The paper presents the concept of Management Information System (MIS) as a distinct subject. It studies the similarities and differences between the subjects of documentation and MIS. The subject of MIS is shown to form a logical extension of the discipline of documentation. Additional topics which are necessary to be studied to make a documentalist an MIS specialist are detailed in the form of a suggested curriculum.

Documentation and Industry

The science of documentation has evolved by itself along with the progressively compelling need for systematic handling of literature in the fields of science and technology. A new profession therefore came into existence to extend a systematic support service to the science and technology community by providing them relevant literature at micro levels. In the process, several methods and systems were developed to productively handle the vast mass of literature for a social utility. Apparently the profession of documentation became extremely useful to organisations intensive in science and technology. Scientific and technological research acquired a new rate of growth with the specialised support extended by this profession.

Industries which have divorced themselves from conducting research and development in a fairly big way, however, hardly found much utility of the profession of documentation. This is particularly true in the Indian situation where barring a few large technologically intensive corporations who have certain long term strategies to lead in technology, over a ten thousand and odd registered companies in the country do not have even a full fledged development facility, leave alone the research: Surprisingly though one individual in every organisation who concerns himself with not too regular intensive technical development activities, keeps himself fairly well informed of the latest developments in his technical sphere of interest. Quite often, even they index some interesting papers which may be of relevance to their organisation in future. Apparently such individuals, who are in large number in this country, are doing a bit of documentation. In other words a vast majority of industries have not found it compelling to employ the services of specialised documentalists, for their survival today does not necessarily depend upon continuous technical advancement and an edge on technology. The reason is simple. Every corporation has a product to manufacture or a service to sell, and has technology available to them as they initially started. The immediate need for them is to manage the corporation in a profitable manner. In other words, they have found it essential to have an edge on management. I hasten to clarify that this management edge does not just arise from a mere knowledge of techniques and methods of management but to be able to apply them in operational situations. The profession of documentation till today can only help them in the area of keeping managers informed about the latest development of techniques and methods in the field of management sciences. It has made little progress in extending its professional capability to participate in a management operational situation. But yet it is a fact that managers need information for making effective decisions. What then the profession of documentation must have in its bag of capabi-
lities to be able to do this information work which has a participatory seat in management operations of corporations? This makes the beginning of another specialisation—Management Information System.

**In This Paper**

After developing a meaning and a framework of the subject of Management Information System (MIS) as distinct from other closely related systems, the typical features of a MIS are presented including general design principles. The contribution of various disciplines towards development of the subject of MIS and their structural relations are subsequently examined to identify the placement of the subject of MIS in the structure of knowledge. The analysis leads to evaluate in detail the similarities and differences between the subject of documentation and of MIS. The difference between the two disciplines at the methodology level is found to be the gap in the knowledge of processing techniques for preparing information from data and knowledge. That the subject of MIS according to this analysis forms a logical extension of the discipline of documentation, areas of knowledge required in addition to the present study of discipline in the profession of documentation are identified and presented as an additional curriculum for education of MIS specialists. Concluding, this paper suggests that if the profession of documentation must become more useful to the industry they need to acquire newer capabilities required of the subject of MIS.

**The Semantic Confusion**

The terms which are often interchangeably used are "Information System", "Document Handling System", "Data Retrieval System", "Computer System", and "Accounting System".

A document handling system as it literally means handles documents. Based on a set of methods and procedures, the document handling system acquires, classifies, indexes, stores and retrieves and disseminates information about documents and their availability in the system. It does not handle information.

The data retrieval system obviously stores data for efficient and "instant" retrieval. It can store facts as they are available in raw form. (For example physical properties of metals).

The computer system is a group of hardware put together in a manner that it can handle routine operations according to sequence of instructions. The material it handles is data and knowledge in the way it is asked to, and it can do this work very reliably and at remarkably high speed.

A system of accounting essentially translates physical processes and quantities budget into language of monetary currency, compiles budgets, and compares the actual performance with budgets, again in the language of monetary currency.

An information system by its words must handle information. I emphasise here the term "INFORMATION". It has a specific meaning different from that of data and knowledge. Take for instance a situation of an individual crossing a road. Before he makes the decision to cross or not to cross the road, he acquires several types of data. Commonly these are the approximate speeds of oncoming vehicles on either side, breadth of the road and the pedestrian traffic around. Unconsciously, though he recalls the data about his personal capability to cross the road in terms of time required. These are only data relevant to his problem at that time. And the problem here is really a number of obstacles which he has to overcome to achieve his objective "to successfully cross the road unhurt". In the process of overcoming these obstacles he has acquired data about obstacles or problems and their behaviour. Subsequently he processes these data in his mind to find the probable time period required for the several oncoming vehicles to run over the line of crossing. Further he matches these data of time period with the time required for himself to cross. Here he has translated all physical processes into a common comparable measure of time. If the time required for the vehicle to reach the point of crossing is more than the time required for him to cross the road, he makes a decision to cross the road. If it is lesser he will make a decision not to cross the road and once again starts acquiring new data and find another convenient time when he can cross the road. These relevant data processed in a usable manner at the right time becomes information for his decision.
Take another case. If someone rushes to you when you are at your desk and tells you about a car which went at a high speed in the street down, it is not information for you at that time... for it is not relevant to your problem (unless of course you are planning at your desk how to cross the road): It is only data for you which will be stored in your memory to be recalled when you next cross that street.

Conceptually, therefore, we can identify without going too deep into semantics, that data and knowledge can be placed on one side and information on the other. The difference that characterises information from data and knowledge are the factors of relevance, usability by way of processing, and timeliness.

In a management situation the same meaning of information holds true. An organisation has a set of objectives to achieve. In this process, it encounters with obstacles which become problems. Data and knowledge about these problems must be acquired and their behaviour must be studied. Subsequently these relevant data and knowledge must be processed to provide information which becomes the basis of defining a problem to arrive at solutions. Decisions are then made by selecting from amongst alternative solutions. Conceptually, we can visualise an inventory of problems on one side arising from the process of achieving objectives, and a base of data and knowledge on the other side. (See Exhibit I).

Extending further this conceptual analysis we can visualise an interaction taking place between the problem inventory and the data base. Resulting from this interaction, relevant data are thrown to the surface of data base which will then be processed and structured to define and solve a problem. Therefore, we can even visualise information as the media of interface between the problem inventory and the data base.

To recapitulate the foregoing discussion, information is relevant, processed, and timely data and knowledge in relation to a problem. In achieving a set of corporate objectives, information has a major role to play. It is accepted that a system for handling information related to management planning, operating, and control problems is essential. The task is now to investigate what makes a MIS.

Management Information System and its Specifications

A MIS is a set of techniques, methods, procedures and hardwares designed to function as a system to provide uninterrupted flow of information in an organisation for making effective management planning, operating and control decisions. It is important to note that the term 'information' has a specific meaning as analysed earlier. The MIS has therefore, an output of information, an input of data and knowledge, and a processing 'black-box' which not only stores and retrieves data but also handles and analyses input data and knowledge to prepare information in relation to specific management problems.

The design of MIS starts from the point of explicit specification of corporate objectives. To achieve the corporate objectives, the corporation must prepare a corporate plan. This defines the overall strategy of the company with a greater emphasis on long term goals. Based on the framework of the corporate plan, several sub-plans are formulated with more emphasis on short term targets. These sub-plans may correspond to marketing, production, materials, finance, engineering, and other functions. Further, these are exploded into more detailed plans till it assumes a shape of specific procedures of actions at the operating level. To formulate these plans and decide upon strategies and targets, information is required. A corporate plan, therefore, specifies the general framework of information requirement in an organisation. The sub-plans indicate specific information requirements related to each function. Exhibit II is a pictorial representation of the inter-relations amongst a corporate planning system and several sub-systems of planning. Exhibit III presents the structure of a corporate plan. The first two items in the plan, namely, "the long range objectives" and "long range and short range goals", are essentially products of decisions made on the basis of information on areas indicated by items 3, 4, 5, 6 & 7.

Broadly the type of information required for a corporate planning system in an organisation falls into three categories:

a) General business environment information.
b) Competitive and industry information.
c) Internal performance data.
No planning can be complete without a control mechanism. The control mechanism must be able to respond to deviations and develop corrective actions with a simultaneous feedback to the original plan for corresponding change. Therefore, for every planning system and sub-system there is a corresponding control system to monitor activities conforming to planned targets. In other words, here again information about actual performance of activities compared with targets and about causes for deviation is required for effective and timely control action. Therefore a system of information is required to produce reports on actual performance concerning sales, products, inventory, costs, and profitability, facilities utilisation, and on many more such activities requiring control in every organisation.

At higher levels of management, these control reports will have more abstracted information covering a wider area of operation than that of at lower levels of management, where more details of limited area of operation form the content of the reports.

The second step then involves identification of input data requirements to prepare the output information as required by the specifications of the information system. In case of planning systems the input data required will concern more of external data and knowledge whilst for control systems more of internal data are required. Generally for a planning system the input data required are:

a) Business opportunities, joint venture offers, investment opportunities, gross national product and Government plans, imports, exports, duties, levies and taxes, consumption trends and purchasing power, labour and employment, political ideals, sociological differences, new technology and methods.

b) Expansions in new ventures, new licences, product innovations, industry and competitive corporate data, raw materials, prices and product styles.

c) Sales data, cost and profitability data, manufacturing capacity data, manpower data, cash flow and inventory and credit data.

The input data for control are essentially production per period, unit materials cost, unit labour cost, product capacity utilisation, machine capacity utilisation, sales data, inventory actuals, and cash flow actuals.

The third step in designing a MIS is to develop a data and knowledge storage facility. Here the storage will be often at a fairly disaggregated level of data. Due to the very bulk of data required to be stored and due to the flexibility required in retrieving data from different approaches of queries, data is often stored on punched cards or other storage media of computer systems. These are called 'Data Banks'.

The fourth and most important step which characterises the MIS is the design and use of processing techniques. These techniques may range from simple arithmetic calculations to advanced quantitative techniques. Statistical methods, linear programming, operations research and simulation methods are often employed to study the interactions of several variable data elements to arrive at meaningful and cost effective alternative solutions.

The foregoing specifies generalised design principles and structure of a MIS. More specifically the destination of information outflowing from the MIS must be determined. This requires analysis of the organisation structure of the corporation, the position descriptions of individuals to identify the responsibilities, decision authority and accountability levels. Based on this analysis and after specific discussions with individuals in the organisation, individual information profiles are constructed to effect flow of information in a manner relevant to specific decision makers.

In summary, the generalised principles of designing a MIS are:

a) Identifying corporate information requirements, constructing individual information profiles, and formulating the output specification of the MIS to the detail of structure, content, and form of presentation of information.

b) Identifying input data requirements, developing source profile of input data, and designing procedures to generate valid input data.
c) Developing a data storage facility and identifying the level of disaggregation of data storage.

d) Developing and using techniques of processing data to prepare information

The Scramble of Claimants

The specialisation of management information system demands a combination of knowledge and skills arising from disciplines such as general management, quantitative methods, accounting and costing methods, computer sciences, and documentation methods and systems analysis. Professionals concerned with each of these disciplines have often expanded their scope of coverage to claim MIS as a part of their specialisation. There was almost a scramble, a few years ago to claim this new blue-eyed baby from the corporate cradle. Accountants occupying seats of conventional data centres in organisations began to profess on MIS. They made a good deal of contribution to this subject particularly bringing into it principles from the discipline of accounting. This, however, tended to lay emphasis on accounting concepts to an extent that the Management Information System became more or less what is called today the Management Accounting System. As the demands on information system further extended into areas of planning the corporate future, no more it was adequate to have only accounting principles to guide MIS development and operation. In place of calculations of costs, revenues and investment budgeting, more sophisticated studies involving interactions and constraints of factors of management problems became a necessity. Very logically therefore professionals of quantitative techniques such as operations research and statistical methods claimed MIS as their speciality because a major feature characterising a MIS is its information processing capability. From this point of processing techniques, the man of quantitative techniques built a framework for MIS which included methods of systems analysis. The men with the discipline of computer sciences, well aware of the fact that the bulk data handling at a high speed and with great accuracy cannot be done without computer systems, professed that MIS is an offshoot of computer applications. Significantly it was so. As computer began flooding in business organisations, reams of data poured out of computer cells as if to justify the enormous investment involved in having such a facility. Confronted with the problem of making this data useful, computer professionals applied themselves to developing the basis for designing MIS. Largely, computer system manufacturers in their prime motivation to increase their commercial gains worked on application of computer systems for MIS. The MIS concept really took its shape with the intensive work of computer professionals. As one will note, several disciplines have contributed their share of knowledge towards development of the subject of MIS. But interestingly, the profession mentioned above have considered MIS as one of the applications for their disciplines, and none have formed MIS as a logical extension of their basic discipline. If such an event had occurred the earlier discipline would have lost its identity giving way to MIS to take its place.

From Documentation to MIS

The foregoing case was not a preamble to accept that the profession of documentation is the right claimant either. Thus far no singular profession having a complete methodology required to design and operate a MIS. If one refers to the history of knowledge development, one can immediately surmise that every new discipline emerged with the support of a number of disciplines contributing to its developments till it finally acquired an identity with an explicit methodology of its own. And subsequently the new disciplines found their filiatory position in the structure of knowledge. I find that the subject of MIS takes its position next to documentation in the structure of knowledge. The two have great many similarities at the methodology level. Yet the difference is also fairly significant. But it is only a logical extension gap.

First step in the general methodology of documentation is to identify user interests, construct individual interest profiles and formulate output specification of the document handling system. These are, however, at the level of documents ... perhaps at micro and macro-level. In case of MIS the methodology still remains the same... but at the level of information. In other words, more depth in the content. It involves analysis of corporate planning and control information requirements, constructing individual information profiles indicating degree of abstractness or detail of information content and the form of presenta-
tion. Based on the information profiles, the output specification for MIS is evolved.

The second step in the methodology of documentation is to identify input data and knowledge required, and develop source profiles and procedures for inflow of data and knowledge. Here again the emphasis is on documents and on more knowledge content than the data content. In case of MIS, it is again identifying input data required, and develop source profiles and procedures for inflow of data into the system. The emphasis is on current operating data both from sources internal and external to the organisation. So again, the analysis of input data requirements follows the same methodology, but the emphasis is more on the content level.

The third step in the methodology of documentation is to design a system for storage of information about documents available in the system which can be addressed with queries to retrieve document references and subsequently original documents themselves. In this area of work, the documentation methodology has refined techniques such as classification and indexing, at a much advanced stage, perhaps not even to the extent required by MIS. The corresponding component of a MIS is the data bank. The emphasis here again is on the data content. The level of disaggregation of data to be stored in terms of cost-effectiveness for long term flexibility of the system is of importance.

The foregoing are the great many similarities at the methodology level between documentation and MIS.

The difference or the "gap" between documentation and MIS is at the fourth and the very important step — at the processing level. Conventionally, in the vocabulary of documentation, the term "processing" denotes analysis of documents at concept levels for indexing or classification, and for abstracting. This is right too. The output specifications of a document handling system demands information about documents to be stored and disseminated that these processing techniques are perhaps adequate. With the MIS, the term "processing" acquires a different meaning altogether. Here it is processing data and knowledge available in their raw form to establish their inter-relationships and draw its relevance to specific management problems. That now the question of establishing inter-relationships arises, one natural reaction will be to shy away from it advocating that it is a research function. True; in case of science and technology information it is fairly difficult to draw a clean line from where the scientists and technologist can take over from the documentalist. Why, even today there are several 'odd-ball' scientists who assert that 'library research' as they call it, is a part of the scientist's own responsibility, and that the documentalist's taking over this responsibility is much too presumptuous of his competence! Strange though it may seem, teamwork made it compelling to devise between specialisations, and for further specialisation to emerge between them.

In the corporate situation this phenomenon has occurred. Processing data and knowledge to gain meaningful information and interpret its relevance to corporate problems have by itself become a fair bit of specialised knowledge. There are definite techniques of processing and specific rules and softwares developed for this purpose. These techniques have their basis in quantitative methods ranging from simple arithmetic methods to advanced mathematics of linear programming, operations research and simulation methods. These techniques do not introduce any judgemental colour to the data and knowledge being processed. One can still be reticent while processing data and knowledge using these techniques, for they are essentially logical processing methods based on a set of explicit assumptions. In other words, we do not encounter with "Eurekas" while processing data and knowledge in corporate situations! They are just a part of planned operations of the corporation.

Here below, I list a few significant techniques which are commonly used for processing data and knowledge to derive meaningful information and briefly indicate their application:

1. **Exponential smoothing**: This technique gives greater weight to the more recent data. It is particularly useful in forecasting.
2. **Moving average**: It is a simple technique of exponential smoothing, but less accurate since it does not give weight to more recent data. This provides a basis to
evaluate past performance eliminating rapid fluctuations by selecting a time period for moving average.

3. **Time series analysis**: Using this technique, one can analyse past data for forecasting variations of performance in relation to specific time periods, such as seasonal variations.

4. **Regression analysis**: If past data is insufficient for forecasting and deriving trends, this technique helps in establishing a given activity with some other activity of which the past data is available. For example, one can relate sales of cars with standard of living.

5. **Input-output tables**: This method provides a basis to describe relationship between several input products or services with output products or services. Using these tables, if some data of others are known the unknown can be found.

6. **Linear programming**: This technique can be used when a problem can be described by a linear function to be either maximised or minimised subject to linear equalities and/or inequalities. A typical application is optimisation of product mix for maximum profitability.

7. **Operations Research**: It essentially involves application of ideas of science, analysis, logic, and good judgement to the study of the quantitatively treatable aspects of problems that arise when decisions have to be made involving operations. A typical application of operations research is in the area of warehousing location, and transportation problems.

8. **Game theory**: It helps describing and analysing competitive situations to define strategies and counter strategies.

9. **Simulation**: It provides a basis by which complex effects of decisions can be studied, as if in reality, by defining the variables in their original multidimensional state.

10. **Discounted cash flow**: It is a method to evaluate capital expenditure projects taking into account taxation and such other factors, and the fact that the earlier a return is obtained the more valuable it is, so that the cash can be re-invested.

11. **Replacement theory**: It provides a set of mathematical techniques to decide optimum life of a plant and equipment and the replacement recovery basis.

12. **PERT/CPM**: These are network techniques frequently used to plan, programme, schedule, allocate resources optimally, and control projects or other one-time jobs.

It is now apperant that there is a knowledge gap between the subject of documentation and that of MIS. The study of the discipline of MIS therefore requires modification of the curriculum of documentation with several additions and deletions. Exhibit IV presents a model curriculum for the study of the discipline of MIS. This curriculum has been evolved after a study of subject areas covered in over 30 books and in several learned papers on Management Information System, and allied disciplines. Also the curriculum of School of Information Science, Georgia Institute of Technology, USA, and that of Division of Computer and Information Science, The Ohio State University, USA, have formed the basis in the development of the curriculum.

**Conclusion**

Said, Alfred North Whitehead, "tomorrow science will have moved forward yet one more step, and there will be no appeal from the judgement which will then be pronounced on the uneducated". And science evolves with changing social needs. If the profession of documentation must become more useful to the industry where the professional utility is evaluated by its pay-off to do it in terms of better productivity, better profitability, and better management effectiveness, it is imperative that it must acquire the specialisation required for developing Management Information System. Twenty years ago a similar situation was encountered where the 'explosion' of literature took place that it required a specialisation of documentation to productively handle and make use of it. Today it is one more step forward required in the refinement of professional capability.
EXHIBIT - II

Source: Harvard Business Review
1. Long-Range Objectives
   Purpose, Profit, Growth.

2. General Long & Short Range Goals
   Profits objectives: Earnings after taxes as a % of sales, per share, Return on investment.
   Rate of return to shareholders, % retained.
   Profit growth rate
   Division profit rates, product profit rates
   Market objectives: Market share by market
   Market share by product
   New markets and new uses for present products
   Diversification directions
   Products objectives: Product line expansion and product improvement
   Product mix
   New product development
   Packaging and distribution
   Resources objectives: Financial return ratios, turnovers (receivables, inventory, capital)
   Acquisition of raw material sources
   Facilities expansion goals to attain product forecast needs
   Acquisitions and mergers
   Manpower goals by skills classification to accommodate growth plans
   Productivity objectives: Automation
   Unit cost on constraints
   Manufacturing labour output
   Salesman productivity
   Overhead cost

3. Review of Current Year (Year to date plus estimated balance)
   (a) Economic, political industry and competitive conditions in each major market or region.
   (b) Industry technological developments. The company's or associate's research and product development accomplishments.
   (c) Volume, profit, return on investment, earnings/share and other ratio goals vis. actuals, Explanation of variances.
   (d) Capital expenditure goals vs. actuals. Explanation of variances.
   (e) Narrative on firm's present position in industry, marketing and manufacturing operation, major problems and obstacles, strengths and weaknesses.

4. Long-Range Forecasts
   (a) Economic, political and sociological trends, movement of benchmarks, and interpretations; charts.
   (b) Technological, industry and market trends and indicators, and interpretations; charts.
   (c) Other trends of significance such as prices, wages, expenses, taxes, interest; interpretations and charts.

5. The Assumptions for the long-range
   (a) Economic, political, sociological.
   (b) Technological, industry and market.
   (c) Prices, wages, expenses, taxes, interest.
6. Preliminary Financial Projections and Goals (1 to 5 years)

(a) "Preliminary existing product short-range volume and profit (trend) forecast.

(b) "Preliminary Long Range Earnings Plan" by year to attain long range goals.

(c) Preliminary Balance Sheet projections by year to attain long range goals.

(d) Capital expenditure projections by year.

(e) Cash flow projections by year.

(f) Profit & Loss and balance sheet ratio, charts of trends and projections.

(g) Return on investment earnings/share and price/earnings goals; charts of trends and projections.

(h) Narrative on financial highlights and expectations, loans, working capital, growth plans.

7. Other Preliminary Planning Information

(a) Markets, products and marketing; charts and exhibits on sales trends, prices, margins, expense trends; market demand and share trends by product and market.

(b) Strategies: growth, products, marketing, Changes of previous period strategies.

(c) Narrative on major projects, their goals and progress made toward them.

(d) Narrative on major problems with preliminary goals for overcoming them.
A MODEL CURRICULUM FOR THE STUDY OF THE DISCIPLINE OF MANAGEMENT
INFORMATION SYSTEM

1. Management and Systems

Management systems, Functions of management, systems concepts
Strategic planning system,
Finance flow system,
Marketing planning system,
Manufacturing system,
Materials management system,
Quality control system,
Project management system,
Employee management system,
Cost accounting system.

2. Information Systems and Management

Information and management process
Information and planning,
Information and control,
Information and operation.

Information sub-systems

Finance information system,
Marketing information system,
Logistics information system,
Personnel information system,
Technology information system.

3. Information Systems Design Principles and Computers

Information requirement specifications
Management information profiles
Input data identification, source profiles, validity factors
Input data procedures
Manual information systems
Computer based information system, MIS applications
Real time computer systems
Information storage - manual
Information storage - Data bank concept
Systems analysis, Programming languages

4. Information Systems and Processing Techniques

Elements of statistical theory and techniques
Risk, uncertainty, decision theory,
Decision tree
Exponential smoothing, Moving Averages

Forecasting Methods

Time series analysis
Regression analysis
Input-output Tables
Linear programming
Operations Research
Game theory, Simulation
Discounted Cash flow
Replacement theory
PERT/CPM, Graphics

5. Universe of Knowledge - Structure & Development

Scientific Method,
Modes of formation of knowledge,
Learning methods,
Philosophy of mind,
Structure of knowledge,
Advanced logic,
Theory of classification,
Facet analysis,
Analytic-synthetic method,
Idea plane,
Verbal Plane,
Notational Plane,
Theory of Notation,
Coding methods,
Indexing theory and techniques.

6. Systems Concepts

Systems definition, Classification

Conceptual vs. empirical; Natural & Man-made; Man/Machine system,
Social systems, Open vs closed system.
Permanent vs temporary; Stationary vs Non-stationary

Principle system quantities and variables, System parameters; components and attributes of components.

Structural; Process; Boundaries; Interfaces.

Models of systems; Black box concept; Feedback; Signal flow graph models; Symbolic models; Analog models; Comparison models.

7. Information System Equipment & Hardwares

EDP equipment; Computer hardwares;
Feasibility study; Evaluation for procurement; planning installation;
workload and evaluation methods;
Installation costing and pricing services.
Reprographic equipment systems,
Feasibility, cost/effectiveness evaluation.

8. MIS Organisation & Personnel

Job Specification of MIS personnel;
Position description; Organisation Chart of MIS group; Performance evaluation measure of personnel;
Training needs and methods.

9. Information Economics

Theory of economics of information;
Value analysis; Cost/effectiveness evaluation; Relationship with corporate performance; Criteria for evaluation.
Source: HBR

EXHIBIT - V