years.

3.1.3 The third area of developments which has influenced the design of information processing systems, has been the developments in information technology. These developments had been in computer hardware as well as software systems. The professionals in this area have tried to develop efficient systems for organising and managing the data in a company as a central resource. The developments in software systems have resulted in developments of special purpose commercial languages, application oriented software, computer models, model building software and data base management systems. This has helped in handling large volumes of data for organising data as a central pool of data which can be used for various applications. These technological developments have considerably influenced the design of computer based information systems.

While the developments in the above 3 areas have taken place almost concurrently, very little work has been done in matching one with the other. For designing information processing for an organisation, study of all the three aspects discussed above, are necessary for effective implementation. None of the above aspects can be looked in isolation while implementing information processing systems.

3.2.0 Developments in computer technology has resulted in the increase of computer capabilities coupled with declining costs. There is a wide range of computers available in the market either through import or from indigenous manufacturers.

3.2.1 Large computer systems having high speed processors and large storage devices as well as very small micro computers with limited processing and storage capabilities are available. The availability of such wide range of computer technology is making it possible for management to choose the appropriate information technology keeping in view the nature of operations, the types of applications, the organisational structure and the technical support available in the organisation.

3.2.2 Exhibit-I gives the salient features of different ranges of computers. The exact details of these features would vary from one computer to the other but the table presents an idea to understand the differences between the various classes of computers.

One could see from the Exhibit that many Hardware and Software features available on large and medium computers are available on mini computers. Micro computers with small processing capabilities and storage devices like diskettes and slow inputs - output peripherals are available at very low cost. The data preparation for computers using data entry terminals is becoming much more popular than the use of cards. These developments not only have reduced the capital cost of computers but also the costs of operating these systems.

3.2.3 The Department of Electronics has set up a procedure for import of computer systems in India. This has helped many users in procuring latest technology at reduced prices. The Department of Electronics before sanctioning the import of computer, demands complete information on the type of applications in the organisation. This has helped the organisation in conducting indepth studies of computer applications for understanding the use of computers for decision making and planning.

4.0.0 IMPLEMENTATION

4.1.0 The above developments make it possible now to develop information processing systems using the appropriate computer technology for planning and decision making in organisation. The planning of information processing systems have to be integrated with the overall planning of management information systems in an organisation.

Management of information has to be recognised as an important organisational task.

Planning of information processing systems as a part of the overall strategy for the design of management information systems in an organisation, is therefore, essential. The reason for planning the implementation of such systems may be summarised as follows:

(a) Information processing systems has direct bearing with the developments in management planning and control processes and the strategy adopted for development of formal management information systems.

(b) The development of these systems involve the use of sophisticated technology and considerable cost.

(c) These systems have to be developed by trainned personnel having knowledge of computer application, latest techniques in systems design and computer technology.

(d) Use of computer based systems has organisational level impact.

(e) Conversion to computer-based systems demands changes in the existing systems, procedures, and methods of working.

(f) Computerisation in bits and pieces may not lead to optimisation of resources and generation of integrated, relevant, and useful information for planning and control.

(g) Benefits of computer information systems would directly relate to the choice of applications.

4.2.0 In order to integrate the developments of information processing systems with the planning and control systems of the organisation, a set of steps have been suggested. Before taking-up the actual computer systems design, it is necessary to use the steps for determining the choice of applications and the nature of information technology to be used. These steps are discussed below.

4.3.0 INFORMATION ANALYSIS

4.3.1 The task of information analysis for identification of applications forms the first step in designing formal computer based information processing systems. In identifying the application areas the system designer has to do the following:

(a) Study the organisational characteristics (the operations and the environment)

(b) identify the major tasks

(c) Study the Planning, decision making and control processes involved in each of these tasks

(d) Identify persons who are involved in conducting these tasks

(e) Classify information system (application areas) on the basis of information requirements of the tasks.

(f) Designing reporting systems.

These steps are necessary to develop the framework for Management information system under which the information processing systems have to be developed.

4.4.0 RELATING INFORMATION NEEDS TO APPLICATION AREAS

4.4.1 Having identified the application areas, the second step is to understand the information needs of each of these applications. As the nature and frequency of processing and analysis will vary from one application to other, these requirements have to be understood for designing information processing systems. In Table-II we have given examples of some of the decisions and examined the nature of requirements in relation to frequency, processing, number of variables and volume of data. These applications have been classified in three commonly known categories of Planning & Decision Making namely; Operational Control, Management Control and Strategic planning. The nature of processing will be different in all these three categories.

4.4.2 The decision relating to the operational control will need more data related to status of events, or need data on possible alternatives in operation (machine loading and allocation, Placing purchase orders, etc.). Some of these decisions can also be programmed. As these decisions eminate data on basic operations, the volume of data to be processed for these decisions would be large. The number of variables, however, will be small because most of these applications relate to individual tasks and not to organisation as a whole.

TABLE - II

Nature of decision	Some Examples	Frequency of decision	Nature of Processing	No. of variables	Volume of data
Operational Control	(1) Placing Purchase Orders (2) Production Scheduling	High (Daily/ Weekly/ Monthly)	(1) Providing Status information (2) Information on alternatives	Small	Large
Management Control	(1) Review of Performance (2) Deciding Product mix (3)Formulating Budgets	Low(yearly/ quarterly/ monthly)	(1) Analysis of variances in costs (2) Information for selecting standards (3) Model Building	Large	Small
Strategic Planning	(1) Choosing New Product Lines (2) Setting Marketing Policies	Very Low (Yearly or as and when needed)	(1) Model Building	Large	Very Small

4.4.3 In contrast, the decision relating to product mix would be made with lesser frequency. The type of Processing needed will be in relation to model building. As the data would already be in processed form, the volume to be handled will be much less compared to the first category of decision making. Similarly, application areas for strategic planning kind of decisions, will be more in the area of model building.

4.5.0 RELATING INFORMATION TECHNOLOGY TO INFORMATION NEEDS

4.5.1 Having studied the nature of information requirements of individual applications the next step would be to match information technology requirements to these applications. These requirements have to be worked up in relation to data preparation activity, nature of input and output devices required, Processor requirements, main memory size and requirements of data storage. In Table-III the relationship of the above requirements with different classes of applications has been given.

4.5.2 The applications in the category of operational control will need fast input/output devices and large storage devices because of the high frequency of decision making and large volume of transaction. In contrast, the model building type of applications will need large size of main memory and computers with slow input/output devices can also be used for these applications.

TABLE - III

Operational Control	Data Preparation activity	Nature of Data input device	Nature of output device	Size of Memory	Size of Storage
	Large	Fast	Fast Response	Small	Large
Management Control	Small	Slow	Slow	Large	Small
Strategic Planning	Very Small	Slow	Slow	Large	Small

4.5.3 These requirements are to be noted while designing computer based systems. As the same information system would be generating information on different decision with different frequency, the nature of processing and hardware/software requirements have to be clearly workedout and incorporated in the system. In table-IV we have taken an example of Production Control information system to demonstrate this relationship. The information on status of Production orders, machines, manpower, would be needed at high frequency. Therefore, the system has to match this frequency for providing information. One can provide this information either attaching a terminal to the computer or have a dedicated micro-computer for this application.

4.5.4 The final configuration of information technology required for an organisation will depend on the mix of applications taken-up for computerisation. Detailed analysis of each application has to be carried-out before deciding on a particular computer hardware/software. As there is a large range of computers available, there are number of choices available to the management for the selection of computers. Some of these choices are:

(a) Installing a large/medium computer with terminal facilities for data entry.

(b) Installing a large/medium computer with terminals facilities in individual departments.

TABLE - IV

Production Control System:

Master data :
i) Productwise m/c hours required
ii) Product-wise Manpower required
iii) Product-wise raw-materials required
iv) Rates of m/c hour, manpower and materials

Regular Inputs :
i) Job cards
ii) Materials issue vouchers

Nature of information generated	Frequency of information required	Input/ Output	Memory	Stage
1. Status of Production orders in progress	High(daily)	Fast response terminals, Dedicated Micro-computer	Small	Large
2. Status of machines	High(daily)			
3. Machine and manpower booking and utilisation	High(daily/ weekly)			
4. Status of Pending orders	High(daily/ weekly)			
5. Statement of costs of Production	Low(Monthly)	Slow Device card reader/ Printer	Comparatively large	Small
6. Statement of cost and Product report compared to standards	Low(monthly/ quarterly/yearly			

(c) Installing a large computer connected with mini computer systems in different departments of an organisation.

(d) Installing a large/medium computer system and providing micro-computers to individual departments for data preparation.

(e) Installing a mini computer system with an external large computer.

(f) Installing a number of mini computer systems in various departments.

(g) Developing dedicated micro computer based applications in each department.

(h) Acquiring a terminal facility from an external computer.

(i) Using an outside computer facility

There could be many other possibilities.

4.6.0 ORGANISATIONAL SUPPORT

4.6.1 Evolving a suitable organisational structure for supporting development of information processing systems is an important factor for the effective implementation. The characteristic of organisation (size, nature of operation, major tasks, etc.), the nature of application areas and the technology chosen, will effect the choice of organisation support needed. Table-V gives some possibilities in relating organisational support for development of information systems with various choices of technology. The choice of organisational support would also depend on the type Technical manpower available in the organisation in the areas of

TABLE-V

Nature of Organisation	Some Examples in Choice of Information Technology	Choices in organisation Support
Large	(1) Centralised System with Terminals	(1) Centralised support for Development of Systems
	(2) Centralised system with mini computers in each Department	(2) Centralised System with staff support in individual departments
	(3) Mini computers only	(3) Responsibility with individual department.
Medium	(1) Centralised System	(1) Centralised Support
	(2) Centralised System with dedicated Micro Computers in Department	(2) Centralised system with staff support in individual departments
Small	(1) Mini/micro computer	(1) Centralised support

information system design. The system designers working with recent technology and new areas of information systems for planning and decision making will need skills in information analysis, techniques for system design and thorough knowledge of information technology being used.

4.7.0 PLANNING OF SYSTEM DEVELOPMENT

Having decided the application areas, the information technology and the organisation support needed the next step would be to plan the development of individual computer based systems. The first task in this step would be to determine the strategy to be adopted for data base design. This step would also involve the prioritising of the system development of various applications, detailed system design, software development, design of new procedures for data flow and translating the various application requirements into computerised systems.

5.0.0 CONCLUSION

Planning information processing systems would have to recognised as an important organisational activity if information systems have to be developed to aid the planning, control and decision making processes. The developments in information technology and its availability at low costs have provided a wide number

of choices for the management in developing information systems. The key to success for using such systems effectively, would be in the choice of application areas and the choice of strategy in the implementation of information processing systems.

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EXHIBIT - I

	LARGE	MEDIUM	MINI	MICRO
(I) HARDWARE				
(a) Central Processing Unit (CPU)				
1. Word Length	32-64 bits	32 bits	16-24 bits	8 bits
2. CPU Cycle time (Approx.)	100 N.Sec.	250 N.Sec.	300 N.Sec.	1 Micro Sec.
3. Main Memory Cycle time(Approx.)	400 N.Sec.	400-600 N.Sec.	400-600 N.Sec.	600-1 Micro Sec.
4. Possible range of Memory Size (Approx.)	1-8 Mega BYTES	512 K BYTES 1 M. MYTES	128 Kilo BYTES 1 MEGA BYTES	8 K BYTES - 64 K BYTES
(b) Storage Capability				
1. Availability of Mag Tapes	Yes	Yes	Yes	Not Common (May be available)
No. of Mag Tapes (Approx.)	Many 4-8	Many 4	A few 1-4	(1-2) (if possible)
2. DISCS	Yes	Yes	Yes	Diskettes
i) No.(Approx.)	Many (4-8)	Many (4)	A few (2-4)	1-4
ii) Capacity (Approx.)	200 MB Each	80-200 MB each	10-80 MB Each	256 KB - 1 MB Each
(c) INPUT DEVICES				
i) Card reader	Yes	Yes	Yes	No
ii) Speed	600-1200 CPM	600-1200 CPM	300-600 CPM	No
iii) Data entry terminals	Yes	Yes	Yes	Yes
No. of terminals provided	Many (300-200)	Many (16-64)	(Relatively low) (8-32)	Limited (1-4)

Contd...

	LARGE	MEDIUM	MINI	MICRO
(d) OUTPUT				
i) Line Printer	Yes	Yes	Yes	Yes
SPEED	600-1600 LPM	600-1600 LPM	600-1000 LPM	60-300 LPM
ii) Video Terminals *1	Yes Many	Yes Many	Yes Relatively less	Yes Limited
iii) Hard Copy *1 Terminals	Yes Many	Yes Many	Yes Many (Relatively less)	Yes Limited
iv) Graphic Terminals	Yes	Yes	Yes	No.
No. of Terminals	Many	Many	Many (Relatively less)	
v) Plotters	Yes	Yes	Yes	No.
(II) SOFTWARE				
(a) Programming Languages				
i) Number	Many	Many	Many	One
ii) Commonly used Languages	FORTRAN COBOL BASIC PL/1	FORTRAN COBOL BASIC PL/1	FORTRAN COBOL BASIC	BASIC
(b) Number of Application SOFTWARE available	Many	Many	Limited	very limited
(c) Operating System				
i) Batch (one program at a time)	Yes	Yes	Yes	Yes

		LARGE	MEDIUM	MINI	MICRO
ii)	Multi-Programming	Yes	Yes	Yes	No.
iii)	Time Sharing*2	Yes	Yes	Yes	No.
(d)	Program Development using Terminals *3	Yes	Yes	Yes	Yes
(e)	Enquiry Processing *3	Yes	Yes	Yes	Yes
(III)	Data Preparation media available	1) Cards 2) Online Terminals 3) Key-tape 4) Offline Key Diskette 5) Micro Computer Data entry System 6) Online/ mini/micro Computer with diskette & terminals	Same as Large	1) Cards 2) Online Terminals 3) Offline Key Diskette	1) Online Terminal 2) Offline Key to diskette
(IV)	Communication Possibilities for connecting to other remote Computer or Terminals	Yes	Yes	Yes	No
(V)	Cost range (lakhs)	75-200	30-60	10-30	1-6

NOTES:

BYTES is a representation for storing a character (numeric or alphabetic)

1 KB = 10^3 BYTES

1 MB = 10^6 BYTES

1 N Sec = 10^{-9} Sec.

1 M Sec = 10^{-9} Sec.

*1 *1 Number of terminals would be approximately similar to the number of data entry terminals

*2 The type of time sharing environment provided to the user would vary from one manufacturer to other.

*3 While deciding on the program development and enquiry terminals, details regarding the response time on the terminals should be obtained. The response time varies from one system to the other. The response time of the terminal and type of applications to be run on the computer therefore limits the number of terminals.

REFERENCES

(1) Robert N. Anthony, John Dearden and Richard F. Vancil, "Characteristics of Management Control Systems", Richard D. Irwin, Inc., Homewood, Illinois, 1965.

(2) William M Zani, "Blue Print for MIS", Harvard Business Review, December 1970.

(3) Electronics Information & Planning, December 1978, Vol.6, No.3, "Computerisation in India : A Statistical Review".

(4) Mohan Kaul and Nitin R. Patel, IIM, Ahmedabad, "Problems of Technology Transfer to Third Generation Computers in India", SEARCC 76 - North Holland Publication Company

(5) Robert V. Head, "Improving Computer System Productivity", Journal of Systems Management, Vol.28, No.12, December 1977.

(6) T C Willoughby and Richard A. Pye, "Top management's computer role", Journal of Systems Management, Volume 28, No.9, September 1977.

(7) Robert G. Murdick & Joel E. Ross, "Information System for Modern Management", Prentice Hall of India Private Limited 1977.