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DISTRIBUTED DATA PROCESSING - A NEW TOOL FOR MANAGING LARGE ORGANISATIONS

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Distributed Data Processing (DDP) is a concept which has emerged on the computer scene rather quietly so far, and is now building up rapidly with the strength of a storm. This concept, evolving through the fusion of advances in technology and the demands on the computer as a management tool, has enabled small manufacturers of computer systems in USA to send shivers down the spine of multinational giants like IBM.

In these we shall consider the relevance of the DDP concept to the Indian situation and suggest how it could influence the computer technology scene in I in India.

PART I

Computers in Management

The role of a computer in a business or corporate environment is totally different from that of a computer in a research-oriented academic environment. In the latter case, generally a large machine with substantial number-crunching capability and very flexible software is required, because the kinds of problems brought to the machine for analysis could have very large variety.

In contrast with this, when it serves as a tool for managing a business, the computer needs to perform a limited number of functions but with speed and great reliability. We note also that the system being managed has a specific organizational structure and a well defined pattern of needs regarding information flow analysis. Considerations other than mere computing power, such and as cost, reliability and conviviality or ease-in-use, gain considerable importance when we view computers in a managerial environment.

Computers in India

The first digital computer came to India over twenty years ago, and now there are more than 300 all over the country. Most of these computers are being used for large scale arithmetical operations in research and academic institutions. In business enterprises, the computers are used for accounting, payroll and similar simple, straightforward applications. As a matter of fact in a recently conducted survey, out of 115 respondents only 3 organisations reported use of computers in managerial decision making*****.

The whole of the computer scene in India shows a lopsided approach to utilisation. There seems to be a total neglect of the priorities sector-wise, function-wise, and application-wise. If we examine the situation closely, we find a lopsided pattern of utilisation. Very few of the obvious priorities have been followed, sector-wise or function-wise. From the figures alongside, we can see that most of the available computer power is applied in the peripheral sectors of the economy, rather than in core sectors. We also find that even when computers are provided to 'core' sector institutions they are generally used in 'peripheral' functions. Rumour has it, for instance, that the Department of Electronics which is prepared to license 30 or more (imported) systems a year does not receive as many well-prepared project reports.

(See Fig. 1 a, b, and c below)

Fig. 1

The distribution of computer power in India – sector-wise and function-wise

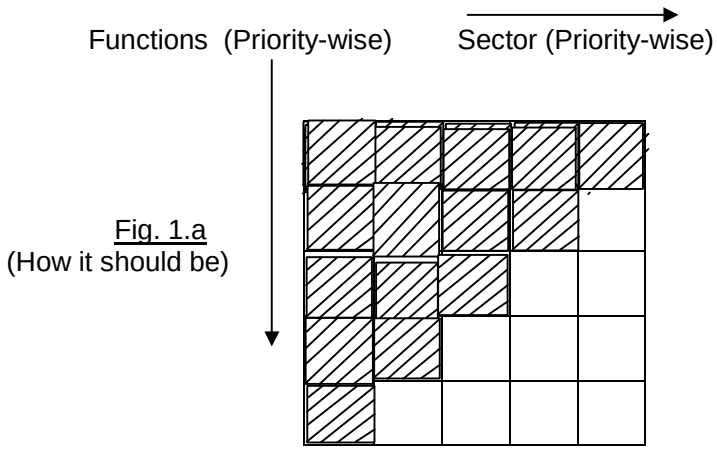


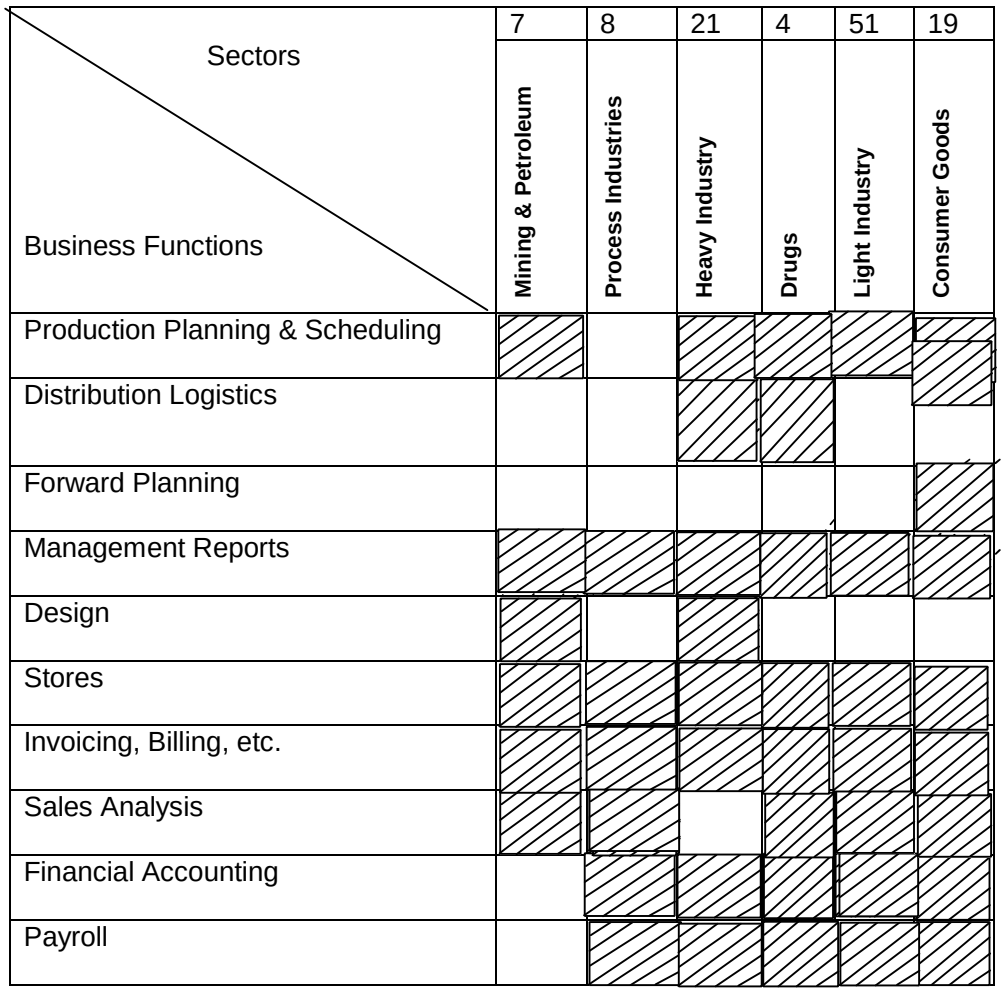
Fig. 1.a
(How it should be)

Fig. 1.b

How it is in Public Administration (No. of Computers (1975)

Sectors / Admn. Functions	30 Public Utilities	8 Revenue Depts.	0 Food Distribution	n.a. Defence	4 Finance & Banking	0 Foreign Trade	35 Science & Technology	15 Other Govt. Depts.
Planning & Project Analysis								
Decision & Catalytic Functions							▨	
Revenue Collection, Accounting	▨				▨			
Project Management	▨			▨				▨
Budgetary Control								▨
Parliamentary Reports								
Manpower Development								
Pensions, PF, etc.				▨				▨
Statistical Reports	▨	▨		▨				▨
Payroll	▨			▨	▨	▨	▨	▨

Fig. 1.c
How it is in Industry and Business (No. of Computers (1975)



The Technology

The reasons for the situation portrayed above are also not very far to seek. The growth of technology in the computer field in the early 60s was mainly oriented towards bigger and more general-purpose machines which could store and handle larger and larger chunks of data.

The technology of bigger machines forced the organisations using them towards centralisation of most information processing functions. This obviously meant centralised decision-making as well, since most of the relevant information and the analytic capability was concentrated in one central place.

This centralisation went well with relatively small organisations or those with geographically concentrated operations. But Corporations or government agencies which were large, 'and which had geographically dispersed organisations were uncomfortable under centralisation. Efficiency dropped, time delays mounted. Their field managers began to fret under the "autocratic" conditions wherein decisions were always taken by the higher echelons, which were out of touch with the environment. Their inability to respond to external changes in time finally forced the top managements to look for an alternative.

***** *Computers in India - .An Overview by Gopalakrishnan and Narayanan, Popular Prakashan, Bombay I975.*

Centralised Teleprocessing

In the West, the answer came first in the form of 'tele-processing'. This was made possible by the superb telecommunications infrastructure pro-existing in Europe, North America and Japan which enabled branch offices which were geographically away from the headquarters to be connected up over telephone lines with the main 'big' computer at the HQ.

Centralised 'Teleprocessing' quickly replaced centralised batch processing by the late 1960s, but it had serious problems.

(a) With a single 'big' computer coupled to lengthy telecom circuits involving complicated i tern failure is always a big risk.

(b) Any query or task coming from a field office over the lines must join a 'queue' and await its turn for processing, adding to line costs and to chances of failure.

(c) Field Managers have a psychological impression of continuously "reporting to the headquarters" and do not feel comfortable about sending away immediately all kinds of raw data, since it may be misunderstood at HQ arid reflect on their performance.

(d) The HQ computer staff are the target of much hostility as the 'masters'. Often they have to make software-system changes without necessarily involving the field managers in previous consultation.

(e) The initial cost of hardware and line rentals is very high. Quantum jumps in investment are then required to expand the computer system if the expanded work load so demands, for larger and larger core memory is required to hold clown line costs!

From a purely technological angle too, centralisation caused difficulties-the data bases become unwieldy: safeguarding against line failures and teleprocessing problems added immeasurably to software complexity and made operating conditions difficult; the CPU would often overload, to further upset schedules. To solve these problems, people were obliged continuously to upgrade CPUs or to ration the availability of the on-line tele-service. However, these "solutions" were only temporary.

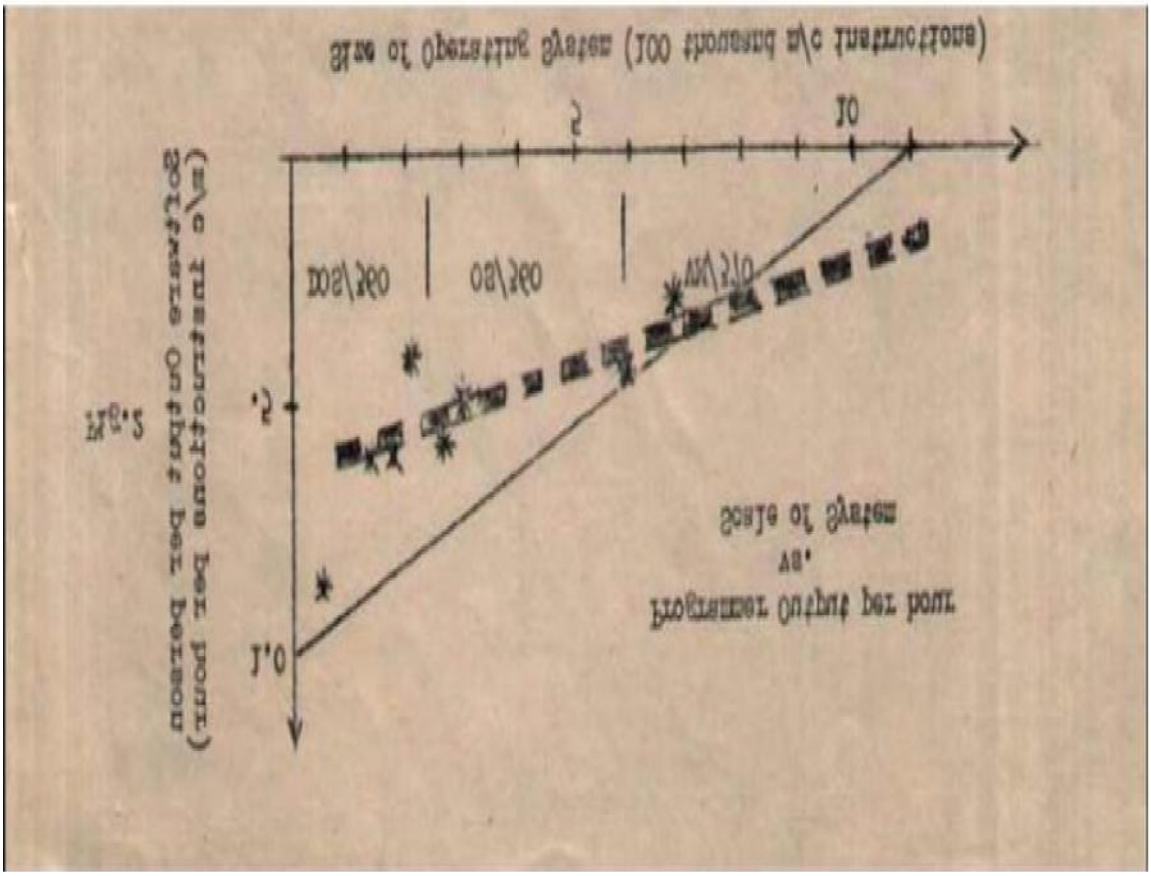
Decentralisation and Minicomputers

The idea of distributed data processing (DDP) was introduced at this stage. In distributed processing the processing logic and the relevant user files would be located physically at the place where the operations occurred.

This simultaneously eliminated the problem of data communication costs and failures, and restored the line manager's control over his own data and even gave him ad hoc access to it, without reference to the EDP which he had never had before.

Meanwhile the "minicomputer revolution" had changed the rules of the game, too. Miniaturization of electronic circuitry made it possible by 1968 to pack a roomful of electronics into a desk-sized box. By taking a fresh approach, the designers of minicomputers were able to provide higher speed and greater flexibility for a low price. Instead of making machines that, dinosaur-like, grew larger and larger, they succeeded in making smaller systems which could be used alone or in modular repetition and were much cheaper and, naturally, more reliable. (See Fig. 2) In January 1977, IBM finally capitulated

to the new trends and brought out its first minicomputer for the DDP market - Significantly this new product was labeled the ”System 1”.



Distributed Data Processing - (Part II)

Distributed Data Processing (DDP) is a concept which has emerged on the computer scene to give actuality to decentralized systems of management for large organizations. It is especially relevant to government agencies in light of the oft-repeated emphasis on decentralization heard in policy statements by the new government.

Certain developments in technology have now provided an alternative superior to teleprocessing in many ways. The advent of “MOS” and Large Scale Integration (LSI) semiconductor circuits in the early 70s have brought about a decrease in size of computers by a factor of 20 and decreases in cost by a factor of 5 or more while increasing the power, speed and reliability of the machines. (See Figs. 3 & 4 Graphs depicting these change)

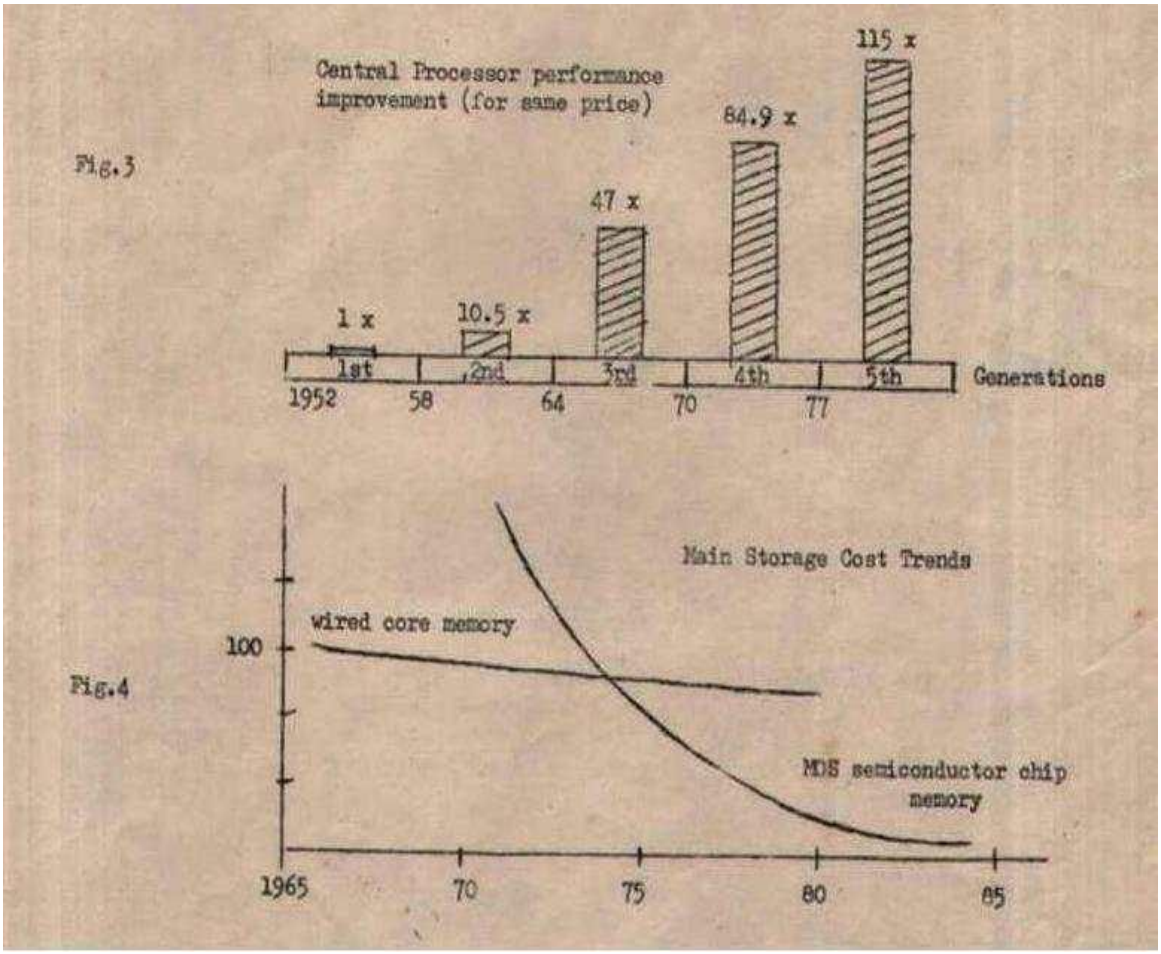


Fig.3

Fig.4

These new technologies and their effects made the concept of DDP, which was very sound in theory and known for some time, practicable and cost effective for the first time. Nowadays, the share of the capital cost represented by peripheral devices – disc storage, printers, terminals – and the control software is much greater than that of the electronic hardware. This means many more choices the customer must make. Also, the cost of punch cards (currently over 10P.) and printer paper (now about 10P, a sheet) is mounting at about 15% a year. These new economic facts call for a new way of looking at computer use.

The Price break-up of typical computer systems is instructive.

1967 Batch System		1972 Teleprocessing System		1977 DDP	
CPU	40%	CPU	25%	CPU	15%
Software	20%	Software	25%	Software	25%
Storage	30%	Telecom	10%	Storage	30%
Input-Output	10%	Storage	20%	Telecom	5%
		Terminals	20%	Terminals etc.	25%

What is Distributed Data Processing

The DDP concept is actually an adaptation of a thumb rule well established in data processing in organizations – namely the 80-20 rule. This rule states that “Put the processing power where 80% of the work is done (or results needed)”.
We derive from this rule the DDP definition: ‘the ability to place computer processing power where it is needed in the organisation’. It can be seen that data communication is not strictly

a part of the definition. It becomes relevant when the DDP concept is implemented in a network form to facilitate the management of a geographically dispersed and organizationally decentralized organization.

Technically, DDP is based upon minicomputers which are dedicated to specific users – managers, departments or offices – because they are cheap and small and because even a single application may result in high utilization efficiency on a mini where it would be impracticable on a conventional machine. There could also be certain files (data) which are common to all the modules which are part of a DDP system; sometimes these are shared, sometimes copied.

A DDP system implemented using the above mentioned philosophy will have the following characteristics:

1. There will be a network of processing nodes which are functionally or geographically distributed and which are connected by some form of communication link (a telephone line, a telex circuit or even posted or hand-carried cassettes or diskettes: these are the size of a 45 rpm. record and held 256,000 characters).

2. Data is stored and manipulated at each node in a manner such that the data base is spread throughout the network, yet is accessible, if needed, to all the nodes.

3. Hardware and Software purchase and development is under coordinated control so that all these elements function as one network system.

Where is DDP appropriate?

For the first time, using the DDP concept, any management can create an information communication and processing network almost exactly to match its organisation chart, and its information flow/processing needs.

Because of its characteristics the potential of DDP can be best utilised in organisations which have the following characteristics:

1. A geographically or functionally dispersed hierarchical system where each of the dispersed subsystems have a substantial volume of operations.

2. Along with the geographical and/or functional dispersal, the subsystems also have been delegated authority and responsibility for the decisions needed to conduct their operations.

3. The “variety”, both external and internal to the system, is quite large (e.g. in an organisation engaged in manufacturing and selling, there could be number of manufacturing units, wide range of products, and numerous types of customers.

4. There exists a need (a felt need or a deliberate policy, or both) to reduce the lead time involved in responding to internal and external changes. This may be because of a highly competitive business environment, as in the USA, or because of changes in demand and supply, or scarcity conditions as in India. In other words, quick decision-making is required. Early decisions are needed which are based upon adequate analysis of actual real-world data.

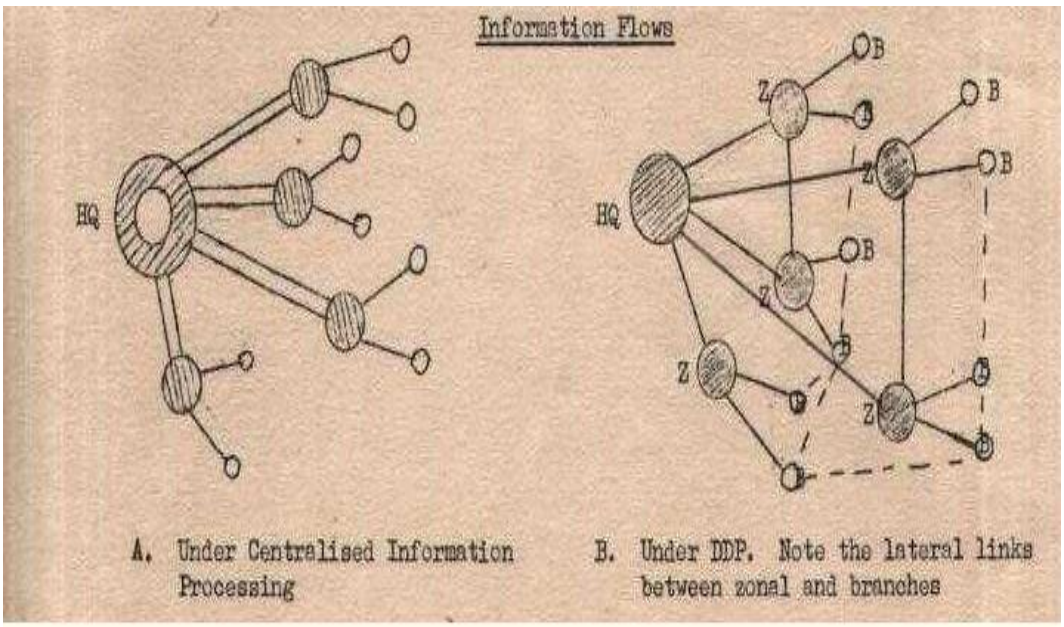
5. Need for some degree of lateral flow of information. Various subsystems not only report to the HQ but also exchange information among themselves.

In such organisations information flow/processing cannot be handled, at all, in a batched mode at a central office as is the practise today in India, nor can it be done efficiently with centralised processing - even if teleprocessing were available or economical - because of (a) the sheer bulk of information, (b) the variety and complexity of the information, and (c) the pressure of time. Therefore it becomes necessary that each element (node) of the system has its own local in-house data processing capability, so that the internodal information flow and intranodal information analysis for decision-making becomes manageable.

Required Managerial Philosophy

Technologically DDP is ready-to-use: all the hardware is available (there is even a variety of manufacturers to choose from); often the philosophy of the top management, as in government today, is already conducive to Decentralisation but a better understanding of DDP is needed in order to exploit its full potential.

DDP can be effectively used only if the organisation has adopted the philosophy of decentralised decision-making. Each node should have definite decision-making authority and a related need for information collection, storage and analysis. This is, of course, in contrast with a situation where all the nodes report the raw data to the HQ and are handed down their decisions.



A. Under Centralised Information Processing

B. Under DDP. Note the lateral links between zonal and branches

Applications in India

The DDP concept has been used by some of the largest and most hard headed, professionally managed organisations in the USA - they include such well-known institutions as Citibank, New York, Missouri Pacific Railway, Bank of America, J.C. Penney & Co., Republic Steel and others.

In India there are numerous organisations which have the characteristics most amenable to

applying the DDP concept. And fortunately - we can say with hindsight - most of them have not yet made much use of computers for decision-making. Firstly, there are the logistics system of commodities crucial to the development of our economy, viz. Food, Steel, Steel, Petroleum, Cement, etc.

Take the example of Steel Distribution by SAIL. It has all the characteristics which make it an ideal candidate for use of DDP, viz.

1. It is a geographically dispersed hierarchical system with its HQ at Calcutta, plants at Bhilai, Bokaro, Durgapur, and Rourkela, with 7 zones, 24 branches and 56 stockyards located all over the country.

2. The variety of products handled by the system is quite large: approx. 1500. There are various categories like structurals, rounds, flats, etc. and within each category there are different sections, sizes and qualities.

3. There are approx. 2200 customers of steel. They vary in terms of the priority accorded to them (e.g. Defence, Government departments, small scale industries, etc.), the kinds and quantity of steel they buy, the point of accepting material (stockyard delivery, direct despatch, etc.), their credit ratings, etc.

DDP appears to be the only workeable philosophy for speeding up the logistics of steel distribution. As it happens a major study is currently underway to apply DDP here. It could serve as a prototype for other core sectors, such as Coal, Petroleum, etc.

Then there are the service industries - Banks, Insurance companies, Airlines, State Transport Corporations, etc.
Finally there are the state government agencies like Electricity Boards, Treasuries, PWD, etc. Each one of them have a network character in their information flows and require decentralised data analysis for field decision-making.

There are some indications already that the philosophy behind DDP is seeping into policy-making bodies which determine the direction which 'informatics' take in India. For instance, the Electronics Commission has adopted the strategy of building a network of nodal minicomputers in each central ministry to provide d-p services to them. The licensing for manufacture and import of minicomputer systems is decidedly more liberal than before. Considering our comfortable foreign exchange position, it is appropriate to import mini-computer systems costing Rs 5-10 lakhs each to catalyse industries like Steel with fixed investments .of over 2000 crores.

Conclusions

We recommend that DDP should be adopted in the sectors which have been identified above, since this is the only approach which meets the technological and the social constraints - including the morale of field officers - of organisations in such a large country as ours. Adopting DDP will also enable us to make a quantum jump in technology usage: We will be avoiding altogether the "teleprocessing" phase (wherein large numbers of terminals are linked to large powerful central computers) which the West went through in the period 1965-1976. A "Teleprocessing Strategy" would on the other hand demand that hundreds of crores of rupees be immediately diverted to upgrade certain of the existing telecommunications circuits to levels needed only by computers rather than people!

With a view to expedite the adoption of DDP for efficient management of large organisations we have the following policy recommendations;

a. Rapidly build up the necessary know-how in DDP.

Two parallel steps are required: On the one hand loosening of controls on the import of minicomputer systems (including peripherals) suitable for DDP. On the other hand expertise should be developed, by giving research and consulting groups contracts to develop designs for DPI' systems for every large public sector organisation.

Manufacturers' agents and. representatives should be permitted also, for example, to import 'model' systems of each make to be operated as service bureaux where their comparative working can be evaluated.

b. Discourage the setting up of conventional EDP equipment.

Applicants for licenses to import or sell conventional computers (of the EC-1030 to IBM 370/155 type) should be required to explain why the work cannot be done better and cheaper by minis in a DDP configuration, or by the existing Regional Computer Centres.

c. Make available the hardware necessary for DDP through local manufacture and import. Given the comfortable foreign exchange position ($ 4000 million at last count) there is no point beating the dead horse of indigenous-manufacture of CPUs. Indian firms should be encouraged first to built much needed and profitable terminal equipment - teletypewriters and visual display units - which can plug into any computer system.

Public sector firms - ECIL and BEL - should formulate their R & D, collaboration and manufacturing strategy so as to meet first, and adequately, the pending needs of the Police, the Army, Navy and Air Force.

The Commercial and Civilian government market should remain open to competition between private manufacturers, OEMs and systems houses based upon imported components and. equipment. Free and open competition is expected to result in a sifting process which would leave five to seven hardware suppliers in the field. These would provide an adequate spectrum of gear from plain terminals, microcomputers and "typewriters with a memory," through minicomputers, 'floppy' disks, cassette and cartridge memories, magnetic tapes, printers, etc. - all the building blocks needed for DDP.

While "free" licensing of this equipment may sound irresponsible at first glance, we would point out that even 25-30 systems at Rs. 10 lakh each would total only Rs 2-3 crores, which is, incidentally, the sum spent on each one of the regional computers imported by the Electronics Commission.