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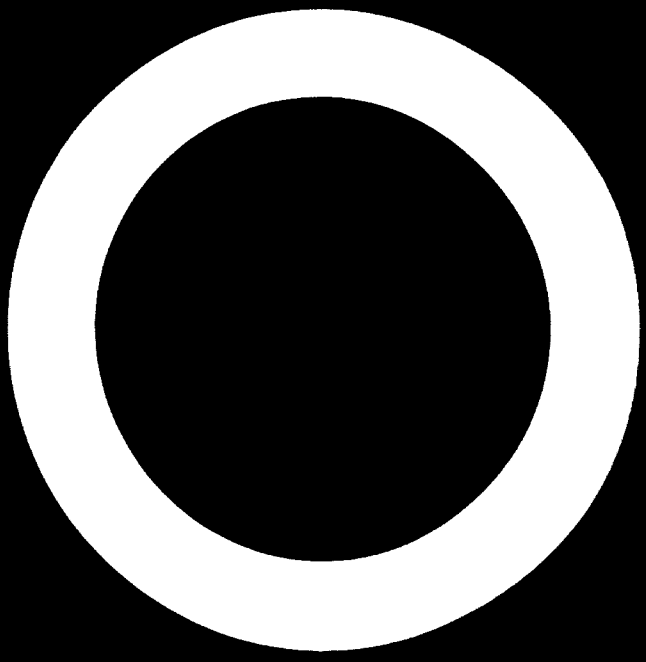
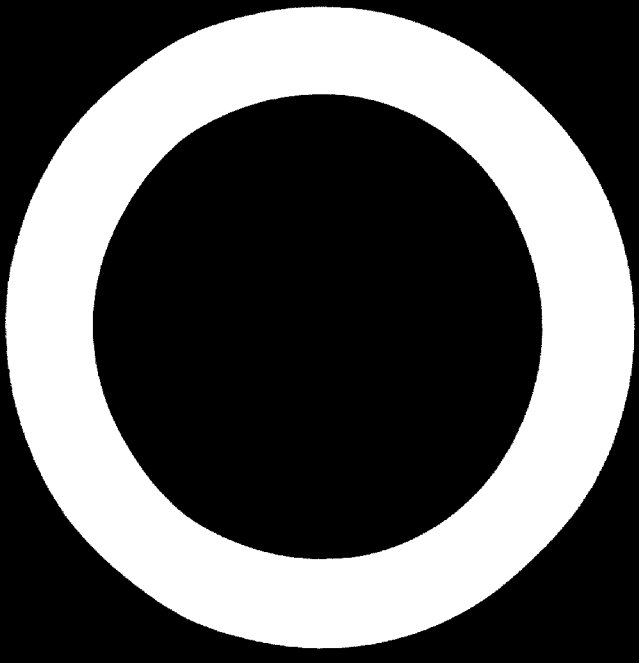
UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

New Perspectives in Management Development, Monograph No. 4.

MANAGEMENT INFORMATION SYSTEMS (MIS).

UNITED NATIONS





UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna

New Perspectives in Management Development
Monograph No. 4

MANAGEMENT INFORMATION SYSTEMS

(MIS)

UNITED NATIONS
New York, 1975

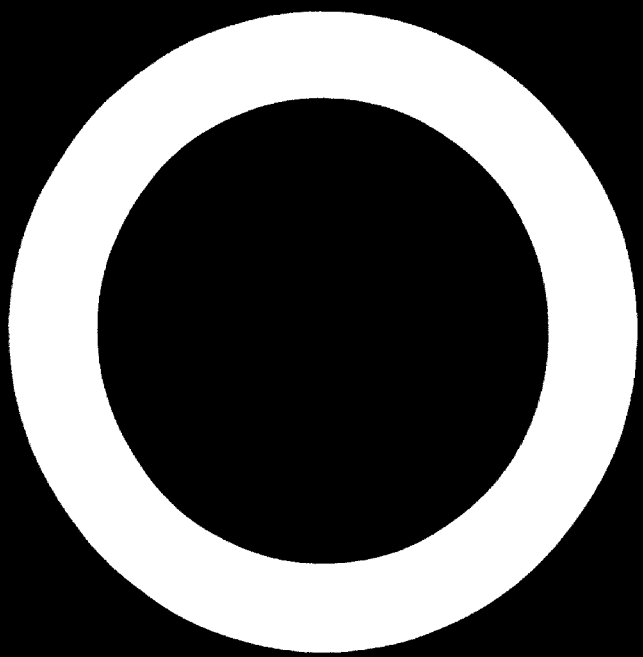
PI/51

September 1975

Preface

This series of monographs is based on the premise that the United Nations Industrial Development Organization (UNIDO) can meet the management needs of the developing countries effectively and efficiently only if technical assistance programmes are focused on the practical problems confronting managers and industrial administrators in these countries.

This monograph is concerned with the application of management information systems as a tool and technique to raise the efficiency and performance of industrial enterprises. It discusses the philosophy, design and basic requirements of a management information system (MIS) and argues that proper use of an MIS is a prerequisite for raising the effectiveness of an enterprise. It maintains that the degree of sophistication of the system should be carefully studied by organizations in developing countries to ensure that the system chosen shall correspond to the needs and capacities of each organization.



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Background

The executive of any organization must decide how much he should know about the detailed, day-to-day operations of his organization. One school of thought has held that he should know everything. This philosophy has led to a proliferation of so-called management reports in many organizations, to the point where the administrator is so overburdened with the tools of management that he has no time left to manage.

The growing complexity of management and the speed and flexibility of modern computer technology have led to increasing acceptance of a new concept of management information. According to this concept, it is no longer possible for an executive to know and retain in his head everything about the operation of his organization; the proper amount of information he should have is the least amount that will still enable him to control all phases of his organization. For such a concept to have practical value, the executive must also be able to answer promptly almost any question about the operation of his organization.

Decision making, a function that should be performed only by highly qualified persons, consists of retrieving, processing and reducing data; weighing the alternative solutions against the given criteria and finding the best; and issuing the orders and controlling their execution.

The quality of the decision making and the efficiency of management can be measured by the performance of the company. However, decision making is deeply influenced by the auxiliary functions, i.e. data retrieval and reduction and feedback control of the orders given. The management information system links decision making, the proper function of management, with its environment, the managed plant.

The environment

Originally, information systems were very informal. Such systems, only slightly modified, are still used in many plants today. In an informal system, the information is gathered manually and transferred orally or in hand-written notes. The advantages are its low cost and rapid

implementation, its disadvantages are long response time, distortions in the communication channels and limits in the scope and amount of information gathered and processed.

In recent years, a rapid shift from informal to formal information systems has taken place. The entirely formal information system is an aid, and a very powerful one at that, to managers, but it cannot produce strategic, policy-making decisions, decisions that involve creative thinking; under conditions of uncertainty it can only facilitate the making of such decisions. Hence, the constantly growing burden of decision making will continue to lie with management. The development of information-processing technology based on computers, however, does offer the means of alleviating this burden, for an MIS can produce the routine, operational decisions that are made at the factory level. This monograph is limited to discussing the use of MIS for this type of decision making.

Most companies operate under the tremendous pressure arising from competition. This pressure tends to limit the amount of time available for planning and the execution or revision of plans. How does a company meet its competition? By offering a good product at a reasonable price and keeping a customer satisfied. It can do this by providing prompt answers to questions on a multitude of matters, such as order status or scheduled shipment date. Management is therefore faced with the need to plan and schedule material, men and machines in response to changing demand.

Departmental conflicts may persist within the company when attempts are made to reconcile the requirements of sales, production and finance. Departments tend to take into account only the costs and information important to them, ignoring those outside their spheres. The sales department is well aware of the importance of customer service and the need for substantial inventories. The production department is concerned with the utilization of its resources. Finance, on the other hand, watches over excessive inventory and carrying costs, fearful of cash drains and their effect on profits.

Although these departments need the same data for different purposes, they usually end up providing and maintaining their own files. However, production problems must be solved from the viewpoint of the organization as a whole.

General approaches to processing of information

In commercial computing, two distinct approaches to the processing of information exist. One is batch, or periodic, processing and the other is in-line, or continuous, processing.

Batch processing is quite satisfactory for most accounting and similar work; this type of work was the first to be automated. From there, batch processing methods were carried over into other areas, including operating support systems. There, however, these methods turned out to be less satisfactory because records became out of date between processing cycles and reports showed status conditions as of some past date, or summaries of activity were cut off at, and reported only up to, some such point in the past.

These deficiencies, inherent in periodic processing of data in batches, can be overcome by continuous processing methods permitting transactions to be entered in random sequence and at more or less random times. In-line processing is not just a technique, but is rather a philosophy on which to base a management information system (MIS).

A management information system

An MIS may be defined as a system that provides selective, timely information to the user. It can make any information in the data base immediately available to the user, to satisfy his anticipated, as well as his unanticipated, information requirements. The most important objective of an MIS is that of improved control, which to a large extent determines the performance of the business, through a reduction in costs and increased profitability. An MIS makes use of available resources to provide managers, at all levels and in all functions, with the information from all relevant sources that will enable them to make timely and effective decisions in planning, directing and controlling the activities for which they are responsible.

The typical executive does not know specifically what data he might need in a contingency, probably because he has not been thinking of his role and his function in the context of data. Most of his actions are based on information he receives from various sources. His essential function is to evaluate information, process it and take action accordingly. Without data on the performance of his business, he cannot plan, cannot exercise control over operations, cannot manage.

One of the main problems in designing an MIS is the structuring of the data base. The most significant attribute of a data base is that it serves as a common base for a variety of applications and subsystems. Under older methods, each department and functional group of a business maintained its own files, with information organized so as to suit its particular needs. This meant a considerable amount of duplication of data.

For example, a typical inventory control record contained data such as the following:

Number of part
Description of part
Standard cost
Raw material used for manufactured parts
Purchase-order quantity or quantity discounts for purchased parts
Where information is to be used

All the data listed above was duplicated in at least one, and sometimes all, of the following files on:

Cost sheets
Purchased parts
Routings
Engineering drawings
Location of stores

If these files were transferred to and centralized in a computer system, the cost of such duplication would be prohibitive in terms of both storage and maintenance.

When a data base for a computer system is set up, the goal of file efficiency can be achieved by:

(a) Eliminating or minimizing data duplication and different versions of data produced at different times;

(b) Making access to the files as easy and economical as possible.

If the business executive does not understand the effect of data-base development on organization and policy and fails to back the new operating policy, the system will not work. Maintaining the quality of the data base is vital to the proper functioning of an MIS. The decision to install an MIS is a complex one, not unlike many other major business decisions. That is why the management executive should not entirely delegate responsibility for making this decision but rather involve himself personally in the question.

System design

The design of a system should provide for bringing existing procedures up to date and creating new procedures for dealing with new problems. It is thus a field where creativity must be exercised, recognized as necessary and suitably rewarded. Such creativity must be exercised within a very strict framework, limited by requirements and resources financial, technical and human on the one hand and to a lesser degree equipment capability on the other.

In the management field, it is important to learn to think of needs as "information products", comparable to industrial products in every respect. In general, needs differ at each organizational level.

Senior executives engage basically in decision making concerned with the formulation of short-, medium- and long-term plans and in supervision. Supervision comprises three activities:

Co-ordination
Checking results
Operational control for non-routine questions (responsibility is normally delegated to others farther down the hierarchy).

An MIS assists top management to improve decision making by integrating aims and data and by evaluating alternatives.

Middle managers are the first to benefit from the implementation of an MIS because they have the tiresome task of solving routine problems, and the MIS can assume much of the work. At this level it would be desirable to see as many decisions automated as possible (closed-circuit decision-making procedures without human intervention) so as to clear away the routine jobs to give managers more time to deal with unusual or important events (non-routine management). The middle manager has not only to carry out the directives received but also to check on and measure the consequences of the decisions taken.

The needs of operating personnel are practical in nature, since they have specific jobs: to eliminate bottle-necks, simplify work, improve processing, eliminate useless tasks, and introduce automatic inspection. This is the level at which measures are determined that will influence the cost of information and the cost-effectiveness of the system.

Throughout the whole design and selection phase of the MIS, men will act as the interface between objectives and needs. The effectiveness of the proposed MIS will depend on the skill of these men and the quality of work they do as:

Members of the data automation (MIS) committee
Members of the project team
Company managers
Operating personnel
Outside consultants, where applicable

Figure 1 shows how the project team interacts with the organization.

The data automation (MIS) committee, composed of representatives of management and experts, identifies problems and defines the data-processing policy, requests specific studies and sets priorities, examines the implications of schemes within the chosen guidelines, assigns responsibilities and co-ordinates the various efforts.

The project team consists of operation and management specialists. It is in contact with personnel at the middle-management level in the organization, who are already well acquainted with the practical problems in their department and have given them much thought. With their knowledge of the planned changes, the designers in the project team must exercise imagination and initiative, without losing sight of the difficulties inherent in making a change.

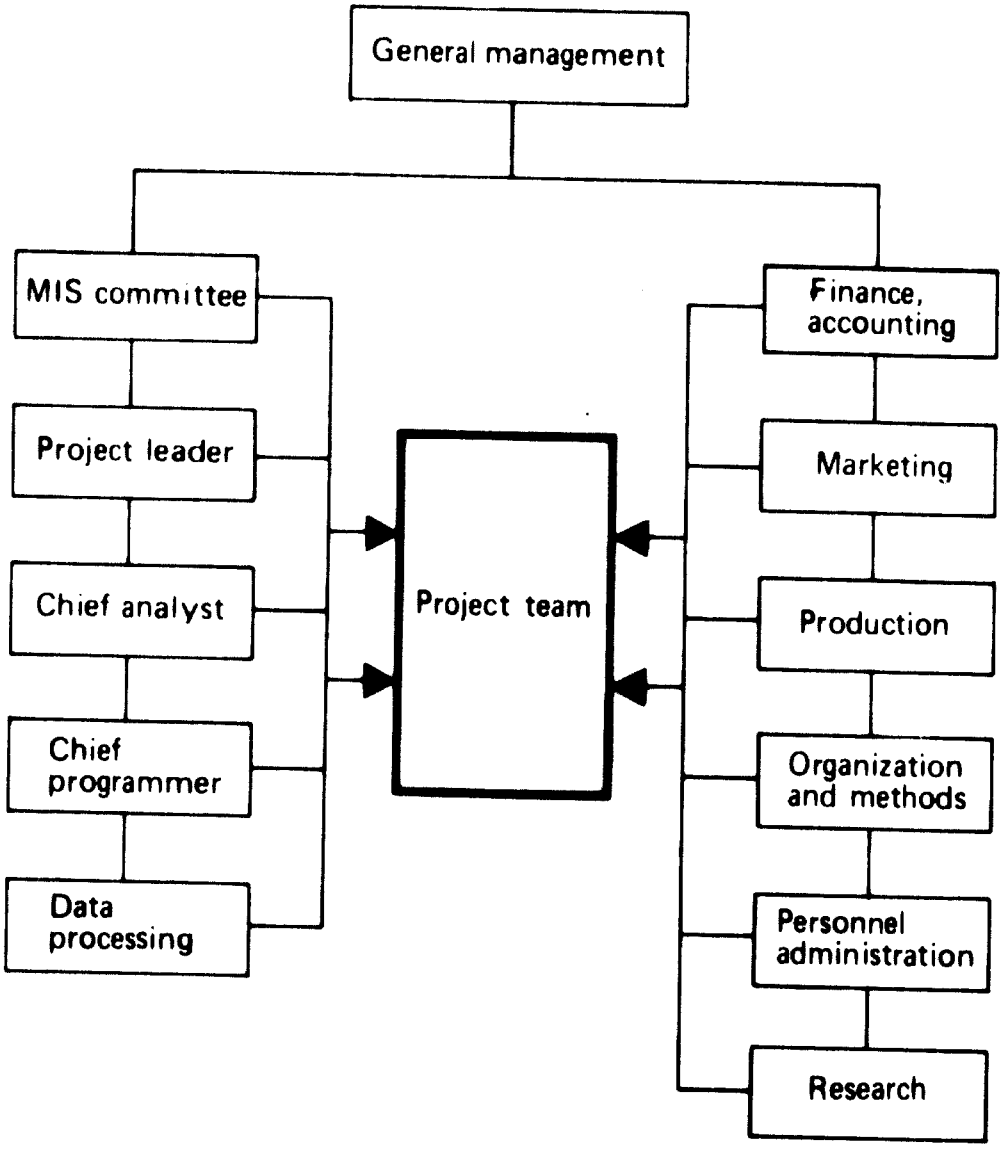

Figure 1. Interaction of the project team with the organization

First steps in installing a computer-based system

An early step in installing any computer-oriented system is to screen and organize the data to be used. Each organization should consider such questions as:

Definition of objectives
- Rational employment of personnel
- Reduction in stocks or overheads
- Increased production
- Improvement of customer service
- Intangibles

Centralization or decentralization of operations
- Future policy and strategy
- Geographical spread of operations and effective decision making
- Modern management techniques
- Decision making by operational research methods

Selection of equipment
- Degree of automation of system
- Configuration of the hardware
- Media and auxiliary equipment
- Software, utility and specialized programs
- Manufacturer's services
- Financial aspects, maintenance, guarantee

Personnel
- Qualifications, training, selection of teams
- Human relations, employment benefits
- Company policy regarding employment, social responsibility

Production planning and execution

The gathering and dissemination of information usually is the manufacturing company's most difficult problem. The manufacturing company is plagued with a combination of problems that differentiates it from other companies. Its costs are heavy, its product is complex. The company faces fierce competition, and it operates in an ever-changing environment. Internal conflicts arise from decentralized planning and excessive records. Information is voluminous, scattered and often difficult to obtain.

Different types of information must be disseminated, such as:

Replies to inquiries
Standard, routine reports
Exception printouts
Shop paper
Special reports

Experience has shown that manufacturing industry needs an MIS in order to organize and maintain the basic files necessary for decision making.

An MIS should be designed to be integrated into the planning and execution of production, as shown in figures IIa and IIb.

Planning

Operational planning begins with the preparation and forecasting of orders. Information on stock availability and ordered items is obtained from inventory records. Product mix or bills of material are also taken into consideration.

After net requirements have been determined, the quantity of orders is analysed to ascertain lot sizes and lead times for both purchased and manufactured items. An assembly order is generated for the assembly area, a shop order for the fabrication area.

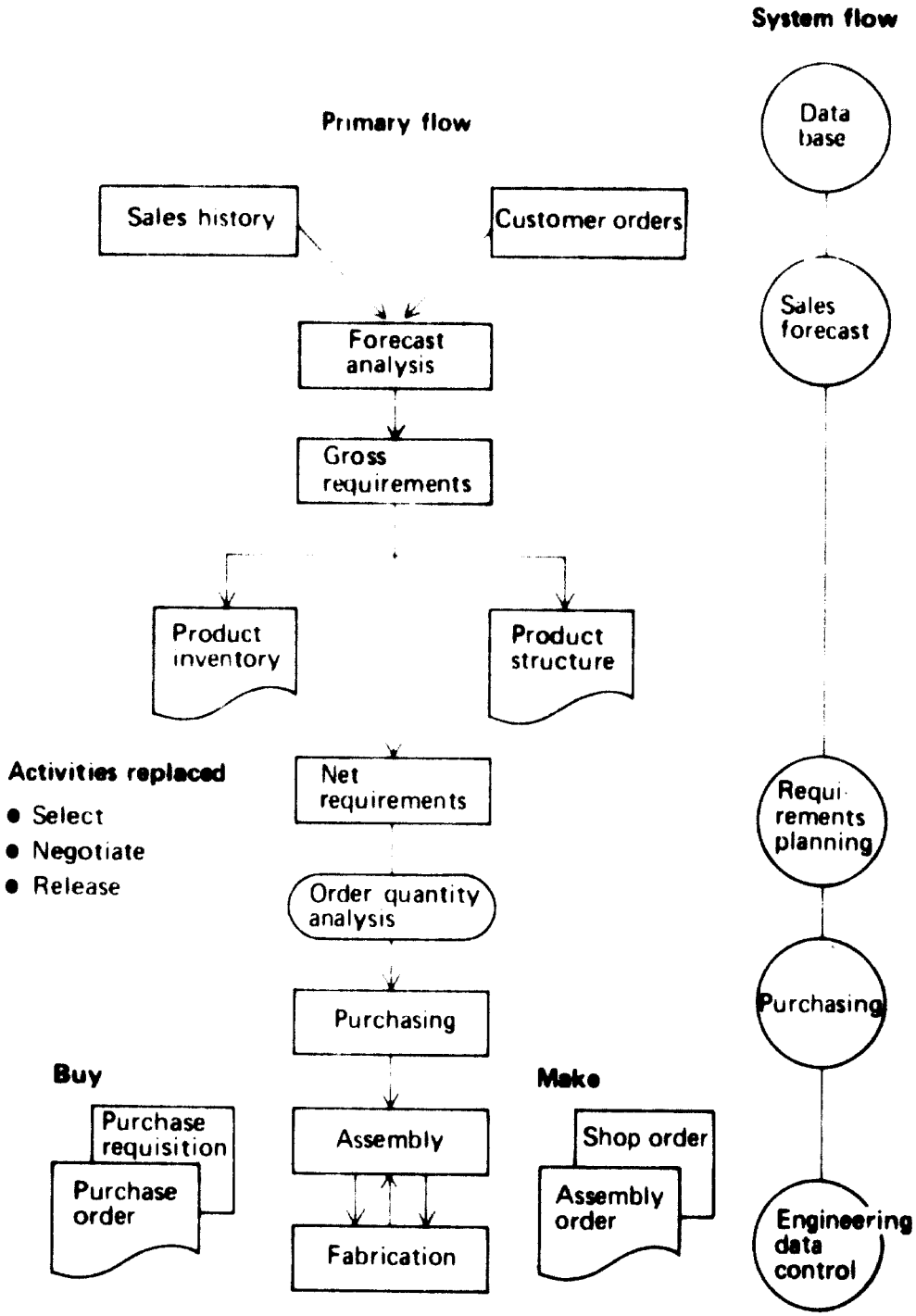

Figure IIa. An MIS for planning production

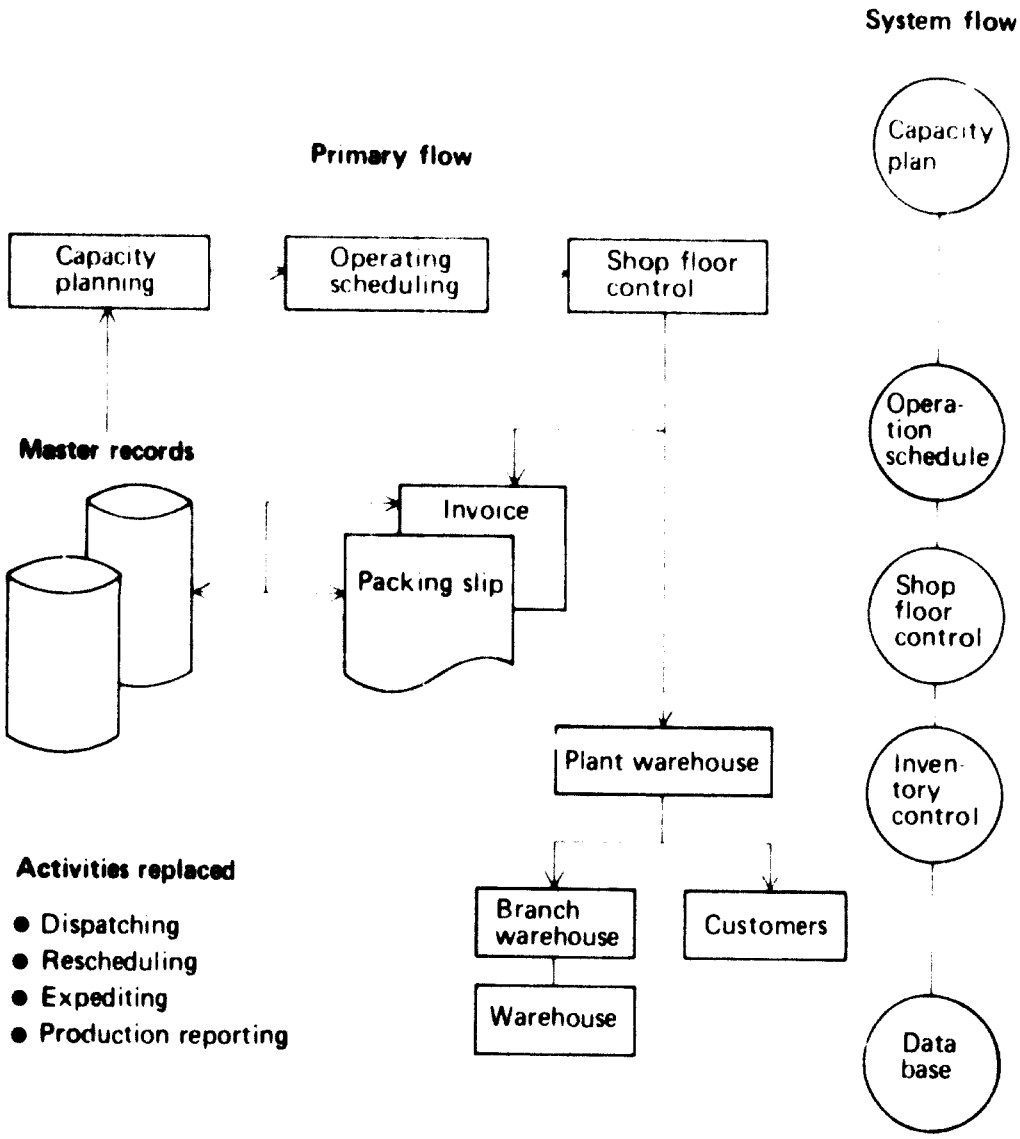

Figure IIb. An MIS for executing production

Execution

Execution begins at the purchasing level with the follow-up of orders. Varied execution functions are performed at the production and assembly stages. Orders are rescheduled and distributed among work centres and closely followed.

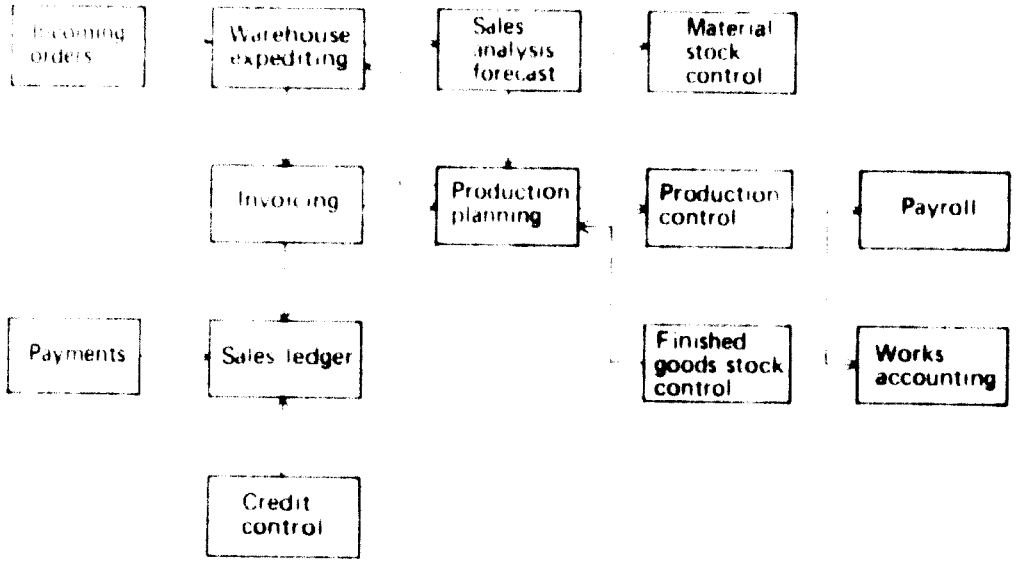

Figure III. Information flow before installation of an MIS

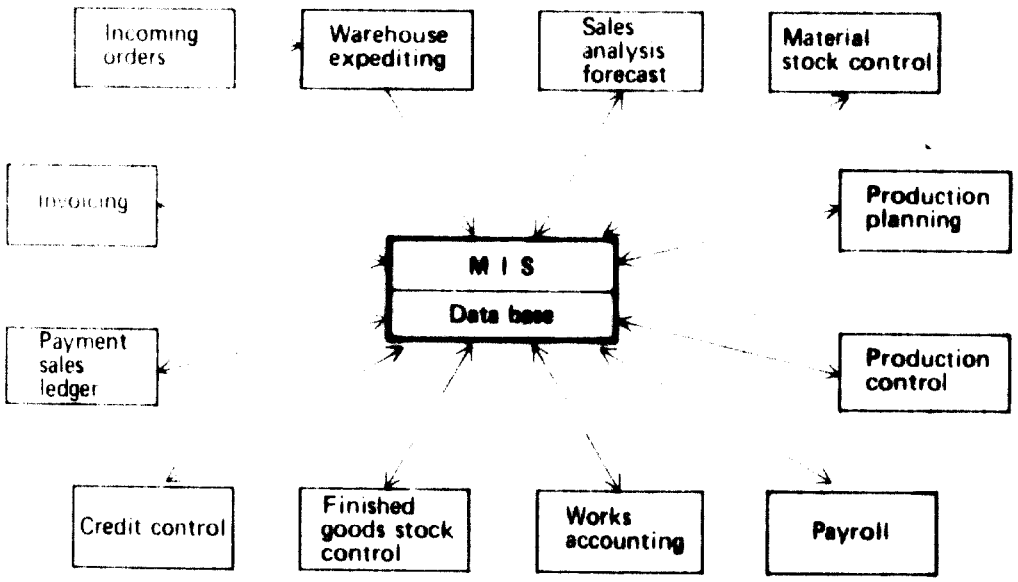

Figure IV. MIS with a data base

Finished goods and components move from the assembly and fabrication areas to the inspection and receiving area. The final step in MIS operations is a shipment authorization requesting the warehouse to pack and ship to a branch warehouse or to the customer.

Interaction between subsystems

As illustrated in figure III, any one subsystem, e.g. production control, usually has interfaces with only a few other subsystems production planning, stock control, payroll and works accounting in the example chosen. Nevertheless, designing an MIS (figure IV) should involve listing, studying, grading and remodelling all the interactions between the various subsystems of the organization.

Inventory control

Materials and inventory control is one of the areas where electronic data processing can be utilized best. This is especially so if mathematical techniques can be used in solving problems in this area. Combining traditional techniques for assessing the economic order quantity (EOQ) and the point at which safety stock should be reordered with the forecasting technique of exponential smoothing provides management with the information required to control its business better. These techniques help to attain:

Improved customer service
Accurate costs to maximize profit and improve competitive position
Reduced inventory obsolescence
Reduced average inventory levels
Improved manpower planning
Improved facilities planning

Figure V shows the information flows necessary for inventory control.

Control of materials and inventory in an assembly plant is greatly affected by information processing, because manufacturing requires that accurate control over raw materials, subassemblies and work in process be maintained. It is quite common, in most manufacturing organizations, to find systems that control materials from the time they are ordered until they and the finished product they are part of become finished-goods inventory or are shipped.

Requirements for materials used in the fabrication of a product are expressed in a bill of materials. This bill of materials is the document that forms the basis for all action taken with regard to materials during manufacturing. The requirements that are developed this way are then checked against the inventory or lists of materials that are always bought, to determine whether the required parts are in stock or will have to be purchased and, if purchasing is necessary, how long it will take.

In an assembly plant, seasonal and economic conditions strongly affect sales. For this reason the policy is to keep stocks of raw materials and parts in the assembly as low as possible, which means that new schedules of shipment from suppliers must be changed as often as several times a week to reduce to an absolute minimum the inventory.

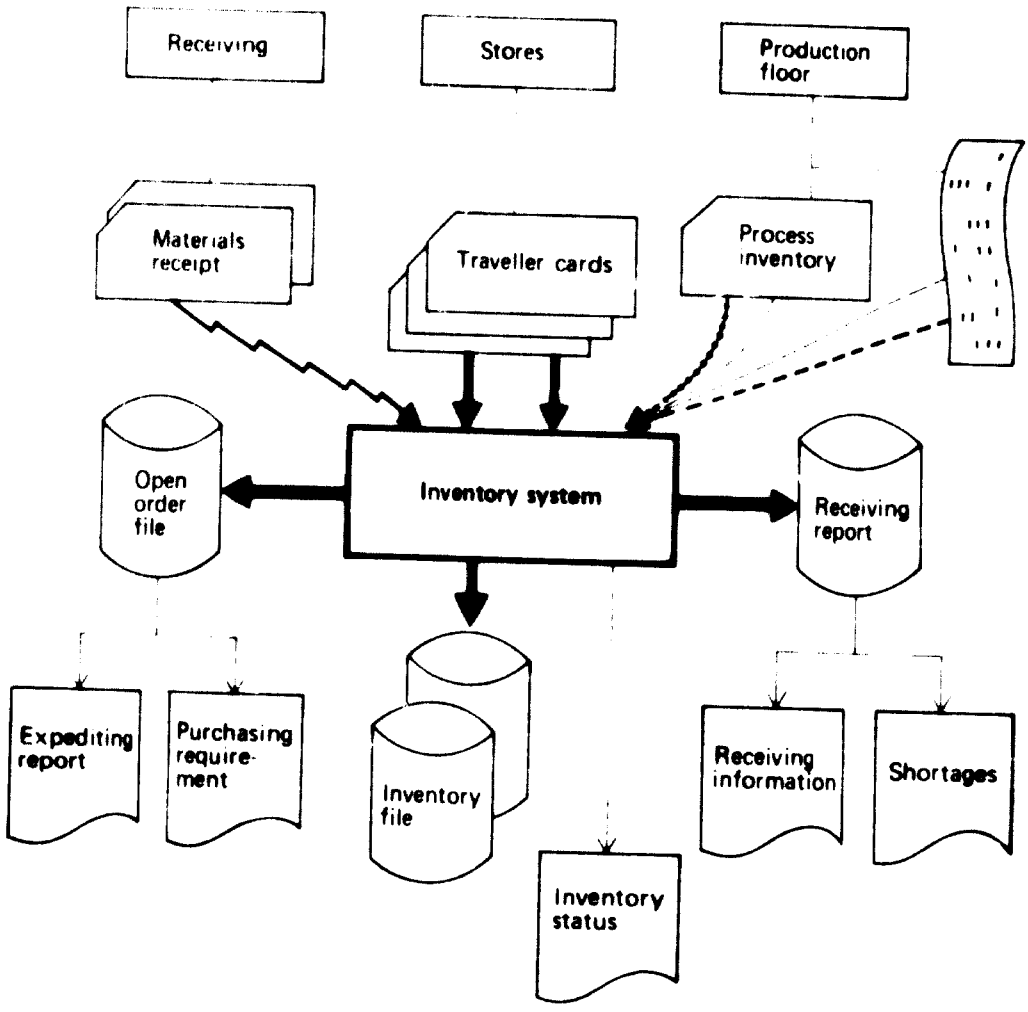

Figure V. Inventory control–information flows

Various statistical means for determining the EOQ and order point for individual inventory items are widely used by manufacturing firms. The EOQ and the order point are usually recalculated periodically as conditions demand. The essential elements of most inventory control systems include a requirement explosion system capable of identifying net requirements, a reorder system, a perpetual control system and an evaluation system.

Depending upon the product line, inventory control systems vary from on-line, real-time data collection and corresponding real-time computing to relatively simple magnetic-tape and punched-card-oriented systems. There is a definite trend towards real-time systems for inventory control. The ability to

Source	Source documents	Resource allocation subsystem Resource acquisition subsystem
Input	Required inventory data	Quantity of resources acquired Time for replenishment and lead time Cost of holding stock and cost of orders or setups
Processor	Inventory decision making process	Decision tradeoffs Reducing order costs or setup costs Reducing carrying costs
Output	Desired inventory policy	Objective: Minimize total inventory costs Requirements and constraints: Reduction in cost possible Demand for stock exists Available storage Stable environment
Use	Order-quantity lot-size decisions	Application: Resource acquisition subsystem Problem variables: Order quantity or order time desired Variable rate of consumption Variable demand Variable time periods

Figure VI. A model for decision making in inventory control

determine quickly the current on-hand, in-process, on-order status of a given item of inventory is highly desirable, particularly for firms using high-cost raw materials, which may become rapidly obsolete.

Unlike many other areas of manufacturing, the outstanding problems of inventory control are not conceptual, but are those of planning and implementation. There are very few, if indeed any, control procedures that have not been successfully accomplished through information-processing techniques.

For most companies, the major obstacle to establishing completely automated materials and inventory control is the systems planning that must be performed. Fortunately, many companies are willing to discuss this type of control system and share the experience with others.

The experience of many firms indicates that the initial systems analysis and implementation costs for installing systems of this type are high but that such systems can be expanded from one division to another or from one product to another at relatively low marginal cost. The equipment and services now available indicate that this is one area of manufacturing that presents few real problems in automation and does generate high return.

Figure VI shows a model for decision making in inventory control.

Conclusions

Time required for developing a management information system

In general, three to five years will be required to develop and implement an MIS, which means an MIS has nothing in common with a conventional system, for which one to two years of studies are usually adequate. The length of the period obviously depends on the size and complexity of the organization. However, if the final objectives have been properly defined and the intermediate objectives have been identified, it will be possible to obtain benefits from the system before it is fully implemented.

Tools such as the Programme Evaluation and Review Technique (PERT) must be used, and they are particularly valuable if it is wished to modify the initial project over the years and the initial schedule must be adhered to as far as possible. Any deviations are likely to be amplified in that the firm and its environment will certainly change in five years and the objectives may then have to be reformulated. Thus, it is essential to design a system that is sufficiently flexible to be modified according to circumstances.

Cost

The cost of implementing a computer-based MIS is usually high; and while considerable gains can be expected in the long run, the investment to be made will be particularly heavy during the initial years of the design phase.

From various studies, the total cost of such systems may be placed at about 1.5 per cent of the turnover for an industrial firm and at about 0.25 per cent of annual movement of funds for a banking or insurance firm. There is no point in establishing an MIS in an industrial or commercial environment unless the organization concerned can expect an eventual financial reward.

Justification for installing a management information system

The installation of an MIS can be justified on the grounds that it results in reduced costs and increased profits and opens up additional possibilities to management. Costs are reduced through saving in clerical staff; control of inventories size and turnover; better credit control, which means fewer significant debts; and better plant utilization through improved production scheduling. Higher profits result from more efficient use of financial resources; increased volume of business because of better customer service, i.e. faster response to orders and inquiries; and generally improved management performance. The MIS makes it possible for management to understand the market potential better; to diversify business activity; to expand into new marketing areas; and to modify product lines.

The costs of equipment and personnel involved in establishing a conventional data-processing system and the savings expected can be fairly accurately estimated. It is much more difficult, however, to assess the increase in profits attributable to the implementation of a sophisticated MIS, and differences of opinions on this matter exist. One view is that a full cost-benefit analysis should be carried out, that is, all expenditure should be considered from the beginning of the feasibility study for the project. Another view is that only the operating costs should be considered. The best approach is felt to lie between these two points of view, and the two types of studies should be undertaken for different purposes.

General considerations

The first step in the design of an MIS is to examine the firm's objectives and the policy followed to attain these objectives. The needs of each company activity should be studied in the light of the proposed objectives (feasibility study).

Two major considerations that should be taken into account in designing an MIS and selecting a computer are:

Degree of centralization of both data processing and decision making

Proportion and location of batch processing and real-time operation

Even though the implementation of an MIS may bring about a concentration of data-processing equipment, a parallel centralization of decision making need not follow. In fact, an MIS makes possible more effective decentralized decision making.

During the design of a new MIS, it is important to work out detailed plans for all those personnel involved in the introduction of the system, including

Top managers

Departmental managers

Operational personnel

Manufacturer's personnel

Data-processing personnel

Project team

The plans should take into account training, organizational structure, job descriptions, recruitment and morale.

When selecting a computer system, management should consider the existing state of systems, data and human resources within the firm, the newness of the proposed computer system and the possible desirability of acquiring equipment from more than one manufacturer.

The terminals determine the technology of the work with the system. Besides the standard input-output devices (punch cards, paper tapes), more modern on-line terminals should be considered number of videointerrogators (displays with keyboards), remote teletypes, printers, keyboards and other remote input-output devices.

Besides the basic software, the user has to have access to the software application packages; for example, packages for job shop scheduling, flow shop scheduling, production flow simulation language, inventory control, management information system are very valuable for the user. Experience with system implementation and the general method of system analysis and of data-bank build-up have to be evaluated.

Last but not least, the interest of the system producer in the project should be taken into account. An interested supplier of a system will assist the user in many ways, one of the most useful of which is in instruction of the company's employees in different fields and at different levels. The supplier

may also give his advice during implementation and assist in supervising operations. He may also share experience gained with similar formal management control systems.

A well-designed information and training programme is essential if MIS methods are to be successfully introduced and used in a company.

Printed in Austria
75-541 – December 1975 – 3,500

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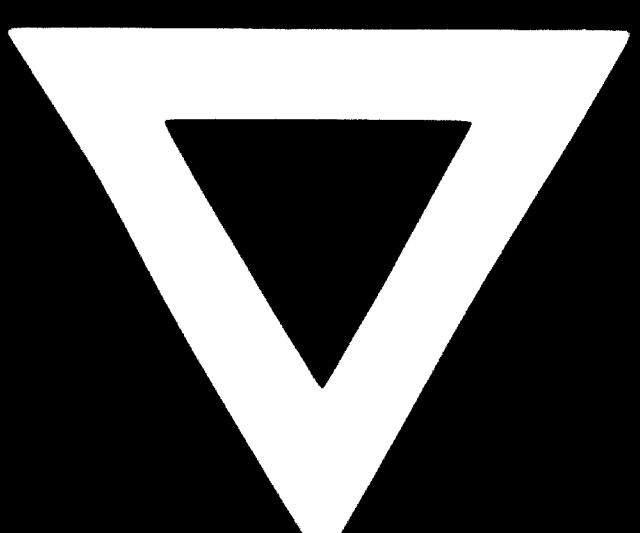

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