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INFORMATION SYSTEM FOR STEEL DISTRIBUTION IN INDIA : DDP AS AN APPROPRIATE TECHNOLOGY

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Abstract

The paper illustrates with the help of an example from our experience, the use of **Distributed Data Processing (DDP)** as an appropriate information system technology for large decentralised organisations in the LDC context.

Since the coming of computers to India in 1961 and till now, they have been used as centralised, batch processing devices, for payroll, ledger accounting and other ex-post-facto applications. Little or no thought has been given to integrating computers into the organisation's decision-making processes at various levels. DDP will change all this.

Apart from matching decentralised organisation processes, DDP and Minicomputers have the important advantage in LDC's, of being highly resilient to power breakdowns, maintenance problems, spare parts shortage and to the lack of experience in the management of large centralised computer centres.

Introduction

Since the coming of computers to India in 1961, they have been used as centralised processing devices for payroll, accounting and ledger updating and other "ex-post-facto" applications where manpower is replaced by computer power. This has been due to a number of reasons: a poorly conceived government policy which prevented the freer import of computer technology, the vested interest of IBM in fully exploiting the Indian market for their older equipment and not least, the failure of managements to appreciate the true potential of computer use, viz, for future-oriented operations management rather than for replacing manual labour.

With changes in Government policy and with the withdrawal of IBM from India*, it is imperative that organisations (particularly the larger ones) radically revise their approach to computer use, and make effective use of recent developments in technology that are more suitable to their needs. The recent SRI study which is reported on here, explored the feasibility of a decentralised information system for the Steel marketing organisation in India.

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* IBM was unwilling to function in India as anything other than a wholly-owned subsidiary of IBM World Trade, and this was not possible any more under Indian law.

Apart from supporting decentralised management effectively, such a system is likely to solve some other critical socio-technical problems in LDCs: *relatively unreliable power supply*, *poor or nonexistent communications facilities* and the general *lack of experience in managing large computer complexes*.

The Steel Distribution System (SDS)

The system we have is the Steel Distribution arm of the Steel Authority of India Ltd. (SAIL), a Government company covering about 75% of the market. (SAIL's total sales are about 7 million tones currently).

Fig.1 shows a broad picture of the organisational linkages today; it shows the boundary of the system and the interfaces with the plants (the production system), and with the market (the customer system). A network of zones, branches and stockyards takes steel to the entire country. There are 7 zones, about 30 branches and 60 stockyards in all. The branch-stockyard system is the focus of selling today, though it was not always thus.

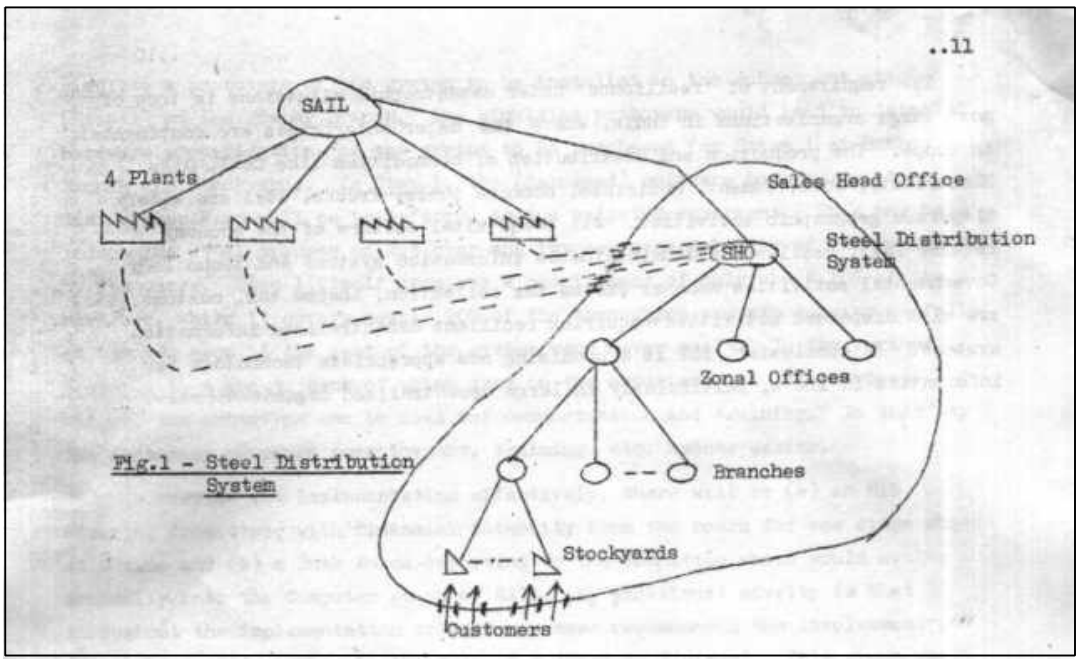

Fig.1 - Steel Distribution System

As seen in the diagram, it is at the interfaces of the SLS with the plants and the customers, that we have two important information and matter-energy exchanges taking place. The two crucial sets of problems at these interfaces are:

(1) Production-Despatch coordination at the Sales Head Office level; which is made difficult by the enormous variety in products and geography;

(2) Sales, Inventory management and forecasting at the field level; made difficult by the enormous product and customer variety.

These problems can be traced to the fact that the information flows are ***unable to match the corresponding variety across these interfaces***.

An analysis of the information needs at different levels has shown the extent of information capture, analysis and retrieval requirements for effectively dealing with these

problems.

A close look at the history of the organisation reveals that the present system of distribution is in fact a step in the process of decentralisation that has been underway quietly over the years. Prior to 1974, for instance, steel was allocated centrally by the Joint Plant Committee. Stockyards were merely delivery points and they accounted only for a very small proportion of the total sales. Needless to say, an enormous number of indents used to pile up at JPC, with the lead-times for decisions and delivery going upto two years. Naturally, uncertainty characterised steel availability, and a considerable amount of black-marketing took place. The current stockyard-oriented system of distribution evolved as a response to this situation.

Organisational Decentralisation and Irformation System Design

If we look at organisatjons as "living systems", i.e. as open, goal-seeking systems, we find that in order to survive and achieve their objectives, they must continuously adopt themselves to changes in their environment. The responsiveness of the organisation, its ability to adapt itself, naturally is a function of the rate of change and of the variety of the environmental disturbances. The more challenging and uncertain the environment, the higher the degree of responsiveness required on the part of the organisation.

How does an organisation achieve this? One must recognise that organisations are hierarchical - i.e. in general, they have more than one level of decision-making. Each decision-making level is termed an 'echelon' which (at) receives information from a lower level, processes the information, makes certain decisions and passes on the relevant (abstracted) information to the higher echelon, and (b) receives information from the higher echelon and passes on more detailed instructions to the lower echelons.

'Decentralisation' to varying degrees in fact takes place in the very formation of an echelon. When does an echelon form? When the 'decider' at any echelon has too many subordinates, the result is an overload of its capacity to process information and make decisions. In this situation of information overload, the decider is unable to digest the information as he is overwhelmed with signals - many of which will be trivial, along with those which are important. He cannot then take effective decisions on important issues. This condition of ***information overload*** also means a dangerously lowered sensitivity to environmental changes as well as poor motivation at the lower levels, since they function as mere information carriers. At this stage it becomes important to form a new echelon or to make the next echelon down the line of command more powerful i.e. to 'decentralise' some of the decision-making. 'Decentralisation' in other words is an evolutionary process which takes place to relieve the stress on a decision maker. Decentralisation, however, calls for increased coordination activity at the top echelon, which is now more easily done because of the fact that top management is freed from the trivial issues that used to go to them earlier.

In a decentralised organisation, decisions at various echelons as well as coordination at the higher echelons require an appropriately organised information system. Information originates at different echelons and is required at other echelons. Having a centralised information system in a decentralised organisation, would mean a massive data flow from the field to the centre and back, before authorisation and action takes place, which is a contradiction of the very concept of decentralisation. Alternatively, the field echelons are assumed not to need any information assistance in their decision makings! A centralised information system here would therefore mean large delays, additional costs in communication and for ineffective decisions, because the information is lacking when it is needed. (These two alternatives have been shown in *Fig.2*). Moreover, in less developed countries (LDc's) like India, the communication infrastructure is very poor. This results in

uneven transit times and the need to hold up aggregation for batch processing till all the week's or month's returns have arrived at headquarters.

In such a situation, we should prefer a decentralised information system where the technology supports the local processing of information at the different echelons for the deciders therein, and the transmission of only limited information across and between the echelons. The local processing which we find in a decentralised information system means also that ownership and control of processing power remains with the user of the information rather than with the computer department. Not surprisingly, this has been found to result in better morale.

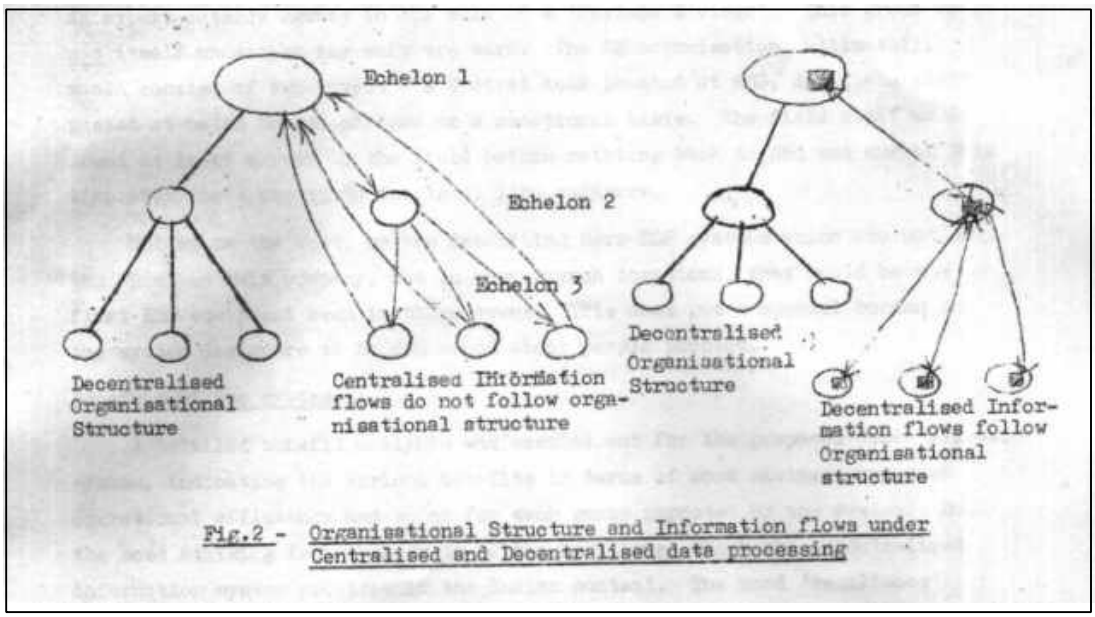

Fig.2 - Organisational Structure and Information flows under Centralised and Decentralised data processing

These conceptual insights can now be compared with our empirical findings about Steel in India. The changes perceived within the organisation can be summarised as: (a) more dispersed decision-making, (b) increased stockyard activity, (a) greater concern for customers, and (d) increased coordination activity at SHO. This shows:

(i) The various levels in the hierarchy, viz, zones, branches, etc. which used to be mere passive layers in the organisation and not responsible for any decisions, are gradually getting transformed into 'echelons'. Though the transformation is naturally not complete, the process of change over the years is quite evident.

(ii) The level of motivation at the lower levels of steel distribution system, SRI's observation suggests, has improved remarkably in the past few years, following the changes in the system. This is one of the major favourable effects of decentralisation.

(iii) The Head Office is no more bogged down with the minutiae of allocating steel to the individual customers. Instead it is able to give more attention to market-related production planning and coordination activities, and to planning for future needs.

(iv) The time interval between the felt need in the environment and the fulfillment of the needs through production and distribution of the required items has come down significantly from 2 years to perhaps a 'worst case' of six months. This better responsiveness to a changing environment is another predictable benefit of decentralisation.

Today, because they still lack information analysing capability, the potential of the intermediate levels as true 'echelons', are still to be fully utilised. For the three field levels viz. Zone, Branch and Stockyard to function effectively as echelons, we must have real information analysing capability at each level.

Distributed Data Processing (DDP) - its relevance

We briefly examine in the table below, the technological developments underlying DDP:

Aspect			Technology Development	Implications of the Development
CPU		50's	Large vaccum tube circuits with 1M Sec. Delay and lot of power dissipating	- Falling cost per circuit - Lower costs for micro-processor than for assembled circuits.
		60's	PCB's – measuring several inches on a side and 100 n. sec. Delay, less power dissipation.	
		Now	IC chip – less than 1/10" on a side for 5 to 10 circuits. Negligible power.	
MEMORY	Buffer	60's	Semiconductor circuits	Faster, cheaper, and Smaller memory
		Now	IC's with Bipolar devices and MOSFETS	
	Main	60's	Core Memory – high cost of support circuitry	Cost of memory now directly proportional to the size of memory – hence development of minis/micros has been facilitated.
		Now	Semiconductor LSI's - no Separate support circuitry.	
	Aux.	60's	Magnetic tapes, discs, etc.	
		Now	Cassetes, floppies, development Of bubble memories, CCD, etc. Apart from faster tape and disc memories.	
INPUT-OUTPUT		60's	Only card punch and paper tape	On-line data entry Possible. Particularly Useful with minis And micros.
		Now	Data entry terminals (VDUs) Cassettes, floppies, etc.	
Overall Costs		50's	Computer hardware component	Hardware costs much

of Application Development		the dominant factor in application cost.	lower than software costs.
	70's	Programming and maintenance costs are dominant.	

Distributed computing is probably an inevitable offshoot of the technological transformations shown above. It has become economical in response to the needs of large decentralised organisations (and also of small individual users) who required their information processing activity to be handled independently in each location. With the availability of a wide spectrum of computers, each sub-system of a decentralised. organisation can now select and use a computing facility suitable for their requirements, their timings, and the local volume and variety of files. Hence the organisational need is at last met by technological developments.

The choices made available by DDP of course are enormous. In the specific context of most LDC's there are certain infrastructural characteristics which are likely to be dominant in EDP design.

(a) Very poor telecommunication service - it is unreliable as well as costly, and liable to frequent breakdowns, making difficult, if not foolhardy, the use of on-line data communications technology to provide on-line service from a large central computer.

(b) Unreliable power supply - load shedding due to power shortages, and even complete breakdowns, as well as drastic fluctuations in voltage and frequency are not uncommon in LDC's. Dependence on a single computer at one location.would make the information system highly vulnerable, while a dispersed system is more resilient.

(c) Maintenance problems and spare parts - Maintenance work is generally more complex on a large computer and requires more expertise. The large variety in the spare parts requirement of a central computer, must lead to frequent spare parts shortages which in turn result in the entire system coming to a grinding halt. One alternative is to have a heavy stock of spares, but with today's monolithic technology, this is hardly economic. The preferable alternative is multiple minicomputer units in DPP, which makes the spareparts problem almost trivial in comparison.

(d) Endemic "labour problems", strikes, occasional violence - A single large central computer makes the NIS extremely vulnerable in this situation.

(e) Lack of skills and experience to manage a large computer complex - Finding and training people to manage a large control system is much more of a burdensome task than providing the minimal skills to operate minicomputers. In fact, in smaller field offices, the branch manager is directly in charge.

Under these circumstances, a DDP system is a much more appropriate form of information technology than the conventional centralised computing systems.

Proposed System for Steel

The system proposed would contain independent computing modules for various levels, viz. SHO, Zone, :Branch and Stockyards, according to their requirements of transaction volumes and information variety. The SHO will have a twin-mini with one unit

primarily supporting the production and despatch coordination activity and the other the market-related activities. They would update their information-images of plant and market on a continuous basis. The resulting "shadow rolling plan" would buffer the uncertainty in the environmnent substantially. The emphasis we believe should be one of minimising uncertàinty, and of more effective management rather than straight-forward mechanisation of activities. The branches would use the computer for transaction-processing and reporting as well as for analyses and forecasts. Since the Zonal office is located in the same city as the largest branch, the two offices share a computer. The requirements for different volumes of transactions were assessed and various modules as described below were assigned to the branches and stockyards.

Stockyard Modules	***Branch or 'Office type' Modules***
S1 Taletypewriter hard-wired to another TTY in the branch office in same town	
S2 TTY with Cassette tape for recording the transactions. (Tape is to be sent to Branch office in a different town)	
S3 Intelligent terminal with Cassette and Printer	B1 Same as S3
S4 16KB Microprocessor with terminal, floppy discs and printer.	B2 Same as S4
	B3 64KB Mini (at all Zonal Offices) with disc, terminals, printers, etc.
	B4 128KB Mini (at Bombay and Calcutta) With disc, terminals, printer, etc.
	H 2 x 128KB Minis (at Sales Head Office) with discs, printers, tapes, terminals, etc.

The total present value cost of the hardware is about $ 850K, A centralised system to take the same transaction volume has been estimated as costing twice as much and taking upto a month for response time.

Implementation

The problem of implementation has to be tackled with extra care, because of the fact that the proposed system would be bringing in an entirely new technology and style of working into the organisation. Furthermore, all organisations in India are still at an infant stare in the use of computers and the proposed system would very likely be the first of its kind in most of the towns it appears in.

.A proper phasing and sequencing of implementation thus is a logical necessity to overcome the hurdles and adjustment problems in implementation. As a Step Zero in the implementation plan, SRI has proposed that SAIL should simulate a prototype of the system to be installed in the subsequent stage (Step 1) at the Bombay Branch. The simulated prototype would lead to detailed hardware specifications of the system to be purchased for Stage 1 at Bombay Branch and Stockyards. In Step 1, the (debugged) software modules written during Step Zero will be transferred to the selected equipment. This may help reduce the usual traumas on cut over and improve acceptability of the system by its users. Step 1 itself requires a committment of only about 10% of the hardware, while it covers nearly 20% of the throughput and. can survive usefully on its own even if the rest of the system were

never built, In the further Steps 2, 3, 4 and 5, each of which draw on the experience of the previous stages, the prototype can be used for demonstration and. training. In this way the necessary manpower redeployment, training, etc. become easier.

To oversee the implementation effectively, there will be (a) an MIS Steering Committee, with financial authority from the board for one stage ahead at a time and (b) a Task Force reporting to the Committee which would evolve gradually into the Computer group of SAIL. An additional novelty is that throughout the implementation process, we have recommended the involvement of an expert outside agency in the role of a 'Systems Advisor'. This group would not itself undertake any software work. The DP organisation, ultimately, would consist of two levels - a Central team located at SHO, and field staff posted at major branch offices on a rotational basis. The field staff would spend at least a year in the field before rotating back to SHO arid during this time they would report to the local line managers.

Unlike in the West, we are describing here EDP systems which are not only the first in this company, but in many branch locations, they would be the first EDP equipment seen in those towns This does put a special burden on the system designers to be concerned about people problem.

Benefits of the system

A detailed benefit analysis was carried out for the proposed decentralised system, indicating the various benefits in terms of cost savings, improved operational efficiency and so on for each group impacted by the system. But the **most striking factor seems to be the resilience which the decentralised. information system provides in the Indian context**. The word 'resilience' connotes the ability to remain pliable and unaffected under catastrophic situations.

The requirement of 'resilience' under catastrophic situations is true of most large organisations in India, where the major enterprises are continental in scope. The production and distribution of commodities like Coal, Oil, Electricity, Food, Cement, Medicines, Machine tools, Trucks, etc. are widely dispersed geographic activities.

All these vital sectors of the economy require fast, resilient and maintainable information systems and technology. Governmental activities such as excise tax collection, income tax, customs, etc. are also dispersed activities requiring resilient decentralised information systems. In conclusion, DDP is a promising new appropriate technology for informatics in LDC's, particularly in large decentralised organisations.

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