Distribution Structure of Corporate Information System

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This paper presents a practical approach to deal with the problems involving performance characteristics like cost, response time, reliability, availability and security; and the relationship between the information system and the decision making system.

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Information Systems in corporations were conventionally designed around a central computer located in the Management Services/Information Systems Department (Banerjee and Sachdeva, 1988). Such a system processed transactions taking place in various functional departments and geographical locations to generate information for use at various levels of managerial activity in the corporation viz, Strategic Planning, Management Control, and Operational Control (Anthony, 1965).

In the batch processing mode, the transactions taking place at the operating level in the corporation are captured manually on paper documents. These paper documents are periodically transported in batches for central punching and processing. The information reports generated at the central computer are distributed to various users. The data files maintained at the central computer get updated periodically and the management reports generated reflect the status of the organisation as on the last cut-off date of data capture. Such reports are useful for medium and long term planning and control.

In the real time mode, the transactions are captured on the on-line terminals and transmitted to the central computer on communication lines connecting the terminals with the central computer. The files maintained at the central computer are updated instantaneously and reflect the status till the last reported transaction. Transactions are made on the basis of the real time data retrieved from the computer as query from the terminal during the transaction. Paper documents to capture the transactions and their transportation to central computer is avoided. Data records are centralised and are available on-line to all the

terminals located at distant locations during the real time. Such systems have been very usefully implemented in the Airlines and Railways reservations, banking and various other organisations.

Centralised System

Until the mid-seventies, most computing was carried out by systems employing a large, centralised computer. The central processing unit (CPU) had a diverse collection of relatively simple machines attached to it, some of them connected via telecommunication links. For certain applications, networks were built in which large number of simple terminals were connected to a central computer system. Sometimes the central computer system had two processors for reasons of reliability, but the processing of each transaction was done by one large computer. Until the spread of microcomputers in the early seventies a commonly accepted rule was Grosch's Law, which stated that the cost of computing was inversely proportional to the square of the size of the computer, (Martin James, 1981). Major economies of scale existed in computing as well as storage of data and program files. Such a centralised system, however, put heavy burden on the communication system.

End-user Computing

The growth of microelectronics and the consequent personal computer has changed the computing scene radically. In the centralised computing system, the user had no contact with the computer except that he received the computer-printed reports. His familiarity with the computer was from behind the glass doors of the computer room. The mass production process of small but powerful computers has changed the economics of computing. It has demolished the Grosch's Law. Centralisation of computing facility is no more considered desirable. Now, every department in the corporation wants to have its own minicomputer for its functional needs. Individual managers in the department would like to have their own personal computers. Some may like to use readymade programs supplied to them while others would like to write their own programs using simple command language. They may like to store and retrieve their own data and simulate policy and decision alternatives using Decision Support packages before arriving at their decisions. This has opened up new frontiers to them for combining their managerial judgement with computer's analytical ability. This class of applications are popularly known as Decision Support Systems.

Distributed System

The proliferation of small computers in the corporation creates the need for integration. The marketing department computer may like to communicate with that of the production department and the production department computer may like to communicate with that of the purchase department. All these departments may like to communicate with the computer in the finance department. The top management may like to know the implications of change in product design in all the functional areas.

Distribution of information system involves three main resources viz. (i) hardware computing devices, (ii) programs, and (iii) data files. The basis of distribution can be functional or geographic; horizontal or vertical. The extent of distribution of reosources may depend on considerations of economy and performance charcteristics such as response time, reliability, availability and security. The physical distribution of resources in a distributed system is transparent to users. The users view the system as a single integrated system. Such an integration is achieved through the communication network underlying the computer network, and software overheads.

Distribution Structure

The distributed information system in a corporation captures data from a number of locations of data sources where the transactions in the corporation originate, stores the data in the form of files or databases at different locations, transmits and processes data to provide information to users at various geographical locations, There are numerous possibilities of locating the processing systems, locating files and the topology of the communication system inter-connecting the processing systems.

The locations of data sources and the locations of end users are the possible candidates for the location of processing systems. The locations of processing systems are the possible candidates for the location of files and programs. One or more copies of the same file may be maintained at different locations depending on their usage. Communication network topologies can also be designed in many different ways to achieve vertical and horizontal integration (Tannenbaum, 1981). The structure of the topology may be hierarchical or tree structure like the headquarters computer connected to various department computers and each department computer connected in turn to the computers in the sections of that department. It may be a loop or ring structure like all the department computers forming a ring. It may be a bus structure or fully connected or irregular.

Theoretically, the number of alternative topologies is very large. A network connecting only ten computer has 45 possible links and the inclusion or exclusion of each link in the structure gives 2^{45} or 3×10^{13} alternatives. Similarly, there are numerous possibilities for locating processing systems, data files and programs. Obviously, complete enumeration or a brute force approach is not possible for generating good solution to the problem.

Information System and Decision Making System

Information System in the corporation is designed to support the decision making system. Mason has described the process of decision making consisting of five stages (Mason, 1981) :

1. Source-consisting of the physical objects and activities which are relevant to the business.
2. Data-observation, measurement and recording of data from the source.
3. Inferences and predictions drawn from the source.
4. Values and Choice-evaluation of inferences with regard to values (objectives or goals) of the organisation and choosing a course of action.
5. Action-taking of course of action.

Mason has classified information systems into four categories depending on whether the first two, three, four or all the five stages of the decision process are taken over by the information system. Mason has called these categories as (i) Data Bank Information System, (ii) Predictive Information System, (iii) Decision-making Information System, and (iv) Decision-taking information system. The stages of the decision process not taken over by the information system are handled with the managerial judgement.

The rationale used in the managerial judgement and reasoning in arriving at the decision is not very clear. Simon has discussed three models of human rationality viz. (i) Subjective Expected Utility, (ii) Bounded Rationality, and (iii) Intuitive Rationality, (Simon, 1977). Simon has also classified management decisions into (i) Programmed or Structured Decisions and (ii) Non-programmed or Unstructured Decision, (Simon, 1983). The procedure for arriving at the decision and consequently its information needs are But, there is no cut-predetermined in the case of a structured decision. and-dried method for handling an unstructured decision and hence its information needs are uncertain.

As the corporations gain more experience in dealing with their decision problems and develop better understanding about them, the 'deep structure' of the decision problem becomes more explicit and the problem hitherto percieved as unstructured evolves into a structured one, (Chonsky, 1971). However, the goal of complete structure is utopian and some decisions are best left to expert judgement. There is close interaction between the information system and the decision making system of the corporation. Decision support systems aim at combining the expert judgement with the computer's analytical ability. They deal with the problems in a semi-structured manner leaving the structured component to the computer and the unstructured component to the expert judgement. The manager may like to use his expert judgement in designing alternatives and use the computer for analysing these alternatives. Every next alternative may be designed keeping in view the results of analysis for the previous alternative. Such a man-machine interactive system is possible only if the manager has an access to the computer processing system and the database through the terminal.

The structure of the information system has to be in conformity with the structure of the decision making system or the organisation structure of the corporation. Even with the conventional Management Information Systems, the computer systems were first installed at the headquarters office followed by the divisional offices before they were extended to the field offices or locations of data capture. The use of Decision Support Systems further strengthens this practice.

Existing (Cost Minimisation) Models

The problem of distribution structure of corporate information system can be divided into the following sub-problems:

1. Design of network configuration involving determination of size, number and location of computers and input/output terminals.
2. Design of network topology involving the structure of communication system.
3. Allocation of data files over the network of computer systems.
4. Allocation of program modules for distributed processing.

Gregory (1983) has dealt with the first problem. He has developed a model to determine the optimal size of computers at 'n' possible location and the optimal allocation of production to these computers with known probabilistic demand pattern. The model attempts to minimize total cost of capacity installation, operating costs, communication costs and cost of service centre in case of demand spillover.

Boorstyn *et al* (1977) and Gerla *et al* (1977) have dealt with the second problem of topology design. The topology design problem assumes a given processing load at a set of locations and a given communication load between each pair of locations. Topology design models attempt to determine the structure of the communication network so as to minimize the total cost of communication.

Chu (1969), Casey (1972), Morgan and Levin (1977) and Manning and Leonard (1983) have dealt with the third problem of data file allocation. The problem of data file allocation basically deals with trade-off between cost of retrieval and the cost of updating a data file. The retrieval cost can be minimized by having multiple copies of file at each location from where retrieval may be desired. On the other hand, updating involves changes in all the copies of the file making it desirable to have only one copy.

Dutta *et al* (1982) have dealt with the fourth problem of distributed processing Distributed processing involves decomposition of processing problem into sub-problems and assignment of various sub-problems or modules to various processors in some optimal fashion. The model developed by them makes use of Quadratic Assignment algorithm to minimize the total cost of running modules on processors and that of communication between modules.

Mahmoud and Reordan (1976) and Gavish and Pirkul (1986) have dealt with the combined problem of location of computing systems and allocation of data files to these locations, Chen and Akoka (1980) have dealt with the combined problem of configuration, topology and allocation of data and program files. They have developed nine cost functions viz, (i) Computer costs, (ii) Database Software costs, (iii) Communication lines installation cost, (iv) Storage cost of databases, (v) Storage cost of programs, (vi) Communication cost of queries from users to programs, (vii) Communication cost of updates from users to programs, (viii) Communication cost of queries from programs to databases, and (ix) Communication cost of updates from programs to databases. They have also developed "bounded branch and bound" integer programming algorithm for the minimization of total cost consisting of the sum of the nine cost functions.

Gavish (1987) has addressed the combined problem of determining the number and location of computing systems, location of databases, assignment of data sources to databases locations and report generation location for each report to be generated by the system. His model assumes a given set of reports to be generated at known frequencies. He has taken into consideration cost factors such as : set up and operational costs for processors, storage devices and access

rights to communication channels; costs involved in transferring transactions from their original points (data sources) to their databases; costs of updating and maintaining the databases; the cost of the retrieving data needed for report generation from the databases; the cost of transferring the retrieved data from the data retrieval locations to the locations in which the reports are generated; cost of generating a report in a location; and the cost of distributing the edited reports to the end users. He has also assumed that only one copy of a database can be maintained, each report can be processed in a single location and every report is generated in a separate report generation process. He has also shown that the resulting Integer Programming problem for cost minimization is NP-complete and has suggested a heuristic for obtaining near optimal solution.

Limitations of Existing Models

Most of the above models have concentrated on a very limited aspect of the distribution structure. The two most comprehensive models are by Chen and Akoka (1980) and Gavish (1987). Both these models have estimated a fairly comprehensive set of cost functions. But, they have not taken into consideration the other performance characteristics such as response time, reliability, availability and security. These factors are either included in the constraints or totally ignored. The problem is treated as a mere cost minimisation problem. The underlying assumption in their approach is that the efficacy of the system with respect to response time, reliability etc. remain constant while different alternatives are explored in search of minimum cost alternative. This is hardly the case in practice.

Chen and Akoka (1980) model treats the information system as a mere transaction processing system where data has to be captured at the locations of its sources, stored, updated and retrieved in response to user queries from time to time. This may be true for an operating Information System but certainly not for a Management Information System or Decision Support System. Similarly, Gavish's model assumes a given set of reports to be generated at given frequencies, their data needs being predetermined. Such structured information systems existed in the past but are giving way to semi-structured system involving man-machine interaction such as in Decision Support Systems.

The above models do not examine the relationship between the information system and the decision making system. The users are just treated as the receipients of information and all users are treated to be equally important. In real life corporations, the officials are structured into a hierarchy and each official is responsible for deffernt class of decisions. The nature of decision made by the official determines the the importance and urgency of the information required. In most organisations the cost of the computers is justified on the basis of a few critical applications and the other applications are just implemented because the computer facilities are available.

The data captured from various field locations or data sources has to be integrated and summarised at various levels to provide information to higher levels of management. This integration of data cannot be merely on the basis of geographic proximity and communication costs involved but has to be on the basis of the responsibility structure in the organisation.

Proposed Cost-Effectiveness Approach

Due to the limitations of the cost-minimization approach, we feel that a more comprehensive cost-effectiveness approach should be adopted involving consideration of all the performance characteristics such as cost, response time, reliability, availability and security. We feel that the information system has to be designed to support the decision making system in the organisation and, consequentially, has to be linked with the responsibility structure in the organisation. For example, in a typical hierarchical organisation, the first candidate for a computer location will be the headquarters office, followed by the divisional offices followed by sectional offices and so on. Depending on the organisational and responsibility structure in the organisation, the structure of distribution of information system is a strategic decision and not that involving cost-minimisation. The coporate computer network may have vertical distribution, horizontal distribution, or some combination of vertical or horizontal distribution. Similary, the distribution of

data in the information system may be dependent hierarchical distribution independent hierarchical distribution, split-data distribution, or separate-data distribution (Martin James, 1981).

Having decided on the form of structure of distribution of processing system and data files, the problem is reduced to that of determining the level of decentralisation. Obviously, the most centralised form is the one in which all the resources viz. processing capacity, data files and programs are located at one logical central location. The most decentralised form will be the one in which all the user locations and all the data source locations have processing capacity and every location is connected to every other location through a direct communication line. The optimal solution lies somewhere in between this most centralised form and the most decentralised form.

We recommend an incremental analysis approach for determining the optimal distribution structure where a composite cost-effectiveness function consisting of cost, response time, reliability, availability and security is maximised. In this approach, we may start from a highly centralised form as an initial feasible solution. This may be the most centralised form consisting of only one location or a few essential locations which are the obvious choice for the location of processing capacity, data files and programmes.

If U is the set of user locations having 'u' elements and S is the set of data source locations with 's' elements, the intersection of U and S may be non empty. The union of U and S may contain 'n' elements such that

$$n \leqslant u + s$$

These 'n' locations are the possible candidates for the location of processing capacity. The cost of installing and operating a processing capacity or communication line consists of the one-time cost which is the initial cost of installing the facility and the recurring cost which is the cost of operating the facility over a period of time. The one-time cost can be converted into an equivalent recurring cost over the life of the facility by taking the interest on capital employed and the depreciation of the equipment or using the standard discounted cash flow techniques. The equivalent recurring cost of the one-time cost and the other recurring cost together forms the total equivalent recurring cost. We take this total equivalent recurring cost in all cases for consideration in determining the optimal solutions.

The cost of installing processing capacity can be considered as linearly related to the capacity installed with the fixed component A and a variable component B per unit capacity, such that the cost Pj of processing capacity Cj installed at location 'j' would be :

$$Pj = A + Cj\,B$$

If there are 'm' data files and 'r' programme files to be located in the system, then the total equivalent recurring cost of the system may be worked out as

$$\text{Cost} = \sum_{j=1,\,n} X_j \cdot P_j + \sum_{j=1,\,m} \sum_{j=1,\,n} Y_{ij} \cdot D_{ij}$$

$$+ \sum_{j=1,\,r} \sum_{j=1,\,n} Z_{ij} \cdot R_{ij} + \sum_{j=1,\,n} \sum_{j=1,\,n} T_{ij} \cdot L_{ij}$$

Where X_j = 1 if processing capacity is located at location 'j'
= 0 otherwise

Y_{ij} = 1 if data file 'j' is located at location 'j'
= 0 otherwise

Z_{ij} = 1 if programme file 'i' is located at location 'j'
= 0 otherwise

T_{ij} = 1 if a communication line is installed between location 'i' and location 'j'
= 0 otherwise

D_{ij} = Cost of maintaining data file 'i' at location 'j'

R_{ij} = Cost of maintaining programme file 'i' at location 'j'

L_{ij} = Cost of maintaining communication line between location 'i' and location 'j'

$$Y_{ij} \leqslant X_j \qquad i=1, m; j=1, n \ldots\ldots \text{(i)}$$

$$Z_{ij} \leqslant X_j \qquad i=1, r; j=1, n \ldots\ldots \text{(ii)}$$

$$T_{ij} \leqslant X_i \cdot X_j \qquad i=1, n; j=1, n \ldots\ldots \text{(iii)}$$

Constraints (i) indicate that a data file cannot be located at those locations where no processing capacity is installed. Constraints (ii) indicate that a program file cannot be located at those locations where no processing capacity is installed. Constraints (iii) indicate that a communication line connecting any two locations may be built only if the processing capacities are located at both the locations.

The response time in a network of (computers is a combination of the processing that at the nodal computers, transmission time in the communication links and queuing delay of messages waiting for the resources. The processing time and transmission time are a function of hardware speed. Queuing delays can be estimated using queuing theory as applied to computer networks (Kleinrock, 1976).

The reliability of a network of computers depends on the node-connectivity and the arc-connectivity of the network graph. An algorithm due to Kleitman (1969) or Even (1975) may be used. For a network of 'n' nodes, Even's algorithm requires 'n' applications of the max-flow algorithm to determine whether the condectivity is at least 'k', whereas Kleitman's algorithm requires 'k' applications of the max-flow algorithm. Under normal circusmstances k is two or three, and 'n' can range from tens of nodes to hundreds or even thousands of nodes. So, Even's algorithm is two to three times faster.

The importance of availability of processing capacity at a particular location may depend on the type of users located there and the nature of decisions made by these users. The corporation may assign weightages to various user requirements and may work out an availability index for a given distribution structure.

The security facilities available at different locations may be different. Depending on the sensitiveness of the data stored, it may have certain security requirements. If additional security arrangements have to be made at a particular location, it may add to the cost of the system.

Depending on the above factors, a composite cost-effectiveness function can be estimated for a given distribution structure as follows :

$$CEF = W_1 (RT) + W_2 (REL) + W_3 (AVL) - W_4 (COST)$$

Where CEF = Cost-effectiveness function
RT = Response time index
REL = Reliability index
AVL = Availability index
COST = Cost of the system
W_1 = weightage attached to response time.
W_2 = weightage attached to reliability
W_3 = weightage attached to availability
W_4 = weightage attached to cost.

Having estimated the cost-effectiveness function of the highly centralised initial solution, we may consider incremental steps towards a more decentralised form. Each incremental step would shift some processing capacity, data file or programme file to mere decentralised location. Duplicating a data file or a programme file at the more decentralised location may also be considered. Every incremental step that leads to improvement in the cost-effectiveness function will be accepted and the others rejected. The optimal solution would be reached when at the margin, the increase in the cost of the system by further decentralisation would be equal to the value of the improvement in performance characteristics.

Conclusion

The problem of determining the optimal structure of the corporate information system is a complex one involving consideration of a large number of factors. The existing models have treated the problem as a mere cost minimisation one. The performance characteristics like response time, reliability, availability and security have either been treated as

constraints or totally ignored. The issues involving linkages between the information system and the decision making system in the corporation, which are of crucial importance, have not been addressed.

We have proposed a practical approach involving development of a cost-effectiveness function by combining the cost factor with other performance characteristics. The problem is treated as an incremental one starting from a highly centralised structure and moving step by step towards more decentralised form. The optimal structure is achieved when on the margin, the incremental cost of decentralisation is equal to the incremental value of the performance characteristics.

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High Intensity Crop Rotations for Maximising Production and Income in West Bengal

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The authors report, in this paper, the levels of production and income that were derived through the multiple cropping demonstrations conducted on farmers' fields in the districts of 24 Parganas (North) and Hoogly in West Bengal from 1981 to 1985.

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West Bengal has been always facing shortage of food, fodder and other agricultural commodities. There is little scope for further extension of area under cultivation. The only feasible alternative left for further increase in agricultural production is by augmenting the productivity per unit area per unit time through high intensity of crop rotations. The introduction of early and premature flowering resistant varieties of jute and the availability of short duration water and fertilizer responsive high yielding varieties of wheat, paddy, potato etc. has made it possible to raise three crops in a sequence within one year where mono or even double cropping were, hitherto, common practice.

In order to introduce new high intensity crop rotations to increase production and income of the farmers and also to utilize available farm resources judiciously, 1242 demonstrations were conducted on the farmers' fields in the districts of 24-Parganas (North) and Hooghly in West Bengal from 1981 to 1985. The main aim was to maximise production per unit area per unit time by using high yielding varieties in conjunction with the package of recommended practices. This article reports the levels of production and income that were derived through the multiple-cropping in the demonstrations.

Materials and Methods

In all, 12 different crop rotations (eight three-crop rotations and four two-crop rotations) were conducted under three situations of water availability namely (a) adequate and assured irrigation conditions, (b) limited

and unassured irrigation conditions and (c) normal rainfed conditions. The details of the package of agronomic practices followed and varieties used for different crop-rotations are presented in Table 1.

TABLE 1 **Details of package of agronomic practices employed for various crops**

Crop rotations	No. of demonstrations	Variety	Sowing/planting time	Harvesting time	Spacing (cm)	Fertilizer N	P_2O_5	K_2O
1	2	3	4	5	6	7	8	9
A. Adequate and assured irrigated conditions								
1. Jute	67	JRO-524, JRO-878 JRO-7835	Early April	Early Aug.	25×7	40	20	20
Paddy	67	Ratna, IR-50, IR-36	Mid Aug.	End Nov.	22×10	80	40	40
Wheat	67	Sonalika	End Nov.	March	20×7	120	60	60
2. Jute	67	JRO-524, JRO-7835 JRO-878	End March	Early Aug.	25×7	40	20	20
Paddy	67	Ratna, IR-36, IR-50	Early Aug.	Early Nov.	22×10	80	40	40
Potato	67	K. Chandramukhi, K. Jyoti	Mid Nov.	February	50×15	120	60	60
3. Jute	24	JRO-524, JRO-7835 JRO-878	End March	End July	25×7	40	20	20
Paddy	24	Ratna, IR-50, IR-36	Early Aug.	Early No.	22×10	80	40	40
Cabbage	24	Pusa Drum Head Savoy	Mid Nov.	February	75×60	120	60	60
4. Jute	60	JRO-524, JRO-7835 JRO-878	End March	End July	25×7	40	20	20
Paddy	60	Ratna, IR-50	Early Aug.	End Oct.	22×10	80	40	40
Mustard	60	Y.S.B.-9, T-59	Early Nov.	February	30×7	60	30	30
B. Limited and unassured irrigated conditions								
1. Jute	21	JRO-524, JRO-7835 JRO-878	End March	End July	25×7	40	20	20
Paddy	21	CR-126-42-1, IR-50	Early Aug.	End Oct.	22×10	80	40	40
Mustard	21	Y.S.B.-9, T-59	Early Nov.	End Feb.	30×7	60	30	30
2. Jute	20	JRO-524, JRO-7835, JRO-878	End March	End July	25×7	40	20	20
Paddy	20	IR-50, IR-36	Early Aug.	Early Nov.	22×10	80	40	40
Pea	20	Bonavelle, Arkel	Early Nov.	End Feb.	30×15	20	40	00

(Contd.)

TABLE 1 (*Contd.*)

1	2	3	4	5	6	7	8	9
3. Jute	20	JRO-524-JRO-7835 JRO-878	Early April	Early Aug.	25×7	40	20	20
Paddy	20	Ratna, IR-50, IR-36	Early Aug.	Early Nov.	22×10	80	40	40
Tomato	20	Pusa Ruby, Mar Globe	Mid Nov.	End Feb.	75×60	60	30	30
4. Jute	35	JRO-524, JRO-878, JRO-7835	Early April	Early Aug.	25×7	40	20	20
Paddy	35	Ratna, IR-50, IR-36	Mid Aug.	Mid Nov.	22×10	80	40	40
Lentil	35	B-77, B-256	End Nov.	Mid March	Broadcast	20	40	00
C. Rainfed condition								
1. Jute	48	JRO-632, JRO-524 JRO-7835	Mid April	Mid Aug.	25×7	40	20	20
Paddy	48	Masuri, Pankaj	Mid Aug.	End Nov.	22×10	80	40	40
2. Jute	32	JRO-632, JRO-524, JRO-7835	Mid April	Early Sept.	25×7	40	20	20
Pea	32	Bonavelle, Arkel	Early Oct.	Mid Jan.	30×15	20	40	00
3. Jute	52	JRO-632, JRO-524, JRO-7835	Mid April	Early Sept.	25×7	40	20	20
Mustard	52	B-54	Mid-Oct.	End Dec.	30×7	40	20	20
4. Jute	18	JRO-632, JRO-7835, JRO-524	Mid April	Early Sept.	25×7	40	20	20
Greengram	18	PS-16	Mid Oct.	Mid Jan.	Broadcast	20	40	00

(*a*) *Adequate and assured irrigation conditions*

Assured irrigation refers to the situations in which farmers have their own irrigation sources like shallow tubewells, pump-sets etc. to provide irrigation water whenever needed. The maximum production per unit area is achieved by advancing sowing times and by applying pre-sowing irrigation to secure full and healthy stand of seedlings. Under this conditions, 651 demonstrations on four three-crop rotations (300% intensity) were conducted from 1981 to 1985. These rotations are: jute-paddy-wheat, jute-paddy-pota to, jute-paddy-cabbage and jute-paddy-mustard.

(*b*) *Limited and unassured irrigation conditions*

Under this situation, farmers do not have their own source of irrigation but depend on the hired irrigation facilities. When water supply is limited and unassured, 2 to 3 irrigations are provided at critical stages meeting only 2/3rd to 3/4th of the water use needs of the crops. A total of 288 demonstrations on four three-crops rotations (300% intensity) namely, jute-paddy-mustard, jute-paddy-pea, jute-paddy-tomato and jute-paddy-lentil were conducted during 1981-1985.

(*c*) *Rainfed conditions*

Under normal rainfed conditions, 300 demonstrations on four two-crop rotations (200% intensity) i.e. jute-paddy, jute-pea, jute-mustard and jute-greengram were conducted in farmers' fields. The purpose of such demonstrations was to encourage

farmers to grow second crop after jute under upland and midland by utilizing sub-soil moisture at the sowing time and availing winter rains during growing period.

Results And Discussion

Production potential of different crop rotations

The details of the average yield of differnt crops followed in various rotations, number of days each crop occupied the field, average yield per day and total production per day are presented in Table 2.

Of the four rotations conducted under assured irrigation, jute-paddy-cabbage produced the highest aggregate yield of 279.49 q/ha followed by 228.08 q/ha obtained from a jute-paddy-potato rotation, while the lowest yield of 70.90 q/ha was recorded from a jute-paddy-mustard rotation. The higher yields of the former two rotations were due to the vegetable crops of cabbage and potato. The yield from jute-paddy-wheat rotation was 89.61 q/ha per year. The yield of wheat was generally low after paddy.

As regards the total duration taken by different crop rotations in the fields, jute-paddy-potato had the

TABLE 2 **Production potential of different crop rotations (average of 5 years)**

Crop rotations	Average yield (q/ha)	Crop duration (days)	Average yield/ cropped day (kg/ha/day)	Production/ rotation/ cropped (kg/ ha/day) day	Crop intensity (%)
1	2	3	4	5	6
A. Adequate and assured irrigated condition					
1. Jute	26.92	109	24.70		
Paddy	37.26	89	41.87		
Wheat	25.43	109	23.33		
Total	89.61	307	89.90	29.19	300
2. Jute	25.84	110	23.49		
Paddy	36.04	89	40.49		
Potato	166.20	88	188.87		
Total	288.08	287	252.85	79.47	300
3. Jute	26.69	110	24.26		
Paddy	35.82	87	41.17		
Cabbage	216.98	94	230.83		
Total	279.49	291	296.26	96.04	300
4. Jute	24.62	115	21.41		
Paddy	37.82	86	43.98		
Mustard	8.46	94	9.00		
Total	70.90	295	74.39	24.03	300

(*Contd.*)

TABLE 2 (*Contd.*)

1	2	3	4	5	6
B. Limited and unassured irrigated condition					
1. Jute	23.91	111	21.54		
Paddy	38.59	85	45.40		
Mustard	8.17	90	9.08		
Total	70.67	286	76.02	24.71	300
2. Jute	24.54	109	22.51		
Paddy	37.67	85	44.32		
Pea	33.06*	105	31.48		
Total	95.27	299	98.31	31.86	300
3. Jute	24.86	116	21.43		
Paddy	34.77	89	39.07		
Tomato	89.14	119	74.91		
Total	148.77	324	145.41	45.92	300
4. Jute	24.02	110	21.84		
Paddy	34.67	90	38.52		
Lentil	8.00	98	8.16		
Total	66.69	298	68.52	22.38	300
C. Rainfed condition					
1. Jute	23.54	111	21.21		
Paddy	32.29	118	27.36		
Total	55.83	229	48.57	24.38	200
2. Jute	23.20	120	19.33		
Pea	26.90*	104	25.86		
Total	50.10	224	45.19	22.37	200
3. Jute	24.32	124	19.61		
Mustard	7.24	86	8.42		
Total	31.56	210	28.03	15.03	200
4. Jute	23.98	123	19.49		
Greengram	5.03	81	6.21		
Total	29.01	204	25.70	14.22	200

* Green pod for vegetable.

minimum number of 287 days of occupation while jute-paddy-cabbage and jute-paddy-mustard were next in order with 291 and 295 days, respectively. The rotation jute-paddy-wheat occupied the field for maximum number of 307 days.

Comparing the efficiency of different rotation on the basis of production per day, jute-paddy-cabbage (96.04 kg/ha/day) proved to be most efficient rotation followed by jute-paddy-potato (79.47 kg/ha/day) because of higher yields of cabbage and potato and low total crop duration. The other two rotations namely jute-paddy-wheat and jute-paddy-mustard produced 29.19 kg/ha/day and 24.03 kg/ha/day, respectively.

Among four three-crop rotations conducted under limited and unassured irrigated conditions, jute-paddy-tomato produced the highest total yield of 148.77 q/ha while jute-paddy-lentil gave the lowest yield of 66.69 q/ha. The second highest yield of 95.27 q/ha was received from jute-paddy-pea rotations. Jute-paddy-mustard secured third position in respect of total yield (70.67 q/ha).

The total time taken by rotation was maximum for jute-paddy-tomato (324 days) and minimum for jute-paddy-mustard (286 days). The other two rotations viz. jute-paddy-pea and jute-paddy-lentil were very close to each other in this regard (299 and 298 days, respectively).

With regard to the production per day, jute-paddy-tomato gave maximum yield of 45.92 kg/ha/day followed by jute-paddy-pea (31.56 kg/ha/day) because of higher yields of tomato and pea. The other two crop rotations such as jute-paddy-mustard and jute-paddy-lentil produced 24.71 kg/ha/day and 22.38 kg/ha/day, respectively.

Of the four rotations conducted under normal rainfed conditions jute-paddy gave highest yield of 55.83 q/ha followed by jute-pea which produced a total yield of 50.10 q/ha per year. The lowest yield of 29.01 q/ha was obtained from jute-greengram while jute-mustard gave a total yield of 31.56 q/ha. Similar trends in favour of these rotations were also observed with regard to the production per day. The rotation jute-paddy gave maximum yield of 24.37 kg/ha/day while jute-pea produced 22.57 kg/ha/day. Jute-greengram was at the bottom (14.22 kg/ha/day). The rotation jute-mustard gave yield of 15.03 kg/ha/day.

The same order was maintained with regard to the crop duration. Jute-paddy occupied the filed for maximum number of 229 days followed by jute-pea (224 days) and jute-mustard (210 days). Jute-greengram occupied the field for minimum number of 204 days.

Economics of different crop rotations

Data pertaining to production cost, gross return per rupee invested and cost-benefit ratio were calculated and have been presented in Table 3. While working out the economics of different crops and rotations, rent on land, depreciation on farm equipment and interest on cash investments etc. were not included. Under adequate and assured irrigation conditions, the net income of Rs. 12727/ha/yr was highest in jute-paddy-potato followed by jute-paddy-cabbage (Rs. 11728/ha/yr) suggesting that the introduction of vegetable crops in the rotations increased the income at farmers' fields. Another rotation jute-paddy-mustard fetched a net return of Rs. 8449/ha/yr. The lowest net return of Rs. 8330/ha was obtained by adopting jute-paddy-wheat. The yield of wheat after paddy was generally lower than after the other crops while the production cost of wheat was higher than mustard. This has been reflected in less net return of jute-paddy-wheat rotation.

The return per day of crop duration was maximum in the rotations which included vegetable crops i.e. jute-paddy-potato (Rs. 44.34/ha/day) and jute-paddy-cabbage (Rs. 40.30 ha/day). However there was not much difference in the net return per day between other two rotations namely jute-paddy-mustard (Rs. 28.64 ha/day) and jute-paddy-wheat (Rs. 27.13 ha/day.

It is interesting to note that of the four rotations conducted under assured irrigated conditions, three rotations jute-paddy-potato, jute-paddy-cabbage and

TABLE 3 **Economics of different crop rotations (average of 5 years)**

Crop Rotation	Average Yield fibre/grain tuber (q/ha)	Stick/straw yield (q/ha)	Gross income (Rs/ha)	Production cost (Rs/ha)	Net income (Rs/ha)	Percentage contribution of each crop to the total net return	Net Return per day (Rs)	Net return per rupee invested	Input output ratio
1	2	3	4	5	6	7	8	9	10
A. Adequate and assured irrigated condition									
1. Jute	26.92	59.30	6958	3966	2992	35.92			1.75
Paddy	37.26	73.60	7917	4184	3733	44.82			1.89
Wheat	25.43	47.25	5520	3915	1605	19.26			1.41
Total	89.61	180.15	20395	12065	8330	100.00	27.13	0.69	1.69
2. Jute	25.84	52.70	7557	4164	3393	26.26			1.81
Paddy	36.04	68.50	7920	4166	3754	29.50			1.90
Potato	166.20	—	14657	9077	5580	43.84			1.61
Total	228.08	121.20	30134	17407	12727	100.00	44.34	0.73	1.73
3. Jute	26.60	53.50	7922	4583	3339	28.47			1.73
Paddy	35.82	67.62	8366	4838	3528	30.08			1.73
Cabbage	216.98	—	11822	6961	4861	41.45			1.70
Total	279.49	121.12	28110	16382	11728	100.00	40.30	0.72	1.72
4. Jute	24.62	54.50	7575	4277	3298	39.03			1.77
Paddy	37.82	65.40	8149	4581	3568	42.23			1.78
Mustard	8.46	—	4429	2846	1583	18.74			1.56
Total	70.90	119.90	20153	11704	8449	100.00	28.64	0.72	1.72
B. Limited and unassured irrigated condition									
1. Jute	23.91	47.50	8013	4901	3112	38.47			1.63
Paddy	38.59	74.26	7673	4238	3435	42.47			1.81
Mustard	8.17	—	4198	2656	1542	19.06			1.58
Total	70.67	121.76	19884	11795	8089	100.00	28.28	0.69	1.69
2. Jute	24.54	53.25	7761	4462	3299	32.25			1.74
Paddy	37.67	76.10	8894	5097	3797	37 12			1.74
Pea	33.06	—	6682	3548	3134	30.63			1.88
Total	95.27	129.35	23337	13107	10230	100.00	34.21	0.78	1.78

(Contd.)

TABLE 3 (*Contd.*)

1	2	3	4	5	6	7	8	9	10
3. Jute	24.86	51.52	7884	4700	3184	38.41			1.68
Paddy	34.77	65.50	8181	4660	3521	42.47			1.75
Tomato	89.14	—	5183	3598	1585	19.12			1.44
Total	148.77	116.75	21248	12958	8290	100.00	25.59	0.64	1.64
4. Jute	24.02	50.30	7118	4009	3109	40.42			1.77
Paddy	34.67	66.70	7679	4259	3420	44.46			1.80
Lentil	8.00	—	2986	1823	1163	15.12			1.64
Total	66.69	117.00	17783	10091	7692	100.00	25.81	0.76	1.76
C. Rainfed condition									
1. Jute	23.54	49.10	6767	3972	2795	46.62			1.70
Paddy	32.29	66.50	6959	3759	3200	53.38			1.85
Total	55.83	115.60	13726	7731	5995	100.00	26.18	0.77	1.77
2. Jute	23.20	48.50	6592	3561	3031	58.00			1.85
Pea	26.90	—	5189	2995	2194	42.00			1.73
Total	50.10	48.50	11781	6556	5225	100 00	23.32	0.80	1.80
3. Jute	24.32	51.75	7050	3940	3100	69.76			1.79
Mustard	7.24	—	3357	2009	1348	30.24			1.67
Total	31.56	51.75	10407	5949	4458	100.00	21.23	0.75	1.75
4. Jute	23.98	49.40	7508	4410	3098	68.36			1.70
Greengram	5.03	—	3077	1643	1434	31.64			1.87
Total	29.01	49.40	10585	6053	4532	100.00	22.21	0.75	1.75

jute-paddy-mustard gave almost equal net return per rupee invested i.e. Rs. 0.73, Rs. 0.72 and Rs. 0.72 respectively. The rotation jute-paddy-wheat recorded lowest net return of Rs. 0.69 per rupee invested because of low yield and high production cost per hectare.

Both jute and paddy crops contributed more than 80 per cent of the net return when wheat and mustard crops were included in the rotations but their contribution remained far below (less than 60 per cent) when vegetable crops like potato and cabbage were included in the rotations. The contribution of potato to the net return was maximum (44 per cent) closely followed by cabbage (41 per cent) while that of wheat and mustard were 19 per cent each in respective rotations.

The input-output ratio of the rotations involving potato and cabbage was higher as compard to the rotations with wheat. The ratio in potato and cabbage was 1.73 and 1.72, respectively in contrast to 1.69 in case of wheat.

However, the crops included in each rotation varied

considerably in this respect. It ranged from 1.73 to 1.81 in jute and from 1.73 to 1.90 in paddy while it remained 1.70 in cabbage, 1.61 in potato, 1.56 in mustard and 1.41 in wheat.

Data presented in Table 3 also reveal that under limited and unassured irrigation conditions, the maximum monetary net return of Rs. 10230/ha/yr was obtained by adopting jute-paddy-pea rotation followed by jute-paddy-tomato which gave Rs. 8290/ha/yr. Both pea and tomato were sold for green vegetable purposes. The rotation of jute.paddy-mustard had third position giving a net return of Rs. 8089/ha/yr. The minimum net return of Rs. 7692/ha/yr was realised from jute-paddy-lentil.

The net return per day was maximum (Rs. 34.210-ha/day) in jute-paddy-pea rotation followed by jute-paddy-mustard (Rs. 28.28/ha/day). The net return per day was almost indentical in jute-paddy-lentil (Rs. 25.81/ha/day) and jute-paddy-tomato (Rs. 25.59/ha/day).

There was not much difference in the net return per rupee invested between jute-paddy-pea (Rs. 0.78) and jute-paddy-lentil (Rs. 0.76) because of least investment on the cultivation of lentil. The rotation of jute-paddy-tomato was at the bottom (Rs. 0.64) in this respect. This was mainly due to less net return from tomato as compared with pea because of difference in selling price. The net return per rupee invested in case of jute/paddy/mustard was Rs. 0.69.

Table 3 further reveals that the contribution of both jute and paddy crops to the net return in all the four rotations ranged between 69 and 85 per cent. The contribution of pea was 31 per cent while that of lentil only 15 per cent. Both mustard and tomato contributed 19 per cent each in the net return per hectare.

As regards the input-output ratio, it ranged from 1.63 to 1.77 in jute and 1.74 to 1.81 in paddy. The input-output ratio of pea, lentil, mustard and tomato was in the order of 1.88, 1.64, 1.58 and 1.44, respectively. The input-output ratio in jute-paddy-pea rotation was highest (1.78) because of higher return from the sale of green pea while it was lowest in jute-paddy-tomato (1.44). The return from tomato was less due to low price.

Of the four rotations conducted under rainfed conditions (Table 3), the highest net return of Rs. 5995/ha/yr was realised in the case of jute-paddy rotation followed by Rs. 5225/ha/yr obtained with jute-pea. The rotation jute-greengram gave a net return of Rs. 4532/ha/yr. The lowest net return of Rs. 4458/ha/yr was obtained with a rotation of jute-mustard.

Similarly, the net return per day was maximum in jute-paddy (Rs. 26.18/ha/day) followed by jute-pea (Rs. 23.32/ha/day), whereas it was very close in jute-greengram (Rs. 22.21/ha/day) and jute-mustard (Rs. 21.23/ha/day).

The net return per rupee invested was maximum (Rs. 0.80) in jute-pea followed by jute-paddy (Rs. 0.77) because of less investment in the former rotation. The other two rotations i.e. jute-mustard and jute-greengram had same net return per rupee invested (Rs. 0.75 each). Similar trends were observed with regard to the input-output ratio. In jute it ranged from 1.70 to 1.85. It is interesting to note that the input-output ratio was highest (1.87) in green-gram. This shows that this crop should be included in the rotation for securing maximum net returns per hectare per year.

There was appreciable variation in the contribution of jute to the net return per hectare. It ranged from 47% to 70% in different rotations. The contribution of paddy was in the order of 53 per cent while that of pea was over 42 per cent. Greengram and mustard contributed over 32 and 30 per cent to the net returns per ha, respectively.

Conclusion

The high intensity crop rotations with jute has thus revealed that in areas where irrigation is available a farmer is able to produce as high as 28 tonnes/ha/yr with a net income of Rs. 11727/ha/yr by adopting jute-paddy-cabbage or 23 tonnes/ha/yr with a uel

return of Rs. 12728/ha/yr by following jute-paddy-potato rotations. These results are similar to the results reported by Mitra *et al.*, 1970; Pal *et al.*, 1978 and Patel *et al.*, 1978. The higher yield in the rotations is a clear evidence of the high yield potential that can be obtained with proper crop rotations and appropriate management techniques.

Considering the production efficiency of individual crops, jute invariably in summer season, paddy in rainy season and cabbage followed by potato, tomato, pea, wheat and mustard in winter season were best under irrigated conditions while jute followed by paddy, pea and mustard was best under rainfed conditions. Therefore for achieving highest productions per unit area per year the ideal crop rotations would be jute in summer season, paddy in rainy season and cabbage, potato, tomato, pea, wheat and mustard in winter season.

These results thus clearly point out the great scope for an increased agricultural production as well as monetary returns through multiple cropping by adopting suitable crop rotations and recommended agronomic and management practices. However, for the success of cropping round the year irrigation facility has to be assured atleast at the critical stages of crop growth, besides adequate and timely supply of inputs like fertilizers, chemicals, credit etc. and development of marketing, communication and transport facilities.

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Entrepreneurial Correlates in Three Types of Firms in Kerala

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This paper attempts to discover the major determinants of entrepreneurship; the process by which organisations renew themselves and their markets by pioneering innovation and risk taking.

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Introduction

Entrepreneurship has been identified with an innovative personality, generally an independent-minded owner manager who makes the strategic decisions for his firm. Entrepreneurship is a multi-dimensional concept which encompasses the firms action relating to product-market and technological innovations (Schumpeter, 1934); risk-taking (Collins and Moore, 1970) and proactiveness (Miller and Friesen, 1978). An entrepreneurial firm is one that engages in product-market innovations, undertakes risky ventures and is the first to come up with proactive innovations beating other competitors to the punch. Entrepreneurship is a composite weighting of all these variables.

Collins and Moore (1970), Shapero (1975) and Toulouse (1980) stressed the importance of personality factors, psycho-dynamic characteristics and the socio-cultural background of the chief executive in fostering entrepreneurial behaviour. Hage and Aiken (1970) called attention to environmental and structural factors of the firm that seem to promote innovation. Ackoff (1970) and Miller and Friesen (1978) stressed decision making and strategy factors as promoting entrepreneurship. Normann (1961) and Hage and Dewar (1973) argued that centralisation will promote innovation, the latter being vital to entrepreneurship, while Litwak (1961) opined that expertise based power and extensive delegation of authority promoted innovation.

Objectives

The objectives of the study were to discover the major determinants of entrepreneurship, the process by

which organisations renew themselves and the markets by pioneering, innovation and risk taking.

Methodology

The questionnaire method was used to gather information on the variables of environment, organisation structure, decision making style (s), strategy and entrepreneurship. A number of distinct aspects for each variable was measured to ensure that it would be broadly and thoroughly represented. Scale items were averaged to obtain the variable score. The construct reliability indices for each of the variables was measured. Locus of control was measured by using Rotter's (1966) Internal-External Scale.

Using the Cronbach Alpha scale, 60 firms in as variagated a grouping as coir manufacturing, broadcasting, paper and pulp, food, construction, transportation, plastics, electronics, chemicals and publishing were selected for the study. There were six firms in each industry group. These firms were chosen according to their accessibility and cooperativeness of the top level executives.

All responses to the questionnaire were obtained by the personal interviews. Sixty respondents of the rank of Chairman, Vice-Chairman and Managing Director were contacted. Whenever more than one respondent per firm completed the questionnaire, the ratings of the highest ranking respondent was used. This happened in 67 per cent of the cases. In 73 per cent of the cases, data were supplied by the Chief Executive. Inter-reliability data were adequate across all variables. In case of diversified and divisionalised companies, each division was treated as a separate entity. In this respect, five of the firms were divisions of three different organisations. In every case, these divisions were controlled on the basis of the financial performance.

For purposes of study, firms were classified into small, medium and big based on some-structural and strategy making characteristics. The determinants of entrepreneurship would be different for each (Table 1).

Small firms : Small firms were having less than 500 employees and had high centralisation of power and authority (Table 2). These firms are generally run by owner managers and are sole proprietory. They operate in a hostile market and in a homogeneous environments. Since these firms use minimal control systems, their decision making process is purely intuitive (least analytical) and their strategies, the least explicitly articulated. They have little or no technostructure, few support staffers and minimal differenciation among its units. Coordination is effected largely by direct supervision. There is generally little planning; time horizons are short and the focus is on operating matters. Since the entrepreneur is in a position to override structural and environmental obstacles to entrepreneurship and can resist entrepreneurial activity in the face of environmental incentives and structural pressures, entrepreneurship is determined by his personality, power and knowledge.

Medium firms : Medium firms have greater than or equal to 500 employees and are centralised. They tend to make use of sophisticated controls, long range planning and greater analytical decisions (Table 2). These firms function smoothly since they are led by a core group of managers and technocrats who dominate the decision making process. In these firms, the process of decision making is analytical and product-market analysis tends to lead to product market entrepreneurship. Where product-market strategies, are too vague and fragmented to command the manager's attention, the focus is more likely on production and operating problems which are an abiding obsession in these firms.

Big firms : Big firms have low centralisation score, open and effective internal communications and high technocratisation (Table 2). These firms by operating in a heterogeneous market tend to be adaptive and their entrepreneurial efforts reflect the demands of the environment and the capacities of their organic structure. In this way, environment and structure determine entrepreneurship in big firms. The more challenging the firms' environment, the greater the need to be entrepreneurial; the more organic their structures, the better they are able to recognise and fulfil this need.

TABLE 1 **Expected type attributes and hypothesised determinants of entrepreneurs**

	Simple firms		Medium firms		Big firms	
	Att.[1]	Hyp.[2]	Att.[1]	Hyp.[2]	Att.[1]	Hyp.[2]
Size	C[3] S		C L		M	
Locus of control		(—)		(—)		(O)
Environment						
Dynamism	M		L	(O)	H	(+)
Heterogeneity	L		M		H	(+)
Hostility	H		L	(O)	M	(+)
Organisation/structure						
Scanning	L	(+)	M		H	(+)
Controls	L		C H	(O)	M	
Communication				(O)	C H	(+)
Resources	L		H		M	
Centralisation	C H	(+)	C M	(O)	C L	(−)
Technocratisation	L	(+)	M		C H	(+)
Differentiation	L		M	(O)	H	(+)
Integration	L		H	(O)	M	
Strategy/Decision making						
Analysis	L		H		M	
Futurity	L		C H		M	
Explicitness of product market strategy	L		H	(+)	M	(+)
Strategic integration	M		H	(+)	L	(−)
Entrepreneurial Imperative	Leadership (personality power and knowledge)		Strategy		Environment and structure	

[1] Att. denotes attributes. H, M and L are high, medium and low respectively. They are ranks relative to the other two groups. S and L are small and large respectively. A blank space indicates no opinion.

[2] Hyp. signifies hypothesised relationship with entrepreneurship. (+) or (−) indicate positive or negative relationship respectively with entrepreneurship on the basis of our hypothesis, while (O) an insignificant relation and a blank space, a non-committal view.

[3] C indicates that these are classificatory variables.

Analysis of Variance (ANOVA) was performed to establish whether groups of firms differed significantly from one another. The means of variables differed significantly across types and hence were excluded from the analysis. When a variable was used to define only one group, t-test was used to compare the means on that variable for the remaining groups to see if they differed.

TABLE 2 Selection criteria, variable means and standard deviations for three types of firms

		SMALL FIRMS No. of Employees less than 500 Centralisation greater than 5		MEDIUM FIRMS No. of Employees greater than or equal to 500 Centralisation & Analysis greater than or equal to 4		BIG FIRMS Centralisation less than or equal to 4 Technocratization greater than 4 Communication greater than or equal to 4		ALL TYPES	
	Sample size	$\bar{X}$ 20	S.D.	$\bar{X}$ 20	S.D.	$\bar{X}$ 17	S.D.	$\bar{X}$ 60	S.D.
Cronbach Alpha	Variables sales (Rs. in million)	18	33	405	923	493	518	237	649
	No. of employees ('00)	2	3	44	100	31	36	22	66
	Leader locus of control	6.0	2.2	4.4	1.9	4.4	1.6	5.4	3.2
	Environment								
0.74	Dynamism	4.0	1.8	3.7	1.1	4.2	1.2	3.9	1.5
0.84	Heterogeneity	3.4	1.4	4.5	1.3	5.2	1.5	4.1	1.6
0.72	Hostility	4.4	1.3	4.0	1.0	4.2	1.0	4.2	1.1
	Organisation/structure								
0.74	Scanning	4.3	1.7	5.1	1.3	5.4	1.3	4.7	1.4
0.70	Controls	3.5	1.7	5.6	0.7	4.9	1.8	4.4	1.7
0.87	Communication	5.0	0.9	4.9	1.2	4.5	1.5	4.9	1.1
0.68	Resource	4.1	1.6	4.9	1.0	4.5	1.2	4.3	1.3
0.79	Centralisation	6.2	0.4	5.0	0.8	3.5	0.7	5.1	1.2
0.68	Technocratization	3.2	1 9	4.6	1.4	5.4	1.1	4.0	1.7
0.88	Differentiation	2.7	1.0	4.0	1.7	4.8	1.4	3.5	1.8
0.71	Integration	4.9	1.3	5.2	1.0	4.3	1.2	4.8	1.2
	Decision Making/Strategy								
0.86	Analysis	3.6	1.3	4.8	0.9	4.7	1.4	4.0	1.3
0.83	Futurity	3.4	1.5	5.5	0.5	4.2	1.7	4.1	1.5
0.81	Explicitness of strategy	3.4	1.9	4.8	1.3	4.2	1.4	3.9	1.6
0.46	Strategic integration	4.5	1.2	4.7	1.0	4.2	1.1	4.3	1.1
	Entrepreneurship								
0.80	Innovation	3.2	1.8	3.8	1.3	4.1	1.6	3.5	1.6
0.84	Proactiveness	3.9	2.0	4.9	1.0	4.7	1.1	4.3	1.5
0.94	Risk taking	3.2	1.3	3.9	1.1	3.8	1.1	3.6	1.2
0.90	Average entrepreneurship	3.4	1.3	4.2	0.8	4.2	1.1	3.8	1.2

Results

The study revealed that the sales turnover of these firms ranged from less than Rs. 1 million to those over Rs. 1 billion. The mean sales was Rs. 237 million and its standard deviation was Rs. 649 million. The average number of employees was 2,270. In every instance, the Cronbach Alpha measure which averaged 0.77 for all variables, well exceeded guidelines set up by Van de Ven and Ferry (1980) for measuring organisational attributes. The Cronbach Alpha coefficient for the seven item entrepreneurial variable was 0.90 (Table 2).

The analysis of variance (ANOVA) showed the variable means of groups to be significantly different according to F-statistic for heterogeneity, resources, differentiation, integration, analysis, explicitness of strategy, proactiveness, risk taking and average entrepreneurship. The t-tests revealed significant differences along controls, technocratisation and futurity variables. It could thus be inferred that the group of firms differed significantly along most variables (Table 3).

The small firms revealed high correlations of entrepreneuership with locus of control, centralisation and technocratisation. Locus of control and centralisation together explain 52 per cent of the variance in entrepreneurship (Table 4). This validates the findings of Normann (1961), Hage and Aiken (1970), Hage and Dewar (1973), Shapero (1975) and Toulouse (1980) but disproves Litwak (1961). Scanning correlated with proactiveness and risk taking only and not with innovation. In our sample of small firms; scanning sometimes resulted in reducing the level of innovation in order to avoid the depletion of resources. There is a positive correlation between technocratisation and entrepreneurship. When leaders are in touch with technocrats, they are more likely to become informed of new product opportunities and to engage in entrepreneurial activity. Technocrats enjoy working at the forefront of their field and want to develop professionally. They may thus try to sell the entrepreneurs on new ideas so that they can have more variety and challenge at the jobs (Hage and Aiken, 1970).

The structural variables so often identified in the literature as being facilitators of entrepreneurship seemed extraneous in the context of small firms. One possible explanation for this is that in small firms, acts of entrepreneurship and innovation tend to be simple. They do not involve complex projects that require the collaboration of specialists. The low level administrative complexities does not call for elaborate structures. Rather entrepreneurship in small firms is very closely tied up with the leader's personality, power and information that nothing else seems to count.

TABLE 3 ANOVA and t-test for 3 types of firms for non-classificatory variables[1]

	F-ratio[2]	t-statistic[3]	
Dynamism	1.0		
Heterogeneity	5.7**		
Hostility	1.2		
Scanning	1.8		
Controls		2.3*	(29)
Resources	2.9***		
Technocratization		2.5**	(34)
Differentiation	5.1**		
Integration	2.9***		
Analysis	6.2**		
Futurity		1.4***	(29)
Explicitness of strategy	5.9**		
Strategic integration	0.8		
Innovation	0.7		
Proactiveness	3.8*		
Risk taking	2.5***		
Entrepreneurship	3.6*		

1. Variables of size, communication and centralisation were omitted since these were classificatory variables.
2. F-ratio presented has 2.54 d. f. Symbols *, ** and *** indicate statistical significance at the level of 0.05, 0.01 and 0.10 respectively.
3. When a variable was used for the purpose of classification for one group only, the difference in means for the other groups were tested using a t-test.

   The degrees of freedom are in parentheses.

TABLE 4 **Multiple regressions for entrepreneurship in 3 types of firms**

Small firms :

Entrepreneurship = 0.31 — 0.35 Locus of control + 0.84 centralisation

Beta :	—0.61	—0.29
Partial F :	11.10	2.50

Overall F : 8.03; d.f. 2.16; p=0.005; R=0.72; R^2=0.52; Adj. R^2=0.45

Medium firms :

Entrepreneurship = 1.40 + 0.11 explicitness of strategy + 0.19 technocratisation

Beta :	0.68	0.33
Partial F :	17.10	4.10

Overall F=10.9; d.f.=2.16; p=0.005; R=0.77; R^2=0.59; Adj. R^2=0.54.

Big firms :

Entrepreneurship=3.2—0.96 Centralisation+0.53 Explicitness of strategy+0.40 Technocratisation

Beta=	—0.57	0.65	0.41
Partial F	13.30	19.60	6.70

Overall F=13.8; d.f.=3.11; p=0.001; R=0.91; R^2=0.82; Adj. R^2=0.76.

Note : In adding variables to the regression equation, a cut off point of 2.0 was used for the calculation of the partial F ratio. Variables not meeting this criteria could not explain a significant amount of variance even at the level of 0.01.

Neither environment, structure, nor decision making styles seem to correlate with entrepreneurship.

Simple firms could be entrepreneurial in stable environment and conservative in dynamic ones. Environment just did not seem to matter. During the course of the interviews, the chief executives of several small firms claimed not to belong to any particular industry. They said the firms were unique and followed a niche strategy. They tended not to view industry factors as constraints. Entrepreneurship seemed to be much more a function of the leader's goals and character than of external events.

The major correlates of entrepreneurship for the medium firms are explicitness of strategy and locus of control. Environment and structural variables seem to matter hardly at all with the possible exception of technocratisation and differenciation. Differenciation by allowing a wide variety of talents and experiences to coexist within the organisation permits managers to generate and implement more entrepreneurial ideas. Familiarity with diverse markets combined with knowledge assorted production techniques and design procedures produced innovations in these firms. Conservatism was combatted by hiring technocrats who collectively constituted an effective pressure group that was lobbying for change. Technocratisation and differenciation correlated only with innovation. This is because in medium firms, technocrats rather than chief executives are responsible for most of the innovations. Innovation may be greatly facilitated by technocratisation and the wide diversity of managerial personnel. But risk taking and proactiveness are more strongly influenced by the explicitness of product-market strategies and the personality of the leader. Explicitness of a product-market strategy and technocratisation together explains 59 per cent of the

TABLE 5 **Product moment correlations of variables with entrepreneurship for three types**

	Small firms				Medium firms			
	Ent.	I	P	R	Ent.	I	P	R
1	2	3	4	5	6	7	8	9
Leaders Locus of control	—0.66†	—0.44*	—0.44*	—0.61†	—0.43*	—0.08	—0.42*	—0.45*
Environment								
1. Dynamism	0.09	0.09	0.05	0.05	—0.06	0.24	—0.06	—0.33‡
2. Heterogeneity	0.18	0.26	0.18	—0.13	0.22	0.46*	0.24	—0.27
3. Hostility	0.24	0.46*	—0.03	0.10	0.12	0.44*	0.00	—0.25
Organisation/Structure								
4. Scanning	0.41*	0.03	0.44*	0.45*	0.21	0.18	0.32*	—0.04
5. Controls	0.12	0.04	0.16	0.04	0.13	0.18	0.14	—0.06
6. Communication	—0.09	—0.29	—0.16	0.40*	0.27	0.02	—0.01	0.55†
7. Resources	—0.10	—0.19	—0.11	0.13	—0.11	0.03	—0.01	—0.27
8. Centralisation	0.40*	0.31‡	0.24	0.35‡	—0.06	—0.28	0.14	0.06
9. Technocratisation	0.51*	0.45*	0.33‡	3.34‡	0.36‡	0.47*	0.19	0.04
10. Differentiation	0.19	0.29	—0.02	0.17	0.34‡	0.55†	0·07	0.03
11. Integration	0.31‡	0.06	0.09	0.69†	—0.11	0.42*	0.28	0.48
Decision making/Strategy								
12. Analysis	—0.10	—0.28	0.03	0.07	0.20	0.24	0.13	0.04
13. Futurity	0.15	0.18	—0.10	0.33‡	0.10	0.13	—0.06	0.10
14. Explicitness of product market strategy	0.24	0.15	0.22	0.18	0.69†	0.51†	0.54†	0.46*
15. Strategic integration	0.02	—0.03	0.08	—0.02	0.33†	0.10*	0.34‡	0.29
16. Entrepreneurship :								
(a) Innovation	0.74†				0.70†			
(b) Proactiveness	0.74†				0.68†			
(c) Risk taking	0.72†				0.72†			
Leaders locus of control	—0.16	—0.01	—0.29	—0.20	—0.64†	—0.45	—0.70	—0.62
Environment								
1. Dynamism	0.52*	0.48*	0.38‡	0.47*	0.35†	0.36†	0.20‡	0.16
2. Heterogeneity	0.44‡	0.38*	0.60*	0.17	0.41†	0.49†	0.35†	0.15
3. Hostility	0.50*	0.60*	0.29	0.33	0.26*	0.43*	0.02	0.04

(Contd.)

TABLE 5 (*Contd*)

1	2	3	4	5	6	7	8	9
Organisation/Structure								
4. Scanning	−0.01	0.03	0.21	−0.27	0.26*	0.08	0.36†	0.18
5. Controls	−0.11	−0.08	0.06	−0.26	0.11	0.07	0.19	0.05
6. Communication	0.38‡	0 29	0.01	0.65†	0.08	0.01	−0.03	0.39†
7. Resources	−0.18	−0.11	0.01	−0.38‡	−0.07	−0.05	−0.07	−0.01
8. Centralisation	−0.60*	−0.44‡	−0.44‡	0,69†	−0.01	−0.03	−0.16	−0.13
9. Technocratisation	0.53*	0.54*	0.24	0.46‡	0.46†	0.44†	0.34†	0.27*
10. Differentiation	0.10	0.08	0.14	0.03	0.46†	0.48†	0.24*	0.29*
11. Integration	0.00	−0.06	−0.15	0.23	0.10	−0.03	−0.04	0.26
Decision making/Structure								
12. Analysis	0.42‡	0.50*	0.42‡	0.11	0.19‡	0.10	0.20‡	0.18‡
13. Futurity	0.37‡	0.40‡	0.48*	0.06	0.25*	0.21‡	0.15	0.26*
14. Explicitness of product market strategy	0.43‡	0.60*	0.44‡	−0.01	0.39†	0.35†	0.30‡	0 27*
15. Strategic integration	−0.31	−0.14	−0.22	−0.47	−0.90	−0.11	−0.01	−0.10
16. Entrepreneurship :								
(a) Innovation	0.91†				0.82†			
(b) Proactivenss	0.86†				0 76†			
(c) Risk taking	0.79†				0.80†			

The symbols *, † and ‡ indicate that the correlations are significant at the level of 0.05, 0.01 and 0.10 respectively.

variance in entrepreneurship (Table 4). However, locus of control does not correlate with innovation in the medium firms (Table 5). While the leader sets the tone for risk taking and competitive aggressiveness, his personality must be complemented with the skills of others in order to boost innovations.

In big firms, all environmental variables and many structural and decision making variables correlated with entrepreneurship, while locus of control did not. Centralisation, explicitness of strategy and technocratisation jointly explain 82 per cent of the variance in entrepreneurship (Table 4). This was due to the fact that the big firms and many interdependencies among all classes of variables. Given that the goal is, to adapt to the environment, the nature of the environment will influence structure and strategy. Strategy and structure in turn can influence decision making and entrepreneurship.

Conclusions

The following are the conclusions that emerged from the study. They are summarised below :

(1) Entrepreneurship is integrally related to the variables of environment, structure, srtategy and leader personality and these variables differ logically and systematically from one firm type to another.

(2) There exists a strong correlation between locus of control and entrepreneurship in small and medium firms, while structural, decision making and environmental variables correlated with entrepreneurship in big firms.

(3) A strong positive correlation was established between centralisation and entrepreneurship in small firms, while in big firms, a strong negative correlation was observed between the two.

(4) A significant correlation exists between technocratisation and entrepreneurship in all categories of firms. This was traced to the fact that the presence of technocrats boots entrepreneurship. Their scientific pursuits, expertise desire of learning and career development may cause them to perceive and to wish to implement ideas for innovations and organisational renewal. But for this as well as for many of our findings, the reverse casual direction is also plausible, namely, that entrepreneurship generates complex projects that require firms to hire technocrats.

Importance

The theme of the paper as well as its central finding seems to have immense practical importance. Different firms require different kinds of forces to stimulate and foster entrepreneurship. In small firms, the focus is on the leader. If he has the wrong personality or inadequate power, entrepreneurship would be rare. In medium firms, entrepreneurship may best be stimulated by explicit entrepreneurial product-market strategies—strategies which systematise innovation and entrepreneurship. This will ensure that entrepreneurship is focussed upon in addition to the routine operating matters. It will minimise the disruptiveness of entrepreneurship; a trait that is unpalatable to these firms. In big firms, environment and organic structure determine entrepreneurship.

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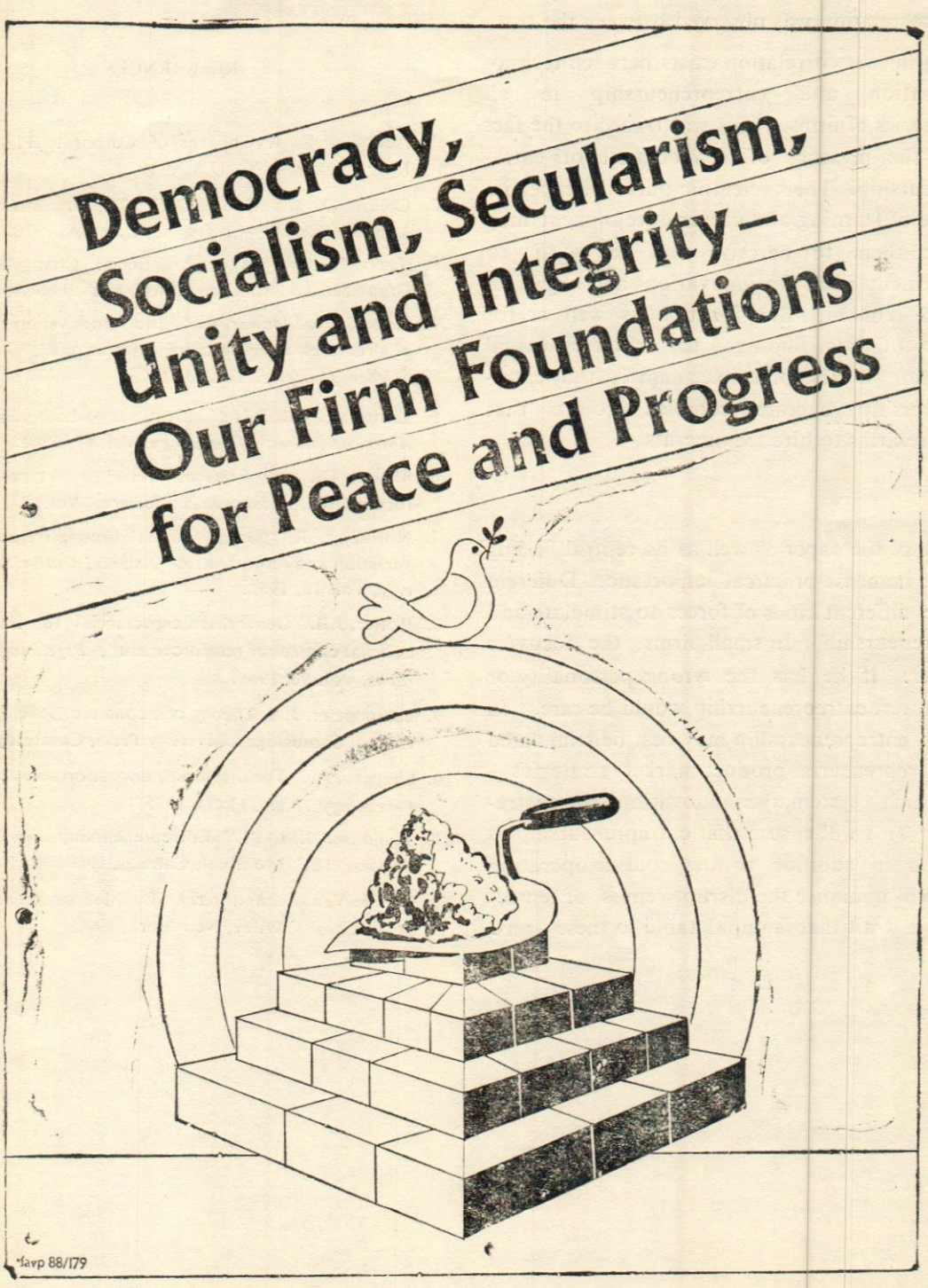
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Navp 88/179

Economic Analysis of Paddy Shelling in Punjab

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This study examines the economics of paddy shelling to the millers. The study also examines the economies-of-scale and works out the break even point for each group of mills.

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Recently the production of rice in Punjab has increased significantly. Apart from being an important foodgrain, it has also turned out to be a prominent cash crop with the Punjab farmers since their staple food is wheat. A large proportion of paddy, the primary product of rice, is surplus with the farmers and only a very small proportion of the total production is retained by them for seed purposes and home consumption. During the year 1986-87, out of an estimated production of 90.33 lakh tonnes of paddy in the State, about 76 lakh tonnes was marketed surplus. Thus, the marketed surplus worked out to be 84.14 per cent of the total production. The produce is generally marketed in the immediate post-harvest period. As such, profitable marketing during the post-harvest period has to play an important role in providing incentives for the increased production of this crop.

Since rice is a secondary product, processing is, therefore, an essential function involved in converting paddy into rice. Efficient processing therefore, has a bearing on its price. There have been various types of rice processing industries viz., hand-pounding, hullers, shellers, hullers-cum-shellers, modern rice mills, etc. But owing to relatively more efficiency of shellers, there has been a mushroom like growth of sheller industry along with increase in rice production in the State.

This study was, undertaken mainly with a view to examine the costs involved in processing of paddy and economics of shelling to the millers. To analyse the economies of scale and to work out the break-even points for each group of mills were the other objectives of the study.

Methodology

With the introduction of high yielding varieties of paddy, Ludhiana district has emerged as one of the important paddy growing districts in the Punjab State. Simultaneously, there has been a considerable growth of sheller industry in the district. Keeping this in view and because of easy access, this district was purposely selected for the study. A list of shellers operating in the district was obtained from the Civil Supplies Department. The shellers were having installed milling capacity varying from 1 to 4 tonnes of paddy intake per hour. These were classified into small (1 tonne), medium (2 tonnes) and large (3 to 4 tonnes). A sample of 3 representing small, 4 medium and 4 large was selected randomly. The information regarding year of start of the mill, type or entrepreneurship. staffing pattern, size and installed capacity of the mills, procurement of paddy and milling pattern, out-turn of rice and other by-products, capital structure of the mill, variable and fixed costs incurred in processing paddy, etc., was collected through specially structured schedules. The data collected referred to the milling season October 1984 to September 1985.

Results and Discussion

Cost Structure: All the rice shellers procured paddy on their own account from local or nearby markets through the commission agents. Besides the price of paddy, the millers had to pay other costs such as market fee, commission, purchase tax, transportation charges, etc. Therefore, the average costs involved on raw material, milling charges, other variable costs and fixed costs were worked out separately. The total costs involved in shelling per quintal of paddy are given in Table 1. To find out the relative economic efficiency of different sized sample mills, the analysis has been made for small, medium and large mills separately.

It may be observed from the Table 1 that the raw material cost alone was Rs. 149.72 per quintal on the basis of average for all the mills. This formed 85.32 per cent of the total costs. The raw material costs in case of small, medium and large mills were worked out to be Rs. 150.66, 150.00 and 148.75 per quintal respectively, which formed 85.29, 85.25 and 85.38 per cent of the total costs. There were only minor variations in the raw material costs amongst different sized mills. This was so because the support prices of different varieties of paddy were fixed by the government and the purchases by the millers were made almost at the same level with minor variations.

For all mills, the average variable costs per quintal, excluding the cost of raw material and the cost of procurement, were Rs 11.65. The samc amounted to Rs 11.94, 11.38 and 11 63 per quintal respectively for small, medium and large mills. The costs decreased as the size of mills increased. The total variable costs per quintal of paddy were found to be Rs. 173.52, 172.40 and 171.49 for small, medium and large mills, respectiveiy, which formed 98.23, 97.98 and 98.43 per cent of the total costs for each group.

The fixed costs accounted for about 1.56 to 2.01 per cent of the total costs for different groups of mills; and the same were Rs 3.11, 3.54 and 2.73 qer quintal respectively for each category. Thus, there was definitely a decline in fixed costs as the size of the mills increased except in case of medium size where there was more investment in buildings. Economies of scale seemed to operate so far as the fixed costs or overhead costs were concerned.

The total variable and fixed costs were worked out to be Rs 176.63, 175.94 and 174.22 per quintal for small, medium and large mills respectively.

Net Shelling Costs

The net costs of shelling of paddy per quintal have been summarized in Table 2. It may be observed from this table that the average net costs of shelling were Rs 14.53 per quintal. The table further brought out that the shelling costs declined from Rs 15.05 per quintal in the case of small mills to Rs 14.36 in case of large mills.

Break Even Analysis

For estimation of the minimum size of the operations required to justify the investment on fixed assets,

TABLE 1 Average Cost Per Quintal from Paddy Processing in Ludhiana District, 1984-85 (Rupees)

Sr. No.	Items of cost	Small	Medium	Large	All mills
1.	Raw material cost	150.66	150.00	148.75	149.72
2.	Procurement cost	10.92	11.02	11.11	11.09
3.	*Milling Charges* :				
	(a) Electricity	0.50	0.50	0.60	0.58
	(b) Repair and maintenance	1.18	0.56	0.46	0.69
	(c) Labour charges	1.39	1.15	1.75	1.43
4.	*Other variable costs*				
	(a) Insurance	0.18	0.11	0.19	0.16
	(b) Losses	6.35	6.73	6.32	6.47
	(c) Miscellaneous charges	0.20	0.20	0.20	0.20
	(d) Interest on variable costs	2.14	2.13	2.11	2.12
5.	Total variable costs	173.52	172.40	171.49	172.46
6.	*Fixed costs*				
	(a) Salaries	0.40	0.42	0.19	0.29
	(b) Depreciation	2.68	2.64	2.16	2.19
	(c) Interest on fixed capital	0.43	0.48	0.38	0.40
7.	Total fixed costs	3.11	3.54	2.73	2.88
8.	Total costs (Variable + fixed)	176.63	175.94	174.22	175.34

TABLE 2 Net Cost of Shelling of Paddy Per Quintal in Ludhiana District, 1984-85 (Rupees)

Sr. No.	Item	Small	Medium	Large	Overall
1.	Total costs (Variable + fixed)	176.63	175.94	174.22	175.34
2.	Cost of procurement and raw material	161.58	161.02	159.86	160.81
3.	Net cost of processing	15.05	14.92	14.36	14.53

the break even point in terms of physical quantity was determined with the help of following formula* :

$$B = \frac{F_c}{P - V_c}$$

Where,

B = Volume of business or break even point in quintals of paddy.

F_c = Total annual fixed cost

P = Selling price per quintal of paddy

V_c = Variable cost per quintal of paddy milled.

The break even point for each group of mills is worked out in the Table 3.

The break even point in terms of physical quantity was 6966.73 quintals for small mills, 15,073.26 quintals for mills of medium size, 16,849 quintals for large mills and 13,036.46 quintals for all mills which formed 23.22, 25.12, 14.04 and 19.12 per cent of the installed capacity and 22.91, 25.38, 16.34 and 19.35 per cent of the actual volume of paddy handled by mills in each group respectively. These are the minimum volumes of paddy to be processed by mills of each group to break even and these should be kept in mind while planning the establishment of paddy processing plants.

Profitability

The net return worked out on the basis of per quintal of paddy processed is presented in Table 4.

Paddy on an average yields 67 per cent of head

TABLE 3 **Break Even Analysis for Sample Mills**

Particulars	Small	Medium	Large	All Mills
1. Value of sale and service rendered per qtl. of paddy (Rs.)	187.13	186.56	188.22	187.31
2. Cost of raw material per qtl. (Rs.)	150.66	150.00	148.75	149.72
3. Other variable costs including cost of procurement (Rs.)	22.86	22.40	22.74	22.66
4. Sub-total (2+3)	175.52	172.40	171.49	172.38
5. Contribution to profits and fixed costs per qtl. (Rs.)	13.61	14.16	16.73	14.85
6. Total fixed cost (Rs.)	94747.64	210272.00	282068.00	194113.00
7. Break even value (qtls)	6966.73	15073.26	16849.00	13036.46
8. Volume of paddy handled (qtls.)	30400	59375	103062	67359
9. Installed capacity (qtls.)	30000	60000	105000	68182
10. % age of break even volume to volume handled	12.91	25.38	16.34	19.35
11. % age of break even volume to installed capacity	23.22	25.12	14.04	19.12

* This formula is based on the simple assumption of linear relationship between cost and output which is likely to be relevant for business decisions in the short-run. It also assumes that the anticipated level of activity or capacity will not be much different from the actual levels. See Savage Christophur, I and John, R. Smell (1967) : Introduction to Managerial Economics, Hutchison & Co., London, pp. 112-118.

TABLE 4 Net Return per quintal of Paddy processed, 1984-85 (Rupees)

Items of cost	Small	Medium	Large	All mills
Average returns/qtl. of paddy milled				
(a) Sale of rice	170.07	170.34	171.85	171.09
(b) Sale of rice bran	3.33	2.75	2.82	2.93
(c) Sale of rice husk	2.33	3.17	2.55	2.71
(d) Sale of total (Broken rice)	10.40	10.30	11.00	10.58
Total Returns	187.13	186.56	188.22	187.31
Total Costs	176.63	175.94	174.22	175.34
Margin to the millers per qtl.	10.50	10.62	14.00	11.97

NB : In one quintal of paddy, there was 67 per cent of the heed rice, 5 per cent rice bran, 20 per cent husk and 8 per cent broken rice.

rice, 5 per cent rice bran, 8 per cent broken rice and about 20 per cent husk. As is evident from Table 1, the average realisation per quintal of paddy for all mills amounted to Rs 187.31 and the same turned out to be Rs 187.13, 186.56 and 188.22 for small, medium and large mills respectively.

Thus the average net margins per quintal of paddy for all mills were found to be Rs 11.97. For small, medium and large groups of mills respectively, the net margins were Rs 10.50, 10.62 and 14.00 per quintal of paddy shelled. The important reason which can be attributed for this behaviour was the economies-of-scale operating with increase in the size of the mill.

Conclusion

The analysis brought out that the average cost of paddy procured was Rs 160.81/quintal and the other variable costs accounted for Rs 11.65 per quintal. On the other hand the fixed costs came out to be Rs 2.88 per quintal. An examination of costs across the size revealed the operation of scale economies mainly in terms of raw material procurement, repair and maintenance, salaries and depreciation, sale of broken rice, etc. Break even point was 19.35% of the actual volume of business handled. The average net margin of profit per quintal of paddy for all the mills was found to be Rs 11.97.

□

PACE—An Effective Productivity Tool for Management

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This paper introduces the technique of Performance and Cost Evaluation (PACE) as a tool of Control, Cost reduction and increased productivity.

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Introduction

Pace is a statistical analytical method based largely upon work sampling[1] and effort rating.[2] PACE (Performance And Cost Evaluation) was originally developed by the Norair Division of North-rop Corporation, USA to control the inputs of human factors to tackle the idle time among the maintenance personnel. It was first installed by West Coast Aircraft Corporation, USA as a means of controlling its maintenance department. Subsequently it is recognised as an efficient tool of cost reduction and improving human productivity. (Smith, 1959; King, 1958 and Loebelson, 1960). In the Indian context, the technique is not in light inspite of its wider applicability and use.

Objectives of PACE Programme

1. To afford management an almost instantaneous view of current performance and its trends.
2. To help management in identifying the factors causing 'out of control' conditions.
3. To measure and control the group effort at the work environment.
4. To estimate the magnitude of idle time.

1. Wok sampling technique is to determine the proportion of time spent in each category with any desired degree of accuracy. The concept of work sampling can be applied by a supervisor to a number of time oriented problems.
2. Effort rating : Effort rating refers to measurement of efforts/contributions made by individuals in respect of assigned work. Effort rating will be based upon the techniques of time and motion studies of a task/operation.

5. To know the factors responsible for excess idle time and for workers presenting themselves out of the work environment.
6. To facilitate the effective control over the inventory management and maintenance of production schedules.

Prerequisites

The installation of PACE programme in an organisation requires the knowledge of work sampling techniques and effort rating, in addition to a team of qualified industrial engineers who have been provided with additional training in PACE observational methods. To operate the PACE programme fully in an organisation it takes Twelve to Fifteen weeks; 5-6 weeks for training the industrial engineers in PACE observational methods and another 5-6 weeks for the installation of the programme.

Components of PACE Programme

PACE programme can, conveniently, be divided into two major components;

I. PACE measurement.

II. PACE programme.

PACE measurement is an index based upon four factors (a) persons assigned to the work/task; (b) persons idle; (c) persons out of work area/task area; and (d) the group effort rating. Once these factors are identified, the PACE measurement index can be calculated in the following manner.

$$\text{PACE INDEX} = \frac{N \pm L - (I + A)}{(N \pm L)} \times E \times 100$$

where,

N = Number of workers assigned to the work/task

L = Number of workers drawn/loaned temporarily from/to other work/task areas.

K = Number of idle workers

A = Number of workers absent from the work/task area

E = Group effort rating.

In the measurement of PACE index three out of four of the values (number idle, number out of work area and group effort rating) are, at least to some degree subjective and hence, might be challenged by those being subjected to measurement. However, the number idle and out of work area can be, fairly, accurately defined.

(i) Idle time Index

In majority of cases, an individual is treated as being idle if he is engaged in some activity not related to the work assigned to him, such as idle conversation, loafing etc. A person out of the work area is not treated as being idle irrespective of his activity. The idleness need not necessarily be caused by a desire on the part of the worker not willing to work, but may be the result of waiting for instructions from his superiors, parts required, and waiting in periods of power failures etc. Thus, persons considered to be idle can be defined and identified by close observation of the different work areas. Idle time index can, thus, be computed as :

$$\text{Idle Time Index} = \frac{\text{Average number idle}}{\text{Number assigned} \pm \text{Loans}} \times 100$$

(ii) Out of area Index

Workers may frequently be out of their assigned work area affecting production for a number of causes. It is generally understood that, except for personal business, many such out of area trips could be the result of poor planning on the part of the work supervisors and other departmental incharges. All absentees from the work area, therefore, should be treated as out of area with the only exception when the worker is officially authorised to perform an assigned work at some other area. The formula for the out of area index is :

$$\text{Out of area index} = 100 - \frac{\text{Number of workers absent}}{\text{Number of workers assigned} \pm \text{Loans}} \times 100$$

(iii) Group effort Rating

Another important variable in measuring PACE index is rating of group effort. Group effort rating involves the rating of individuals' effort/contribution in a work/task with the help of time and motion studies. Based on these individual effort rating the average group effort will be rated in the next stage. The average group effort rating is usually called the average of the tempo of the individual members of the group by industrial engineers. For instance, a 100 per cent effort rating is based upon the commonly accepted norm of an average typist typing a script of 3000 words in an hour, the individual ratings of four-men group are :

Man	*Words Typed*	*Rating (%)*
1	3300	110
2	3000	100
3	2400	80
4	2800	93
		383

The group effort rating computation is :

$$\frac{383}{4} = 96 \text{ per cent}$$

It is desirable to handle the group effort ratings by experienced industrial engineers who have undergone additional training in PACE observational procedures. The success of PACE programme in any organisation to a large extent will be determined by the rating of effort of groups consistently by industrial engineers.

PACE Programme

PACE programme is basically a graphical analysis depicting the PACE measurement index and other related indices. The PACE measurement index and its components, the idle time, out of area and group effort indices can be used in the analysis and control of the human factor in the production function. The value of the PACE index can be improved substantially by combining it with other indices which together constitute the PACE programme. Some of the significant indices to be included as a part of the PACE programme are:

(i) Personnel Index
(ii) Schedule Index
(iii) Shortage Index

(i) Personnel Index

The personnel index is the ratio between the number of workers in the group this week and the similar number for the preceding week expressed as a percentage. Personnel index indicates the utilisation of human factor in the production function. When all the workers in the group performed with a 100 per cent effort rating and were never idle and out of area, the group task would be performed with the minimum personnel requirement. Therefore, as the PACE index moves upward and approaches 100 per cent limit, the number of personnel required should approach the minimum. The personnel index would be computed in the following manner :

$$\text{Personnel Index} = \frac{\text{Group size this week}}{\text{Group size last week}} \times 100$$

The personnel index value over 100 per cent says that the group size has increased and it needs to be investigated to identify the possible cause, unless the assigned task has correspondingly increased. In such circumstances, the components of the PACE index (idle time, out of area and group efforts indices) would be the logical area for the initial investigation.

(ii) Schedule Index

The schedule index is a device to measure the degree to which the production schedule is being maintained. The index is based upon the ratio of items produced per unit of time to items scheduled to be produced during that unit of time. The time unit for the purpose may usually be one week or one

month. The formula for the computation of the index is:

$$\text{Schedule index} = \frac{\text{Actual units produced}}{\text{Units scheduled to be produced}} \times 100$$

An index of 100 per cent indicates that production is being carried right on schedule. When the index is below 100 per cent, the components of PACE as well as the shortage index should be checked. On the other hand, if the index is continuously above 100 per cent, it suggests that the group size should be reduced. When the index is continuously below 100 per cent, the components af PACE index and shortage index should be checked so as to correct the cause if those indices are out of control. If all those indices are within the control range, very likely the group size will have to be increased.

(*iii*) *Shortage Index*

The shortage index is helpful in maintaining a given production schedule. This index indicates the degree or extent of shortage of required parts/components to produce a particular product. Parts/components usually come from two sources; 1) within plant production and (2) outside suppliers. Maintenance of all production schedules at 100 per cent needs the regular flow of the required parts/components from their respective sources. An effective system of inventory control is needed to assure that parts/components procured from outside suppliers are on hand when needed.

The impact of shortage index can be seen in schedule index, idle time index and ultimately in PACE index. A high shortage index can lead to low schedule index, high idle time index and consequently low PACE index. This can be seen in the early weeks of installation of PACE programme (see Table-2).

Shortage index can be defined as the ratio of the number of shortages to the total number of parts in stores. The index will approach zero as the number of shortages decreases. Any decline in the index indicates improvement in the inventory control and efficient stores management. Generally 0 to 5 per cent of shortage index is considered to be control of shortages. Depending upon the criticality of the parts, the control limit of shortage index has to be set. For instance, if the critical ratio of the parts is 0.1 per cent, to bring the ratio upto a 5 per cent control limit of shortage index, the ratio must be multiplied by a factor of 50. Similarly, for 1 per cent critical ratio, the factor will be 5. Thc shortage index can be computed using the following formula.

$$\text{Shortage index} = \frac{\text{No. of shortages}}{\text{No. of parts in Dept.}} \times \text{shortage factor} \times 100$$

As already stated, the shortage index is an important index which has influence on PACE, idle time and out of area indices. High shortage index may result in low effort and PACE indices and high idle time and out of area indices. High shortage index calls for an immediate enquiry so as to identify the reasons. The reasons, usually include :

(i) poor planning of the parts required,

(ii) failure of the inventory control department to requisition the parts,

(iii) delays in supplying the parts by the suppliers etc.

Therefore, high shortage index needs to be investigated and controlled without any delay.

Installation of PACE Programme

The following steps are generally involved in the installation and operation of the programme.

1. Constitution of an observation team.
2. Imparting Training
3. Making the observations
4. Computation, presentation and analysis of of indices
5. Taking corrective actions, if necessary.

For a hypothetical example, PACE observations and computation of various indices are provided in Table 1 and Table 2 respectively. Similarly a chart

TABLE 1 PACE—Observational Chart

Week No.	Units schedul-ed	Units produc-ed	No. assigned	No. Loaned	No. avail-able (4+5)	Number absent	Number absent (6+7)	Average No. Idle	Average group effort	Parts in stores Dept.	No. of parts out of stock	Critical Ratio 1% shortage factor
1	2	3	4	5	6	7	8	9	10	11	12	13
1	250	205	140	2	142	130	12	32	80	4723	302	5
2	250	188	140	0	140	127	13	34	82	4723	359	5
3	250	200	140	6	146	135	11	30	81	4723	368	5
4	235	195	140	10	150	141	9	25	79	4723	312	5
5	260	221	140	8	148	138	10	26	83	4723	283	5
6	265	231	130	7	137	129	8	21	80	4723	217	5
7	265	239	130	5	135	128	7	19	76	4723	321	5
8	260	229	138	9	147	142	5	22	70	4723	179	5
9	250	230	140	11	151	145	6	17	73	4723	227	5
10	260	247	140	6	146	138	8	15	75	4723	170	5
11	270	246	142	5	147	138	9	11	81	4723	151	5
12	280	272	145	—5	140	131	9	9	85	4723	179	5
13	285	291	144	—4	140	135	5	8	83	4723	142	5
14	280	311	143	—8	135	131	4	10	79	4723	132	5
15	290	307	140	—10	130	127	3	7	80	4723	123	5
16	300	324	138	2	140	138	2	5	77	4723	94	5
17	300	309	139	—9	130	127	3	3	79	4723	142	5
18	310	341	140	—11	129	128	1	4	82	4723	113	5
19	290	316	138	—12	126	126	0	3	85	4723	94	5
20	300	336	136	—6	130	130	0	2	86	4723	104	5

showing all the indices computed on a graph is presented in Fig. 1.

Evaluation of the PACE programme

An evaluation of the PACE indices with the help of a PACE measurement chart, week by week, provides a valuable direction in improving the human productivity and cost reduction. Fig.1 shows all the indices so far discussed for a hypothetical example. A comparative analysis of the chart reveals the following:

1. The PACE index is on a rising trend and reached control area in the 20th week. The PACE index was at a low level in the early weeks of the installation of the programme due to high idle time and out of area indices and gradually approached the control area.

2. In the early weeks of the programme, idle time, and out of area indices were high because of high shortage index. But in the later weeks there seems to be some control over the idle time and out of area indices; as a result they are well within the control causing improvement in the PACE index.

3. Schedule index in the beginning shows that

TABLE 2 PACE—Measurement Chart

Week No.	Pace-Index	Idle-Time Index	Out of Area Index	Group Effort Index	Personnel Index	Schedule Index	Shortage Index
1	55	23	8	80	100	82	32
2	54	24	9	82	99	75	38
3	58	21	8	81	104	80	39
4	61	17	6	79	103	83	33
5	63	18	7	83	99	85	30
6	63	15	6	80	93	87	23
7	61	14	5	76	99	90	34
8	57	15	3	70	109	88	19
9	62	11	4	73	103	92	24
10	63	10	5	75	97	95	18
11	70	8	6	81	101	91	16
12	74	6	6	85	95	97	19
13	75	6	4	83	100	102	15
14	71	7	3	79	96	111	14
15	74	5	2	80	96	106	13
16	73	4	1	77	108	108	10
17	75	2	2	79	93	103	15
18	79	3	1	82	99	110	12
19	83	2	0	85	98	109	10
20	85	2	0	86	103	112	11

production is not on schedule. This is due to low PACE, high shortage, idle time and out of area indices. From 13th week onwards the production was ahead of schedule. However, schedule index above 100 per cent is also not advisable because it usually results in the problem of shortage of parts/components.

4. The shortage index has not yet reached control, stage but the optimistic note is that it is on a declining trend. Therefore, efforts are to be intensified further to bring it down into control area.

5. The personnel index has been declining in the later weeks of the programme except in the 16th week. Personnel index in this case is more or less fixed at 95 per cent horizontal trend indicating a 5 per cent reduction in group size every week—a very enviable achievement when PACE is on a rising trend.

6. The group effort index, which after first few weeks, tends to follow closely the PACE index.

From the foregoing analysis it is necessary to identify the areas which need immediate attention. PACE touched the control area in the 20th week. However, still there is scope for improvement. Since, idle time and out of area indices are well under control, little improvement can be thought of; the

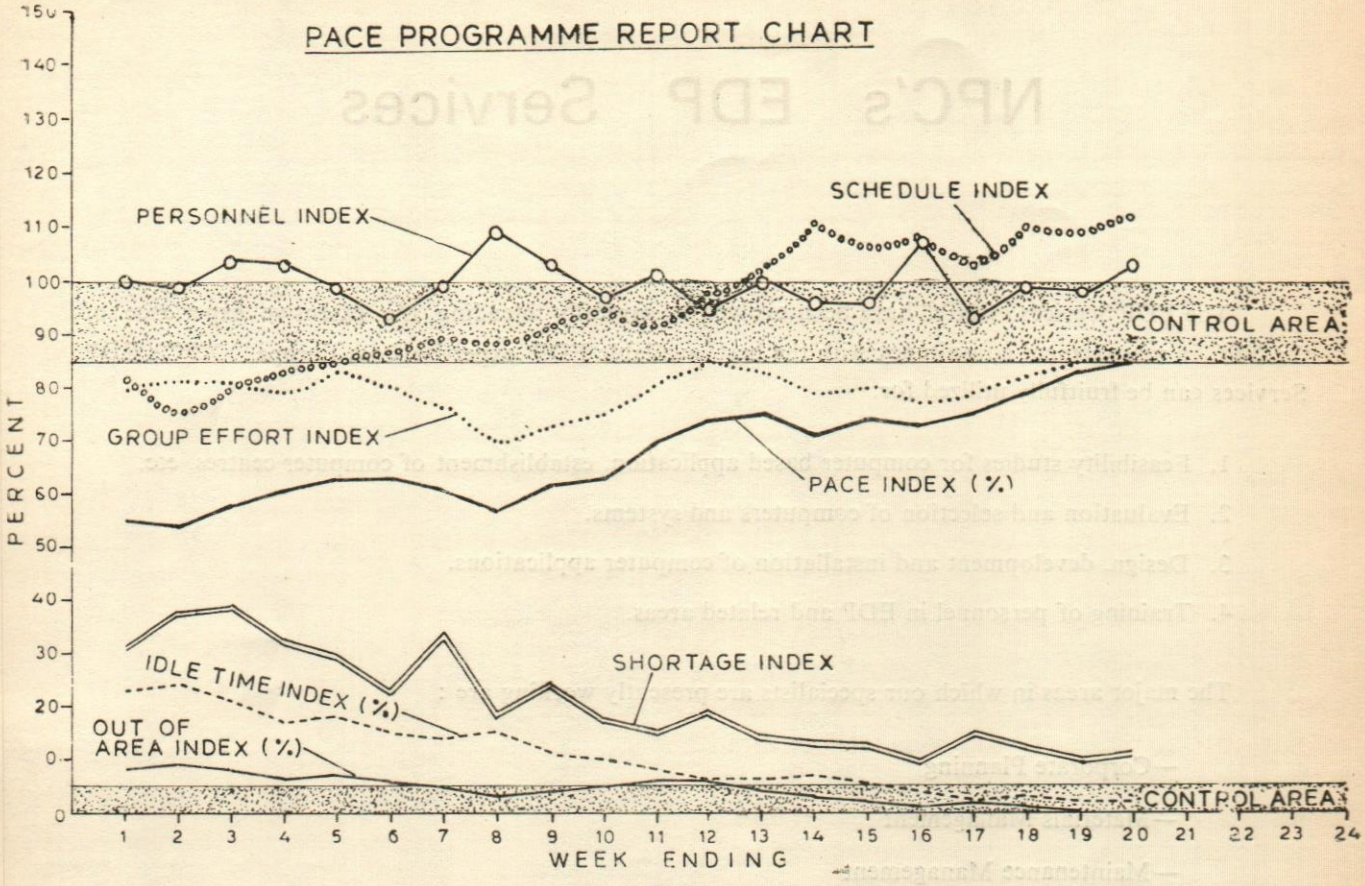

Fig. 1

schedule index which has been moving at around 100 per cent during later weeks resulting in some more shortages. The schedule index can be reduced by reducing the group size, resulting in decreased shortages, improved group effort and finally in increased PACE. Figure.1 suggests that the gradually improved performance can be attributed to operation of PACE programme in the organisation.

Conclusion

PACE programme, if properly implemented, helps in identifying the weak spots that work as constraints on efficient performance of an enterprise. In particular, PACE helps in ascertaining the magnitude of idle time; employees' performance at work place; extent to which production schedules are maintained; magnitude of shortage of parts, components and so on. PACE, therefore, facilitates effective control of various inputs and cost reduction and improved productivity at different stages.

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Milk Producer's Perception of Factors Affecting Productivity of Dairy Animals

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The authors identify separately for the landless, marginal, small and medium-large categories of livestock owners, factors affecting milk productivity of dairy animals as perceived by the livestock owners.

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To enhance the production potential of our milch animals the only way is to develop superior technologies for mass adoption and to create the required infrastructural facilities vital for adoption of those technologies. The problem perceived as well as measures suggested by the livestock owners (milk producers) should be taken into consideration while formulating the communication and developmental strategies for enhancing milk production in the country. Keeping this in mind a study was taken up to identify the landless, marginal, small and medium-large milk producers, perceptions of the factors affecting productivity of dairy animals so that the knowledge could be used in dairy extension programmes in order to enhance the productivity of dairy animals.

Gill and Batra (1967) attributed low productivity to insufficient feeding. Juneja (1967) and Singal (1979) emphasised on the importance of artificial insemination as a method of breeding. Juneja (1967) observed that artificial insemination was still not popular in rural areas. The National Commission on Agriculture (1967) and Sandhu (1978) reported that the breeding coverage under artificial insemination centres was very low in many states. Jain (1969) and Tyagi (1973) reported the shortage of good pedigreed bulls and inadequate number of artificial insemination centres. Tomer (1978) maintained that artificial insemination had still many problems for its successful implementation in rural areas. He concluded that not

more than 30% of cows and 20% of buffaloes were artificially inseminated. The author attributed this problem to the ignorance of people about the role of genetic potential of animal in its productivity. When fed up with natural service only they brought the animals for artificial insemination. Balasubramaniam and Knight (1982) reported that repeater poor conception was the most important reason for partial and non-adoption of artificial insemination by the farmers. Sohal (1973) reported irregular supply or non-availability of ready made balanced feeds besides the problem of its high cost and adulteration. Jackson (1978) observed low intake of nutrients in the face of extremely limited supplies of feeds as the first constraint. Shortage of feeds and fodders has also been reported by Pandey and Ojha (1970), Khurody (1970), Ghosh (1974), Grewal (1977) and Gill (1979).

Methodology

A study was conducted in Bithri Chainpur and Nawabganj blocks of Bareilly district of Uttar Pradesh. There were 12 villages covered under the O.R.P. and Lab to Land programmes of I.V.R.I., Izatnagar. All the 12 villages were selected purposively for the study.

The livestock owners (milk producers) of the 12 villages were stratified into four categories-landless, marginal (below 1 hectare), small (1-2 hectares) and medium-large (more than 2 hectares). A 25 per cent sample was selected randomly from each category of the livestock owners independently. In this way 36 landless out of 146 units, 92 marginal out of 370 units, 63 small out of 255 units and 54 medium-large out of 218 units (total 245 out of 989 livestock owners) were selected which formed the sample of the study.

The data were collected from January to March, 1986.

The milk producers were asked through an open ended question to mention three important items which they perceived as the main factors affecting the productivity of their dairy animals. The factor in its negative aspect was considered as a hinderence and in its positive aspect as a help. They were further asked to rank them according to their perceived degree of importance. The factors ranked 1, 2 and 3 were given weighted scores of 3, 2 and 1, respectively. The total rank score for each factor was obtained by multiplying the frequency of the factor it was ranked first, second and third by the respective weightage and adding them up. The factors were then arranged in descending order of importance on the basis of their total weighted score and finally ranked i.e. higher the numerical rank lower the perception of its importance.

The Data were also analysed statistically using the Friedman Test (Conver, 1980) to see the significance of the difference in the livestock owners' perception of factors affecting productivity of milk of dairy cows and buffaloes.

Findings

The total rank score and order of the factors affecting productivity of dairy animals were computed separately for the landless, marginal, small and medium-large categories of milk producers and are presented in Table 1.

Finance' was ranked as the most important factor by landless and marginal categories of milk producers and as the second important factor by the small and medium-large categories of milk producers. Adopting modern methods of animal husbandry practices for increasing animal productivity requires high initial investments. It was natural for the milk producers who had low economic viability to identify 'finance' as the most important factor for higher productivity of dairy animals. The responses indicate that all categories of milk producers are concerned with credit. There is, therefore, a need to further streamline the accessability and availability of credit facilities from the banks and other financial institutions to the livestock owners and making them aware of such credit facilities.

'Good quality green fodder in lean season' was the next important factor affecting the productivity of dairy animals, which was perceived by the landless. It was ranked second by them (Table 1). Since they do

TABLE 1 : Landless, Marginal, Small and Medium-large Livestock owners' (Milk Producers) Perception of the Factors Affecting Productivity of Dairy Cows and Buffaloes

	Landless [n=36]		Marginal [n=92]		Small [n=63]		Medium large [n=54]	
	Total rank score	Rank order	Total rank score	Rank order	Total rank score	Rank order	Total rank score	Rank order
1. Finance	65	I	206	I	77	II	73	II
2. Good quality green fodder in lean season.	61	II	—	—	—	—	—	—
3. Cost of medicines concentrates, mineral mixtures and other inputs.	34	III	30	IV	26	IV	26	IV
4. Genetic potential of milch animals.	21	IV	72	III	53	III	31	III
5. Care of milch animals	17	V	—	—	—	—	15	VI
6. Efficient A.I. services.	11	VI	15	VI	11	VIII	7	VIII
7. Technical knowledge of animal husbandry practices for rearing the animals.	9	VII	26	V	12	VII	9	VII
8. Irrigation facilities for growing nutritious green fodder crops.	—	—	180	II	93	I	17	V
9. Supply of good quality seed of fodder crops.	—	—	13	VII	20	VI	89	I
10. Feeding of nutritious green fodder, concentrates and mineral mixtures to milch animals.	—	—	9	VIII	24	V	5	IX

not own land they are unable to have home-grown nutritious green fodder crops. Whatever land they are able to lease-in is used for food/cash crop production for meeting their family needs. They, thus, depend upon external source for the good quality green fodder during lean season. Obviously they are aware about the importance of feeding nutritious green fodder for increasing the productivity of their ruled animals but find it difficult to translate this knowledge into action.

'Cost of medicines, concentrates, mineral mixture and other critical inputs' like improved variety seeds of fodder crops, fertilisers, pesticides and irrigation water etc. was ranked as the third important factor affecting productivity of dairy animals by landless and fourth by the marginal, small and medium-large categories of milk producers. It is, therefore, necessary that the development, extension system and service programmes are further and suitably strengthened with regard to ready availability of these essential critical

inputs to the milk producers at reasonable rates throughout the year.

'Genetic potential milch animals', a contributing and important factor for achieving higher productivity of dairy animals, was ranked third by the marginal, small and medium-large and fourth by the landless milk producers. It's perceived importance by all categories of milk producers indicates their awareness about the significance of genetic capability of a milch animal for higher milk production. It is, however, imparatively important that the facilities for providing them milch animals with higher genetic potential for milk production are readily accessible and available to them.

'Care of milch animals' as a factor influencing the productivity of the milch animals was perceived by the landless and medium-large categories of milk producers only and was ranked fifth and sixth respectively, by them. The finding reflects on their awareness about the contribution from the adoption of good animal managemental practices to achieve higher milk production from their dairy animals.

The importance of 'efficient artificial insemination services' as an important factor, was perceived by all categories of milk producers. It was ranked sixth by the landless and marginal and eighth by the small and medium-large categories of milk producers. Efficient and timely artificial insemination service along with other critical inputs need to be provided to the milk producers for increasing the productivity of the milk in the rural sector.

'Technical knowledge of the animal husbandry practices for rearing the animals' was an important factor perceived by all categories of milk producers. It was ranked fifth by the marginal, seventh by the landless, small and medium-large categories of milk producers. It may, therefore, be said that lack of technical knowledge for rearing the animals was one of the important constraints in obtaining higher productivity of dairy animals. In order to fill this gap in knowledge, the extension education and training programmes should be made an integral part of the animal husbandry developmental endeavours, Training courses need to be developed in various aspects of feeding, breeding, health care and management for the livestock owners in order to increase their knowledge and skills in the respective areas, so that higher productivity from dairy animals could be obtained by the livestock owners. Handling of liquid milk, making of milk products and their marketing are other important areas in which training programmes could be arranged consequently.

'Irrigation facilities for growing nutritious green fodder crops' was perceived as another important factor which would help in obtaining higher productivity of fodder, and thus of milk. It was ranked first by small, second by the marginal and fifth by the medium-large categories of milk producers. Assured supply of irrigation for growing nutritious green fodder as well as food crops is very essential especially for the small and marginal farmer for increasing their fodder crop and milk production. Non-availability of this important critical input, in time, holds up their progress in achieving higher productivity.

'Supply of good quality seeds of nutritious fodder crops' was perceived as a factor by the medium-large, small and marginal categories of milk producers which affects productivity of dairy animals. It was ranked first by the medium-large, sixth by the small and seventh by the marginal categories of milk producers. This is an essential inputs for growing nutritious green fodder for feeding the milch animals and its non-availability, in time, acts as a definite constraint.

'Feeding of nutritious green fodder, concentrates and mineral mixutres to milch animals' was perceived as a factor which influences the higher productivity of dairy animals. It was ranked fifth by the small, eighth by the marginal and ninth by the medium-large categories of milk producers. In order to mitigate this constraint livestock owners (milk producers) need to be motivated and educated for feeding of nutritious green fodder, concentrates and mineral mixtures to their milch animals for achieving higher productivity and returns from them.

Significance of Difference in the Livestock Owners' Perception of Factor Affecting Productivity of Milk of Dairy Cows and Buffaloes

The calculated value of F (9,27) using the Friedman Test is 3.35 which is greater than the tabulated value of F (9, 27.; 0.05) = 2.25. Hence the livestock owners' perception of different factors affecting the productivity of milk of dairy cows and buffaloes were significantly (P/0.05) different: The pair-wise comparison of the factors under study is shown in Table 2.

TABLE 2 : **Significance of difference in the Livestock Owners' Perception of Different Factors Affecting Productivity of Dairy Cows and Buffaloes**

Avg. Ranking of the factor over the groups	Factors	1	2	3	4	5	6	7	8	9	10
1.5	1	—	*	—	—	*	*	*	—	*	*
7.75	2		—	*	*	—	—	—	*	—	—
3.75	3			—	—	*	—	—	—	—	*
3.25	4				—	*	*	—	—	—	*
7.50	5					—	—	—	—	—	—
7.00	6						-	—	—	—	—
6.50	7							—	—	—	—
4.25	8								—	—	*
5.75	9									—	—
7.75	10										—

— nonsignificant difference
* significant difference at 5% level

The perception level of factor 1 is significantly higher than that of the factors 2, 5, 6, 7, 9 and 10. The perception level of 2 is significantly higher than that of 3, 4 and 8 but less than 1. Similarly the perception level of 10 is less than 1, 3, 4 and 8. The perceptions of others i.e. 3, 4, 5, 6, 7, 8 and 9 can also be interpreted in the similar manner.

The results indicate that the factors 1, 4, 3 and 8 in order could be taken as the most important factors 2 and 10 as least important perceived factors affecting the productivity of milk of dairy cows and buffaloes.

Conclusion

On the basis of the findings it may be concluded that all the categories of milk producers perceived 'finance', 'cost of medicines, concentrates, mineral mixture ond other inputs', 'genetic potential of milch animals', 'efficient artificial insemination services', 'technical knowledge of animal husbandry practices for rearing the animals' as the most important factors affecting productivity of dairy animals. 'Irrigation facilities for growing nutritious fodder crops', 'supply of good quality seed of fodder crops' and 'feeding of nutritious green fodder, concentrates and mineral mixtures to milch animals' were also perceived important factors affecting productivity by the marginal, small and medium-large categories of milk producers.

Implications

On the basis of above finding the following are obvious :

1. Organisation of educational and training programmes in feeding, breeding, health care and managemental aspects of dairy husbandry are important and should be given more emphasis in dairy extension work. Training programmes would help the livestock owners to get the lastest information on animal husbandry practices and economic and efficient use of costly and scarce critical inputs.
2. Genetic potential of milch animals was an important factor perceived by the milk producers for achieving higher productivity from dairy animals. Rearing milch animals with high genetic potential should, therefore, be encouraged by providing them efficient, convenient and timely artificial insemination services at their doorstep. Facilities for purchasing and ready availablity of animals having higher genetic potential of milk production also need to be looked into.
3. In order to obtain higher productivity of milk on a sustained basis, attention has to be paid on adequate and timely supply of seeds of improved varieties of nutritious fodder crops like berseem, lucerne, oats, cowpea and makchari etc.

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Optimum Utilisation of Resources for a Production Planning Problem

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This paper deals with the problem of determining the optimum use of resources for a production firm subjected to different costs due to inventory, advertising obsolescence and quantity discount for bulk purchase.

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Introduction

A business firm always decides about the amount of inventory that it should keep in order to run its business more smoothly and efficiently. Due to this, it is of considerable importance to determine the optimum order quantity that the firm should keep from time to time. In view of this, certain standard inventory models. like EOQ & ELS model may be considered. The decision variables contain those resources which are to be produced, planned, organised, co-ordinated and hormoniously related and controlled with an objective of achieving desirable results to increase the profitability of the business firm. This in turn requires to fix up the production schedules with an objective of fulfilling business mans' requirements.

Ladaney & Sternlieb (1974) have considered an inventory model using fixed mark-up of prices. Buzacot (1975) has considered such a model which may be affected due to the rising inflation. Some studies are also made by Brahmbhatt, et. al., (1980) Dave & Jani (1984) Budhbhatti & Jani (1980, 1985, 1986) Subramanyam & Kumarswamy (1981) etc. on these (1988) lines.

The purpose of this paper is to formulate a production planning inventory model with an objective of maximising the net returm to the producer and to determine the optimum levels of out put, optimum values of labour employed and capital invested. The costs due to the advertisement expenditure and obsolescence are also to be considered.

The sensitivity analysis is carried out to illustrate the application of this model.

Assumptions

Following are the assumptions for this model :

(1) Lots of size q are for each replenishment.

(2) Demand rate is R units/year which is a function of the unit selling price p (Rs) Here we have the case of a variable demand function.

(3) Shortages are not allowed to occur.

(4) Lead time is zero.

(5) Replenishing size is constant with the lot size of q units per replenishment.

(6) Unit inventory holding cost is C_1 (Rs) /unit/ year)

(7) Advertisement cost is a fraction of the total revenue and is given by α_1 pR (Rs/year) (α_1 is a given constant, $0 < \alpha_1 < 1$)

(8) Cost due to the damaged goods is given by α_2 C (q) R, where α_2 = lot fraction defective and C (q) represents the cost of q units replenished, thus allowing for the quantity discount case.

(9) The net revenue (profit) is a real, continuous function of the lot size q.

(10) The production firm produces only a single commodity, having its output Q by employing the linear production function model which consists of only two variable input factors of production-viz capital investment K & labour employed L.

(11) The unit replenishment cost is C_3 (Rs) per order which is fixed.

Formulation of The Model

A manufacturer is implementing the frequent advertisement efforts to promote the sales of the produced units. The units which are stored in the warehouse can get damaged. The production function of the manufacturing firm is assumed to have linear form which can be written as $Q = \alpha K + \beta L$ where α & β are the marginal physical products of capital and labour respectively

The problem for the manufacturer is to determine the optimum lot size to be replenished under the given market conditions, with a view to maximise his net return. For the selected inventory system, the model is derived under the given situations, a numerical example is given and the model is also tested for its sensitivity.

Derivation of the Model

We use production function in its linear form as given by

$$Q = \alpha K + \beta L \qquad (\alpha>0, \beta>0)$$

Here we take the ratio of the capital K and the labour L as fixed. Suppose that it is given by

$$\frac{K}{L} = m \text{ or } K = Lm$$

This ratio determines the share of input factors of production. Both L and K are in monetary units.

then $Q = \alpha mL + \beta L$
$= (\alpha m + \beta) L$

also let $q = a + bQ$ where $q < Q$
$= a + b(\alpha m + \beta) L$
$= a + AL$

Where $A = b(\alpha m + \beta)$ & $A > 0$

Production cost $= CQ$

Production cost $= C(\alpha m + \beta) L$

$$= \frac{CAL}{b} \qquad \ldots I$$

Advertising cost $= \alpha_1 (pR)$

Let $p = \theta C(q)$ $\qquad (\theta > 1)$

Denote the unit price related with the unit cost function by means of mark-up parameter θ

here $C(q) = g - hq$ $\qquad g>0, h>0, g>h$

Which is the quantity discount cost function.

Hence $p = \theta(g - hq)$

$$R = \frac{sf}{p\eta}$$

we further assume that $\eta = 1$, So that $R = \frac{sf}{P}$

Hence advertising cost $= \alpha_1 sf$ ... 2

Cost of damaged goods $= \alpha_2 C(q) R$

$$= \frac{\alpha_2 sf}{\theta} \quad \text{... 3}$$

Total inventory cost (TIC)

$$= \frac{C_1 q}{2} + \frac{C_3 R}{q}$$

$$= \frac{C_1 (a + AL)}{2} + \frac{C_3 sf}{\theta (g - hq) q} \quad \text{... 4}$$

Hence total cost

TC = Production cost + Advertising cost + Cost of damaged goods + Total inventory cost. ... 5

So that $TC = \frac{CAL}{b} + \alpha_1 sf + \frac{\alpha_2 sf}{\theta}$

$$+ \frac{C_1 (a + AL)}{2} + \frac{C_3 sf}{\theta(g - hq)q} \quad \text{... 6}$$

Total revenue (TR) $= R[P - C(q)]$

$$= \frac{sf}{\theta c(q)} [\theta C(q) - C(q)]$$

$$= \left[\frac{\theta - 1}{\theta}\right] sf \quad \text{... 7}$$

Hence Net Revenue (PROFIT) $P = TR - TC$

$$\Rightarrow P = \left[\frac{\theta - 1}{\theta}\right] sf \left[\frac{CAL}{b} + \alpha_1 sf + \frac{\alpha_2 sf}{\theta}\right.$$

$$+ \frac{C_1 (a + AL)}{2}$$

$$\left. + \frac{C_3 sf}{\theta \{g (a + AL) - h (a + AL)^2\}}\right] \quad \text{... 8}$$

An attempt is made to investigate the optimum value of the input factors L^* & K^*, optimum amount of production Q^* and optimum order quantity q^*, so as to maximize the profit P of the system as a whole.

The necessary condition for maximization of profit is

$$\frac{dP}{dL} = 0 \quad \text{... 9}$$

and sufficient condition is $\frac{dP}{dL} < 0$ ... 10

Now $\frac{dP}{dL} = 0$ gives

$$\left[h^2 L^4 - 2Ah(g - 2ah) L^3 + A^2 (g - 2ah^2) - 2h(ga - ha^2) L^2\right]$$

$$+ \left[\frac{4bhAC_3 sf}{(2C + bC_1)\theta} + 2A(ga - ha^2)(ga - 2ah)\right] L$$

$$+ \left[(ga - ha^2)^2 - \frac{2bC_3 sf (g - 2ah)}{(2C + bC_1)\theta}\right] = 0 \quad \text{... 11}$$

$$\& \quad \frac{d^2P}{dL^2} < 0$$

$$\Rightarrow \left[\frac{g^2 - 3h(a + AL)[g - h(a + AL)]}{(a + AL)^3 [g - h(a + AL^3)]}\right] > 0$$

Solving (11) we get the optimum labour input L^* from which K^* and P^* can be obtained.

Application

To illustrate the above model, we consider here a numerical example as under.

Constants : $g = 50$, $h = 0.1$, $a = 1$, $b = 0.1$, $\alpha = 0.3$, $\alpha_1 = 0.1$, $\alpha_2 = 0.05$, $m = 2$, $\beta = 0.4$, $s = 50$, $f = 40$.

Parameters : $C = 0.5$, $C_3 = 10$, $C_1 = 1$.

Mark-up Parameter : $\theta = 2, 3, 4$.

With the above hypothetical values, the polynomial equation (11) is solved to determine the optimum value of L such that P is maximum. The optimum solution is as given in Table 1.

From Table –1 it may be concluded that with the increase in the mark-up parameters θ, the optimum

profit P* also increases and the optimum value of the lot size q*, Labour L* and Capital K* are decreasing.

TABLE 1 : Optimum Solution

Mark-up Parameter θ	Labour L	Capital K	Out-put Q	Lot size q	Profit P
2	70.26	140.51	70.26	8.026	33.33
3	68.32	136.64	68.32	7.832	70.20
4	67.12	134.24	67.12	7.712	88.77

Sensitivity Analysis

The model can also be tested for its sensitivity by changing the values of all the parameters by 5% and 10% simultaneously or varying only one of the parameters at a time while all other remaining parameters are kept fixed.

In Table 2, the values of the optimum profit are given when the mark-up parameter θ takes some

TABLE 2 : Total Sensitivity

Mark-up Parameter θ	Value of P: All Parameters increasing Simultaneously 5%	All Parameters increasing Simultaneously 10%	All Parameters decreasing Simultaneously 5%	All Parameters decreasing Simultaneously 10%
2	31.14 (—6.57)	29.16 (—12.51)	35.44 (6.33)	37.43 (12.30)
3	68.11 (—2.98)	66 21 (—5.68)	72.18 (3.82)	74.12 (5.88)
4	86.75 (—2.28)	84.89 (—4.37)	90.70 (2.17)	92.59 (4.30)

Note : The figures shown in parenthesis are percentage change in the expected net profit as compared to the corresponding solution given in Table 1.

TABLE 3 : Partial Sensitivity

Changing Parameter	Mark-up Parameter θ	Value of P: Value of one parameter increasing 5%	Value of one parameter increasing 10%	Value of one parameter decreasing 5%	Value of one parameter decreasing 10%
C	2	31.69 (—4.92)	30.07 (—9.90)	34 96 (4.89)	36.60 (9.81)
	3	68.59 (—2.29)	67.00 (—4.59)	71.80 (2.28)	73.41 (4.57)
	4	87.18 (—1.79)	85.61 (—3 56)	90.35 (1.78)	91.72 (3.32)
C_2	2	33.02 (—0.93)	32.82 (—1.53)	33.59 (0.78)	33.79 (1.38)
	3	69.99 (—0.30)	69.80 (—0.57)	70.40 (0 28)	70.61 (0 58)
	4	88.60 (—0.19)	88.43 (—0.38)	88.94 (0.24)	89.11 (0.38)
C_1	2	33.14 (—0.57)	32.95 (—1.14)	33.52 (0.57)	33.70 (1.11)
	3	70.01 (—0.27)	69.82 (—0.54)	70.38 (0.26)	70.57 (0.53)
	4	88.58 (—0.21)	88.40 (—0.42)	88.95 (0.20)	89.13 (0.41)

Note : The figures shown in parenthesis are percentage change in the expected net profit compared to the corresponding solution given in Table 1.

particular values and all the other parameters observe simultaneous increase by 5% and 10% respectively. It is observed that as θ increases, the optimum profit P^* also increases when all the parameters increase their values simultaneously. Similar fact is also observed when for increasing value of θ, all the parameters observe simultaneous reduction by 5% or 10% respectively. Thus general tendency is to find an increase in P^* when all the parameters increase or decrease simultaneously.

Table 3 gives optimum profit when the mark-up parameter θ takes some particular value and only one of the other parameters increases or descreases by 5% or 10% respectively.

It is observed that when particular parameter increases by 5% or 10%, the profit P^* also increases for the changing value of the parameter θ, Similar fact is also observed when that particular parameter alone decreases by 5% or 10% respectively for the increasing value of θ. Such a variation in P^* is found to be more or less similar as compared to the original solution given in Table—1. Thus it may be concluded that with respect to sensitivity, the three parameters C, C_1 & C_3 are almost alike in nature.

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Skills of Human Resources : Need for Periodical Review

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The paper reports on the results of a nation wide survey carried out by the authors about the practices of conducting Human Resource Review in Organisations.

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HR Review

The human resources review focusses on the present whereas the human resources forecasting emphasises the future of organisational human resources and the organisation's adaptation to external pressures and changes. In view of constant technological advances occuring in the area of work and operational activities there is an urgent need to review the approach of the organisations towards skill development.

Human resources development is of little value unless it is closely related to a set of clearly specified organisational objectives. The steps to be be followed in achieving this much needed attention are :

1. A decision on where the company should concentrate its efforts.
2. Introduction of new, modern equipment to meet the company's possible market share on a continuing basis.
3. Collection of data on existing manpower skills.
4. Assessment of continuing development needs and plan of action.

It is difficult to isolate corporate planning from human resources development. There is tendency, however, for companies to carry out training as an independent activity. The corporate plan must be thought of as a major input into a training plan. The training plans must be modified and adapted wherever necessary to account into the changes in demand for services and new developments. The training plans should be reviewed and updated on the basis of five

year corporate plans and more frequently, if necessary, using the results of specific strategies implemented during the previous years. The training, after all, is not some technique to be looked at or used occasionally but is an essential part of organisational development. This provides dynamism for the organisations to adapt to future challenges and necessitates structural changes in response to the shifts in the internal and external environments.

The components of human resources review are examination of quality of workforce, maintenance and analysis of skills, determination of expected losses, internal organisational movements, promotions and transfers. This can be termed an investigative activity, systematically analysing internal human resources situation over periods comparable to a year. The qualiy of the required workforce can be assessed by conducting job analysis and job specifications which provide details of skills, capacities and attributes demanded by various jobs in organisations. The results of job analysis and existing skills inventory can be compared to assess the gap in quality of skills required by the organisation.

One of the major problems encountered in HR review is the prediction of employee turnover. The conditions responsible for turnover are classified as 'Pull Process' (where the employee is attracted away from the organisation due to outside conditions) and 'Push Process' (where the employee is repelled from the organisation due to inside conditions), and the combination of two processes have significant influence on employee turnover. The HR review differentiates between the various processes leading to human resources wastage as well as the demand of certain skilled employees because of shortages in availability.

Any expansion of business activity calls for an additional dose of human resources. The growth of human resources provides an insight into the growth of organisation itself and it can safely be presumed that large scale induction is carried out at periods of growth. Another vital aspect of HR review is the analysis of overall age distribution of human resources in the organisation. Categorywise or skillwise groupings show the future problems of human resources management such as large scale retirements, clustering of younger people at lower levels, restricted growth opportunities, shortage/redundancy of some skills, etc. More information can be obtained if the data generated is with a matrix combination of age-grade, age service and age-skill distributions. The HR review provides among other things, the strengths, weaknesses, and trends in human resources skills and their availability. The HR review can be conducted as and when changes occur or periodically, to review the situation.

Results of Survey*

A nationwide survey has been carried out about the parctices of conducting Human Resources Review in organisations. A specially designed questionnaire was distributed to 200 companies representing major industrial sectors. The details sought through the questionnaire include the following :

(i) Periodical review of human resources
(ii) Participation of management
(iii) Employee turnover
(iv) Training of employees
(v) Job data, and
(vi) Retraining programmes.

Only 45 organisations' replies were suitable for analysis. Personnel discussions were also held in 23 organisations. Their distribution among various industrial categories is shown in Table 1 and Table 2.

Out of 45 firms, only 10 organisations carry out periodical review studies and only 18 maintain systematic human resources inventories. About 30 per cent of larger companies having more than 2000 employees carry out periodical reviews and get information regarding absenteeism and turnover in broad categories like managers, supervisors, skilled workers, unskilled workers and clerks. Only three out of the ten carrying out periodical review compute categorywise figures. Vital information regarding age distribution and trends in the human resources in each category is generated by

* Extracted from the unpublished thesis on "Manpower Planning in Manufacturing Organisations" by K.N. Krishnaswamy to Indian Institute of Science, Bangalore.

TABLE 1 : Sector-wise Distribution of Number of Manufacturing Organisations

Industrial Sector	Public Sector	Private Sector	Total
1. Electrical Sector	3	4	7
2. Electronics & Communications	2	2	4
3. Textiles	—	3	3
4. Chemicals, Drugs & Dyes	2	3	5
5. Metals	1	6	7
6. Automobiles & Accessories	1	2	3
7. Agro-based	—	2	2
8. Machine tool, General Engineering & Defence	1	6	7
9. Heavy Engineering	2	1	3
10. Miscellaneous	1	3	4
	13	32	45

TABLE 2 : Distribution of Organisations having Human Resources Planning Group

Size (No. of Employees)	Above 10,000	4,000 to 9,999	2,000 to 3,999	1,000 to 1,999	Below 1,000	Total
Number of Organisations	8	9	12	14	2	45
Organisations having HR Planning Group	7	6	6	7	1	27

only five firms. Table 3 gives the details of organisations carrying out the systematic periodical review.

HR Review Periodicity

Whenever there is a change in the level of organisation activity, either expansion of existing product range or addition of new products or services, the impact is felt on manpower allocation and requirements. The degree of impact depends upon the intensity of change in the activity levels. If periodical HR reviews are undertaken, the process of change and adjustments with regard to human resources deployment and utilisation is greatly facilitated. Alternatively, the review can be taken whenever the changes take place. In such instances, the reviews will be quick and limited in objective to assess the overall impact on the manpower allocation and requirements.

TABLE 3 : Distribution of Organisations Carrying out Systematic HR Review

Size of the Organisation (No. of employees)	Total No.	No. of organisations maintaining systematic HR Inventory	No. of organisations reviewing HR inventories Systematically
10,000 & above	8	2	2
4,000 to 10,000	9	5	4
2,000 to 4,000	12	5	3
1,000 to 2,000	14	5	1
Below 1,000	2	1	—
	45	18	10

Larger organisations having more than 2000 employees reviewed human resources periodically irrespective of the degree of changes whereas smaller companies mostly reviewed this when there was a substantial change in level of activity such as increase in production target, extended product/service range and changes in product-mix. The details of distribution of organisations conducting HR reviews are given in Table 4.

Participation of Management

Another important factor in HR review is the parti-

TABLE 4 : Distribution of Organisations Making HR Reviews only when Change Occurs (Nos)

Size of Organisation (Total No. of Employees)	10,000 & Above	4,000 to 10,000	2,000 to 4,000	1,000 to 2,000	Below 1,000	Total
Type of Change						
1. Change of level of company activity	6	4	8	13	2	33
2. Change of nature of activity	6	4	7	6	—	23
3. Change of organisation	5	3	8	5	—	21
	6	5	9	13	2	35

cipation of various levels of management. HR review, ideally speaking, is an organisation-wide activity since it requires inputs from various functions and departments. While the entire responsibility is not with the personnel department, it has to do the bulk of coordination and consolidation work. Table 5 gives the details of participation in HR review. The operating departments provided data in 90 per cent of the organisations and the personnel department took up the responsibility of coordination work and presentation of consolidated report to top management irrespective of the size of organisation and the mode of conducting HR reviews. The review reports are studied by top management and decisions were communicated to the personnel department and to other departments/ functions for implementation.

TABLE 5 : Participation of Management in HR Review
(No. of Organisations in which Participation Exists)

Size of Organisation (No. of Employees)	10,000 & Above	4,000 to 10,000	2,000 to 4,000	1,000 to 2,000	Below 1,000	Total
Participation in HR Review						
Top Management	2	1	5	3	—	11
Personnel Department	8	8	12	12	1	41
Industrial Engineer	2	—	2	—	—	4
Departmental/Divisional Managers	1	5	9	4	1	20
Computer Division	2	1	—	—	—	5
1, 2 & 4 above together	3	3	2	1	—	9
	8	9	12	14	2	45

Employee Turnover

Employee turnover is a very common occurence in all organisations. Since turnover is driving force for HR planning in any organisation, it has to be measured. Table 6 provides the details of organisations maintaining turnover rates and other details. Out of 43 organisations, only 35 maintain employee turnover information, 21 of them conduct exit interviews and 17 of them determine age profiles of employees.

Job Data

One of the important prerequisites of good HR review system is having a comprehenisve file of job tasks, job description and specifications. In the absence of job data, the organisation will be unable to recruit the 'right man for the right job'. Selection procedures and techniques become of no avail. Transfers, prmotions, and reallocation of employees in dynamic environment become very cumbersome and ineffective. Development of employees for higher positions becomes a difficult task.

TABLE 6 : **Distribution of Organisations Carrying out some Manpower Planning Functions (Nos)**

Size of organisation (No. of Employees)	10,000 to Above	4,000 to 10,000	2,000 to 4,000	1,000 to 2,000	Below 1,000	Total
Manpower Planning Functions						
Maintaining employee labour turnover information	8	6	8	12	1	35
Exit interviews	5	4	6	5	1	21
Determination of age profiles of employees	4	5	4	4	—	17
Total	9	8	11	13	2	43

Training of Employees

All the organisations used some form of training or the other for their employees. Where a formal training programme was not used at induction level, the employees were kept on probation for a period of one or two years and were provided on-the-job training. The details of the survey pertaining to employees' training are given in Table 7. Managers and technical staff received special training in and outside the organisation in about 65 per cent of the organisations whereas for clerical employees and workers there was hardly any special training. Workers for skilled categories were trained in 30 per cent of the organisations. Many of the technical executives and managers were trained in the foreign collaborators' plants in the initial stages to facilitate the transfer of technology from the parent organisation.

TABLE 7 : **Distribution of Organisations Using Different Training Methods for Various Categories of Employees (Nos)**

Type of Training	Special Training Programmes	Outside Institutions	On-the-job training
Category of Employees			
Managerial	32	32	27
Technical	30	27	38
Clerical	2	1	38
Workers	10	6	41

Table 8 depicts how the organisations maintained their job data. While for workers job data was

TABLE 8 : **Distribution of Organisations Maintaining Job Data for Various Categories of Employees (Nos)**

Size (No. of Employees)	10,000 & Above	4,000 to 10,000	2,000 to 4,000	1,000 to 2,000	Below 1,000	Total
Job Data maintained for						
Management Positions	4	4	1	5	1	15
Technical Positions	8	5	8	11	1	33
Clerical Job	7	4	3	3	1	18
Workers	8	7	10	13	2	40
Total	8	9	12	14	2	45

maintained in almost all organisations the managers and clerical positions were not covered in 80 per cent of the cases. Discussions show that the managers' job data were kept flexible in many organisations to allow for changing demand of educational skills and personality characteristic. Though clerical jobs were as routine as many production/technical jobs of workers, it might have been neglected because of weak unionisation (which is generally very strong among workers). None of the 23 organisations in which personal discussions were held with officers, used the approaches of functional job analysis.

Retraining Programmes

Managerial knowledge and engineering techniques are very rapidly changing and accumulating. Therefore, every organisation must feel the need for continuing development of their managers and technical personnel through short term courses and programmes. Table 9 shows the distribution of companies arranging retraining progammes for their employees. Larger companies do this more systematically than the smaller ones. The frequency (Table 10) is once in four to five years. The most usual period of retraining through refresher programmes or deputations was that of 2-4 weeks duration. In a small percentage of cases, 8-12 weeks programmes were also used.

Some more interesting observations were collected from organisations where retraining programmes are conducted regularly. They are : In a large proportion of organisations, these retraining programmes were not viewed favourably by the top management; participants considered that these programmes served more as an escape from routine jobs than as means of developing the capabilities and skills. On the other hand the training managers are in search of methods for evaluating the impact of these programmes on the participants.

Conclusion

The review of human resources skills is so important that their can be no organisation which is not in some way, performing it. The degree to which this is practised varies from unit to unit depending upon a variety of factors. The survey shows that all organisations either in a fragmented way or in totality, either sporadically or continuously carried out elemental functions which are associated with HR review. Human Resources Review was systematic only in one fifth of the organisations studied. This was contributed by mostly larger organisations for changes in production level or products. Small organisations reviewed when their was a change in the activity level. Participation in reviews and also in exit interviews was mostly limited to personnel department as well as submission of consolidated report to top management, and that too in larger organisations only.

Individual job descriptions were maintained for workers in all organisations but not for secretarial and

TABLE 9 : **Distribution of Organisations having Retraining Programme for Employees (Nos)**

Size (No. of Employees)	10,000 & Above	4,000 to 10,000	2,000 to 4,000	1,000 to 2,000	Below 1,000	Total
Type of Retraining Programmes						
Systematic specialised programmes	5	5	2	4	—	16
Sporadic and special programmes	3	2	6	7	1	19
Total in sample	8	9	12	14	2	45

TABLE 10 : **Sizewise Distribution of Organisations vs Retraining Frequency (Nos)**

Size (No. of Employees)	10,000 & Above	4,000 to 10,000	2,000 to 4,000	1,000 to 2,000	Below 1,000
Frequency of Retraining					
Every Year	—	1	—	—	—
Every 2 to 3 years	2	2	—	1	—
Every 4 to 5 years	3	3	2	3	—
Total	5	6	2	4	—

clerical positions. Employee turnover seems to be the problem faced mostly in the case of highly skilled and qualified human resources. It is better for the organisations to adequately plan the career of personnel and keep a watch specifically on the peer group relationships of their key personnel in particular. This will help in retraining and developing their special categories of employees.

It is amply evident that training and retraining programmes for skill development are being conducted in organisaitons in one form or the other, irrespective of their difference. The regular retraining programmes ranged form 2 to 4 weeks on special areas of skills and repeated in a frequency of 4-5 years. Organisations may consider (inspite of the differences between organisations) :

1. Carrying out inventory of skills, job analysis periodically to assess the gaps in skill requirements.
2. Integrating the skill development activities with the future/corporate plans of the organisations.
3. Designing rigorous skill development programmes during growth/preparation stage of employees (4 to 9 years of service) in the organisation rather than in the initial or productive or decline stages of their careers.
4. Conducting HR reviews to avoid any crisis in mid-stream or drifting.

These are the sequential decisions available to us to overcome any deficit in availability of requisite skills for the organisation. What we need at this stage is the required will and decision-making.

□

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Energy Consumption Trends in Indian Pulp & Paper Industry

V. Raghuraman
K.C. Mahajan
P.K. Srivastava

The Inter Ministerial Working Group (1983) identified energy conservation measures in various industries. To study the response of the industry to these measures, a follow-up survey was conducted by the National Productivity Council. Some of the salient features of the Survey and the major findings are discussed in this paper.

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Introduction

Pulp and Paper constitute a major industrial sector in India and is one of the energy intensive activities. In 1981-82, this sector consumed 2.4 million tonnes of coal, 0.5 lakh tonnes of fuel oil and 1350 million units of electricity. The monetary value of the energy consumed was estimated at Rs. 200 crores comprising Rs. 135 crores thermal energy and Rs. 65 crores electricity. The sector is characterised by higher levels of specific energy consumption due to following reasons:

(i) Obselete technology.

(ii) Lower economies of scale when compared to that prevailing in developed countries. Typical size ranges from 10 TPD to 300 TPD in India; whereas the integrated mills are of 300 TPD and above in scandinavian countries. In fact, the plants installed before the seventies have expanded their capacities in stages and there is no optimisation of the plant and machinery including utilities. In a way, these plants are basically a cluster of small scale units.

(iii) Variations in cellulosic raw materials lead to non-optimisation of plant and machinery and also the operating parameters vis-a-vis raw materials.

(iv) Fluctuating market demand for various types of paper and paperboards leads to sub-optimal use of plant and machinery.

A comparison of energy utilisation in a typical Indian and Swedish integrated bleached kraft paper mills is given in Table 1.

TABLE 1 **Break-up of Energy Utilisation in a Typical Indian & Swedish Integrated Bleached Kraft Paper Mill**

Description	Indian Mill (1980-81)	Swedish Mill (1979)
I. Purchased Energy (M. Kcal)		
(i) Fuel	9.37	3.53
(ii) Power	0.79	0.76
Total	10.16	4.29
II. Fuel Sources (M. Kcal)		
(i) Purchased fuel	9.37	3.53
(ii) Internal fuel (B.L., Bark, etc.)	4.58	4.65
Total	13.95	8.18
III. Fuel Utilisation (M. Kcal)		
(i) Steam cycle & process	11.47	7.38
(ii) Back pressure power	2.48	0.80
Total	13.95	8.18
IV. Electricity (KWH)		
(i) Purchased power	918	884
(ii) Back pressure power	658	711
Total	1576	1675
V. Power Generation Efficiency, %	22.8	85

Source : Report of the Inter Ministerial Working Group (1983) (Mimeographed).

IMWG Study Report

Keeping in view the higher specific energy consumption in Indian mill, the Inter-ministerial Working Group on Utilisation and Conservation of Energy constituted in 1981 (IMWG) under the chairmanship of Shri D.V. Kapur, the then Secretary, Heavy Industry, selected the Paper and Pulp Sector, as one of the twelve sectors for energy audit studies. The study revealed energy conservation potential of 10-30% of the prevailing energy consumption levels. The energy conservation measures identified by the IMWG were as given in Appendix 1.

Follow Up Energy Audit Study

To study the response of the industry to energy conservation activities, a follow up questionnaire Survey was conducted by the National Productivity Council as a part of the study sponsored by the Department of Power in 1986-87. Some of the salient features of the Survey and the major findings are discussed in the present paper.

Twenty two units from the industry responded to the questionnaire Survey on rational use of energy. The distribution of thermal and electrical energy consumption in the sector during the year 1985-86 revealed that thermal energy accounted for 85%, the rest being electrical energy. The thermal energy cost accounted for about 48% of the total energy bill during the year.

Year-wise variations in the energy consumption pattern, energy prices and energy bill cummulatively for the units covered during the study are given in Table 2.

The recorded variations in the energy bill can be attributed to increassed prices for various forms of energy and transportation cost. These might also be due to increase in the share of captive power generation for meeting electrical energy demand. The prices of various of energy is given in Table 3.

Specific Energy Consumption

Energy accounted for approximately 15-25% of the cost of paper manufacture. For analysing the specific energy consumption trends the sector has been broadly divided into three groups, i.e., large mills, and newsprint mills so that similar units could be treated toge-

TABLE 2 **Energy Consumption Figures of 22 Paper Mills**

Energy Source	Unit	1983-84 Qty.	1983-84 Cost. (Rs. Lakhs)	1984-85 Qty.	1984-85 Cost. (Rs. Lakhs)	1985-86 Qty,	1985-86 Cost. (Rs. Lakhs)
(A) Thermal							
Coal	1000 Million Kcal	5097	4594	5928	6181	6020	6991
Fuel Oil	,,	248	733	310	929	394	1304
Others	,,	16	12	31	25	52	57
Total Thermal	,,	5361	5338	6270	7135	6466	8352
(B) Electricity							
Purchased	Miliion Kwh	625	3479	822	5455	806	5869
Generated	,,	407	2030	480	2505	654	3306
Total Electri-city	,,	1032	5509	1302	7960	1370	9175
Total	1000 Million Kcal	6248	10847	7389	15095	7644	17527

TABLE 3 **Prices of Various Energy Forms (in Rs.)**

Energy Source	Uuit	1983-84 Max.	1983-84 Min.	1983-84 Avg.	1984-85 Max.	1984-85 Min.	1984-85 Avg.	1985-86 Max.	1985-86 Min.	1985-86 Avg.
1. Coal	Tonne	619	234	378	709	267	439	716	277	479
2. Coke	Tonne	1831	1100	1779	2138	1010	1832	2270	743	747
3. Diesel	KL	3336	3315	3327	3778	2895	3383	3865	2862	3430
4. LSHS	Tonne	2865	2865	2865	2924	2890	2898	3272	3146	3251
5. Fuel Oil	KL	3150	2669	2917	3383	2524	3052	3922	2867	3242
6. Lignite/Leco	Tonne	—	—	—	525	525	525	814	522	811
7. Rice Husk	Tonne	203	170	180	210	104	200	350	107	302
8. Bagasse	Tonne	451	199	237	645	197	479	727	697	698
9. Purchased Power	Kwhr	0.79	0.44	0.56	0.94	0.58	0.66	1.07	0.55	0.73
10. Self Gen. Power	Kwhr	0.69	0.15	0.50	1.70	0.15	0.52	1.84	0.21	0.59

ther for inter unit comparison purposes. Comparative performance of the units is too complex an exercise due to wide variations in the manufacturing process, unit size, differences in raw materials, product and byproducts, and other considerations such as age and process, capacity utilisation and productivity levels which strongly depend on operational and maintenance skills and attitude of the work-force, management style and related factors. Average specific energy consumption figures are given in Table 4.

TABLE 4 Specific Energy Consumption in Paper Mills

	1983-84	1984-85	1985-86
Large Mills			
SP. Thermal*	9.01 (22-4)	8.42 (23-3)	8.37 (16-3.3)
SP. Electrical‡	1638 (2388-1232)	1678 (2147-1286)	1642 (2177-1310)
SP. Energy* (Total)	10.42 (24-6)	9.86 (25-4)	9.78 (17-5)
SP. Cost † (Thermal)	11.33 (23-5)	10.57 (29-4)	10.91 (23-4)
SP. Cost † (Electrical)	10.56 (18-6)	10.83 (15-7)	11.00 (15-8)
SP. Cost † (Total)	21.89 (34-12)	21.39 (41-12)	21.91 (36-12)
Small Mills			
SP. Thermal*	5.99 (11-3)	5.79 (8-3)	5.13 (9-3)
SP. Electrical ‡	1170 (1749-424)	1110 (1559-375)	1003 (1864-385)
SP. Energy (Total)	7.00 (13-3)	6.75 (9-3.1)	6.00 11-3.3)
SP. Cost † (Thermal)	7.79 (13-2)	6.93 (13-3)	6.95 (13-2)
SP. Cost † (Electrical)	9.46 (18-1.5)	8.09 (17-1.2)	8.27 (24-1.5)
SP. Cost † (Total)	17.25 (29.4)	15.02 (24-4)	15.22 (28.-4)
Newsprint			
SP. Thermal*	6.36	6.62 (7.3-6.4)	5.43 (6-5.1)
SP. Electrical ‡	1995	1978 (1982-1977)	1825 (1973-1658)
SP. Energy * (Total)	8.08	8.32 (9-8)	7.00 (7.3-6.5)
SP. Cost † (Thermal)	8.67	10.28 (10-6.6)	9.32 (9.5-9.1)
SP. Cost † (Electrical)	20.75	21.74 (22-2.15)	16.05 (23-10.0)
SP. Cost † (Total)	29.42	32.02 (32-31)	25.37 (33-19.1)

Legend : * Figures in Million Kcal/tonne.

‡ Figures in Kwh/tonne.

† Percentage of energy cost to sales turnover.

Figures in Parenthesis are maximum and minimum for the respective items.

A close analysis reveals that due to power shortages almost throughout the country, pulp and Paper units were increasingly relying on captive power generation; its share in the power demand being estimated to be about 40% for the units responding to the follow up energy audit. Cogeneration accounted for about 97% of the captive power generation in the sector; average cost of self generation being Rs. 0.59/kwh as agninst Rs. 0.73/kwh for grid power.

Intra-Unit Variations in Energy Productivity

Variations in specific energy consumption/cost for the year 1984-85 and 1985-86 over 1983-84 was worked out. The computation of specific energy consumption of the plants manufacturing more than one product has been done on the basis of turnover with a correction factor (—ratio of price of the products during the concerned year, i.e., 1984-85 or 1985-86, and the price in 1983.84) to account for the variations in the prices

of the manufactured goods. There were wide variations in the performance of some units. Table 5 gives the breakup of units' performance (categorised into eight groups) based on reduction in specific energy consumption levels in the year 1985-86 (or 1984-85 if 1985-86 data are not available compared to 1983-84 for 1984-85 if 1983-84 data are not available).

TABLE 5 Intra-Unit Energy Productivity Performance

Item	Number of Units in Category*							
	A	B	C	D	E	F	G	H
Thermal Energy	10	1	1	2	—	5	2	1
Electrical Energy	4	3	4	2	4	3	—	2

* Categories :

A : Reduction more than 10%
B : Reduction between 5 and 10%
C : Reduction between 1 and 5%
D : Reduction or increase of the order 1%
E : Increase between 1 and 5%
F : Increase between 5 and 10%
G : Increase more than 10%
H : Quantification not feasible due to lack of information.

Thus the above analysis has brought out the need for lowering down energy cost in the industry by more intensive application of energy conservation measures as recommended by the IMWG.

Energy Conservation Measures

Energy conservation has emerged as an important tool for cost reduction in the manufacturing process. On the basis of feedback received from the units, the measures found to have been considered by them are given in Appendix II.

However, only a few of the units have reported cost-benefit analysis for the measures already implemented. Energy savings to the tune of Rs. 124.54 lakhs in 1984, Rs. 10.9 lakhs in 1985 and Rs. 1.49 lahks in 1986 are reported to have been achieved in the sample cross-section of the units responding the Survey. The cost benefit analysis of the specific measures implemented successfully in this sector is given in Table 6.

TABLE 6 Cost Benefit Analysis of Energy Conservation Measures

Measures Code*	Year of Implement-ation	Investment ('000 Rs)	Energy Savings ('000 Rs)
1	1986	10	9
2	1985	0	130
3	1984	24	3094
3	1985	0	160
3	1986	4	9
4	1984	0	1974
5	1984	42	3060
5	1985	23	102
10	1986	24	38
12	1983	2075	1546
14	1984	750	654
17	1986	3	45
20	1982	100	1620
23	1984	15	64
24	1985	548	797
25	1984	550	517
26	1986	9	3
28	1970	18000	15500

* See Appendix II.

Though a number of relevant energy savings measures have emerged, degree of success was found to be varying. The status of implementation has been categorised into the following five groups.

Status I Measures successful and substantial savings achieved

Status II Marginal or meagre savings achieved.

Status III Savings not quantified

Status IV Measures under consideration.

Status V Measures under implementation.

The status of energy saving measures widely popular in the sector in the sample units covered during the Survey is given in Table 7.

TABLE 7 Number of Units According to Status of Implementation

Measure Code*	I	II	III	IV	V
1	1	3	—	—	—
2	1	4	—	2	1
3	3	4	1	—	1
4	1	5	—	1	—
5	1	5	1	2	2
6	—	—	—	1	—
7	—	—	—	1	7
8	—	1	—	—	—
9	—	2	—	—	—
10	1	4	1	—	2
11	—	—	—	2	1
12	1	—	—	—	—
13	—	3	—	1	1
14	1	—	—	—	—
15	—	—	—	—	4
16	—	—	1	—	—
17	1	—	—	—	—
18	—	1	—	—	—
19	—	—	—	2	1
20	1	8	—	—	1
21	—	—	—	1	—
22	—	1	—	—	—
24	2	7	—	1	—
25	1	6	1	—	1
26	—	—	—	2	—
27	—	1	—	—	—
28	1	3	—	1	2

* See Appendix II.

The above results highlighted that a wide range of of energy conservation measures have been explored; in the future years, more such measures would be implemented by the units and energy conservation would be of much wider acceptance.

Energy Management Function

Only a small fraction of the energy savings potential has been realised by the Indian pulp and paper industry. Energy savings have, by and large, been confined to the units that have religiously adopted energy conservation measures. The study has indicated that a number of units have failed to initiate any action to conserve energy. with the awareness on energy conservation, a few units have established independent cells or exclusive departments for energy conservation activities, while others follow one of the following approaches :

(a) A committee consisting of representatives from different departments.

(b) One coordinator looking after energy conservation in addition to his normal functions.

(c) One coordinator exclusively incharge of energy conservation programmes.

The study shows that out of the twenty two units responding to the Survey, four established independent cells, thirteen constituted committees from various departments, four have co-ordinators exclusively incharge of energy conservation and twelve have co-ordinators not exclusively incharge of energy conservation activities. In six units, there were none responsible for energy management function.

Energy Reporting System

Of the twenty two units covered during the Survey, ten units reported energy consumption figures in the annual reports. Further, while four units reported these figures shiftwise, six units analysed daily, sixteen units weekly, fourteen units monthly and eleven on yearly basis.

Energy Audit Function

Energy audit is an organised approach for indentifying energy waste in a facility and determining how this waste can be eliminated at a reasonable cost and within a reasonable time frame. It is analogous to the conventional audit but goes one step ahead, in as much as it not only provides information on energy

balance but also helps in formulating appropriate plan of action to run the units with minimum sepcific energy consumption/costs. The energy audit is emerging as an effective tool to identify, implement and sustain energy conservation programmes in Indian paper industry. Analysis of data collected during the Survey revealed that of the twenty two units covered, eleven conducted some type of energy audit. Table 8 shows the energy management setup alongwith the type, frequency and mechanism of energy audit function. While 50% of units have yet to gear up for energy audit function, nine were already practising simple energy audit on a monthly basis, while eleven have a system of yearly energy audit. Whereas eight units organised this function internally, five of them organised both internal and external audits; one plant was dependent on external agency alone.

TABLE 8 Energy Management Set up Vis-A-Vis Energy Audit

Energy Management set up	No. of Units	Type Energy Audit* T1	T2	T3
1. Independent cell	4	3	3	4
2. Committee consisting of representative from different departments	13	8	5	6
3 Exclusive incharge coordinator	4	3	3	4
4. Co-ordinator not exclusively incharge of energy conservation	12	7	4	4
5. None responsible for energy conservation	6	0	0	0

* T1 — Energy Andit : Plant as a whole
T2 — Energy Audit : Equipmentwise
T3 — Energy Audit : Productwise

Energy Norms

It is useful to fix targets for specific energy consumption for purposes of monitoring the efficiency of energy use. Energy norms have been developed for plant as a whole in twelve units, for various departments in eleven, for individual equipment in five and for various products in nine units. Of the ten units which have instituted energy audits for plant as a whole, six units have established norms for the entire plant and for various departments, four have established norms for vrious equipments and six units for various products.

Energy Culture

The success of the energy conservation programme depends on the motivation of operating and maintenance personnel. The study has revealed that ten out of twenty two units responded to the Survey has taken seriously the task of training the personnel for imporving their skills and achieving optimum energy efficiency at shop floor level. In addition, involement of the management, finance and purchase departments, trade unions and other interests is very crucial for achieving quick results. Only six units have introduced award/incentive schemes to promote energy conservation. The practice for creating awareness on energy conservation through postures is in vogue in eight units. Three units together have a provision for energy conservation amounting to Rs. 3.07 crores.

Effect on Energy Conservation

The success of energy management can be assessed by the intensity of energy conservation programmes, as depicted in Table 9.

Among the seven units with none responsible for energy conservation, four have so far not taken any initiative to implement energy conservation programmes. Among them, in one unit, thermal energy consumption for the year 1985-86 was increasing at the rate more than 10% compared to that in 1983-84 figures while electrical energy consumption was increasing at the rate of 5 to 10% in another unit. A number of plants, especially the small paper plants, seemed to have shown laxity in improving energy productivity. More intensive work is needed for accelerating the pace of energy conservation activities in these units.

TABLE 9 Impact of Organisation Set up of Energy Management on Implementation of Energy Conservation measures

Energy Management Set up	No. of Units	Degree *				
		1	2	3	4	5
Independent cell	4	2	2	0	0	0
Committee from different deptts.	13	4	8	0	3	0
Exclusive Co-ordinator	4	2	2	0	0	0
Co-ordinator not exclusively incharge	12	5	9	0	2	0
None responsible	6	0	0	2	5	0

* Degrees :

1. A number of measures implemented and found successful/ profitable.
2. No of measures identified, implemented a few of them and more are likely to be implemented in future.
3. A number of energy conservation measures identified and none has been implemented.
4. Very slow progress and achieved very little.
5. Yet to start the energy conservation activities.

Conclusion

The present Survey has shown that, by and large, energy intensive pulp and paper industry is conscious of the need to conserve energy which has become expensive in recent years. Productivity Boards, Productivity Awards, professional research organisations and industry associations can continue to play a significant role in catalysing the implementation of energy conservation programmes. The plant level action plan for energy conservation may be launched. Targets for energy savings should be fixed and reported in the cost audit reports on a mandatory basis.

The paper industry which has been facing recessionary pressures and depressed demand and raw material uncertainties would find energy conservation a boon to reduce production cost. The Survy showed that some of the leaders in the industry have already proved merits of undertaking energy conservation measures. Let us hope that more units would emulate them.

→

APPENDIX—I Energy Conservation Measures' Identified by the IMWG Report

Short Term Measures

—Combustion control in coal fired and chemical recovery boilers.

—Plugging of steam, hot water, hot air, black liquor leakages.

—Improving condensate recovery.

—Improving thermal insulation.

—Improving maintenance of energy conversion and user equipment, instruments and control systems.

—Improving power factor.

—Optimisation of process parameters.

Medium Term Measures

—Retrofitting of heat trap devices in boilers (economisers and air pre heaters).

—Casacading of steam utilisation in paper machines and evaporators.

—Replacement and inter change of over sized pumps and motors.

—Improving digestor blow heat recovery systems.

—Optimising hot water utilisation.

—Increasing number of effects in the evaporators.

—Reduction of water consumption and hence pollution load.

Long Term Measures

—Improving co-generation systems by installing high pressure boilers and suitable steam turbines.

—Introduction of facilities to use bark, sawdust and forest residues as supplementary energy sources.

—Optimisation of total plant hydraulic systems.

—Balancing of production equipment and utilities.

—Replacement of multiple small size equipment with large high efficiency units.

—Adoption of energy efficient techniques/equipment, viz., vapour recompression, disc refiners, improved centri-cleaners and microprocessor based control systems for paper machines, etc.

APPENDIX—II **Energy Conservation Measures' Identified by the Respoding Units**

Measure Code	Description
1.	Black liquor recovery boiler operation & combustion improvement.
2.	Chipper house performance improvement.
3.	Digesters performance improvement.
4.	Multi effect evaporator performance improvement.
5.	Boiler (Coal Fired) operation & combustion.
6.	Parallel operation of in-house power generation with state grid.
7.	Compressor operation optimisation.
8.	Suction press in place of plain press in paper machine.
9.	Low pressure drop centricleaners in bleach plant.
10.	Motor of right size.
11.	Variable speed drive motor.
12.	Increasing number of effects in evaporator.
13.	Boiler (Coal Fired) of better efficiency.
14.	Thyristor drive in place of MG sets.
15.	Use of copper flexibles.
16.	Pumps of right size.
17.	Process modification in paper machinery/stock preparation.
18.	Additional state for bown stock washer.
19.	Vapour recompression system.
20.	Water conservation.
21.	Vapour absorption refrigeration steam.
22.	Lime kiln (Oil fired) stopped.
23.	Blow heat recovery system improvement.
24.	Waste heat recovery.
25.	Poser factor improvement.
26.	Lighting efficiently.
27.	Coal replaces oil in boilers.
28.	Cogeneration with back pressure turbine.

Family Plan Based Resource Allocation for Economic Development and Social Justice

Jagpal Singh

The author aims at evolving an alternative methodology for formulating economic development plans through the preparation of family based investment plans at the levels of village, cluster, block, state and nation. The paper presents such a plan for a cluster of ten villages of Roorkee Block based on the data collected directly for the purpose. The paper merits attention for its methodological novelty.

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Introduction

A review of the planning strategy followed in India indicates that a macro-frame of resource allocation, has been adopted. Since under such a strategy the decision to allocate the resources for different activities and areas is taken at the level of nation or state, there is little scope for a poor family to get the required amount of money for acquiring the desired inputs. This leads to a large portion of human and other resources available with the family being unutilized. or underutilized. Consequently the poor families could neither place effective demand to fulfill their basic needs nor participate actively in the process of creating the desired facilities and services in their areas. As a result, the poor persons remained illiterate, unskilled and untrained, especially in modern technologies, and the villages remained without adequate facilities and services. The situation demands a pattern of resource allocation which can bring the illiterate, unskilled and untrained persons into the mainstream of production process. This calls for the preparation of family based investment plans for the village (mohalla), cluster, block, state and the nation. The scope of this paper is to present such a plan for a cluster of ten villages of Roorkee Block based on the data collected directly from 460 families.

Objectives of Resources Allocation

To achieve the objective of social justice, income of every working person is to be raised upto the minimum level of national average. The objectives of

resource allocation then are :

(i) to provide adequate amount of monetary resources to every family for acquiring the inputs which are required to generate gross output per working person, atleast, equivalent to the national average.

(ii) to produce the desired quantity of goods so as to maintain price stability in the economy.

(iii) to create and maintain the desired facilities and services including defence services.

(iv) to carry on R and D activities for developing technologies appropriate to the country.

Family Plan

Family plan is a statement showing the disposal of gross income generated by the family in a year and the amount of money which is needed for generating this gross income. It is observed that the family spends it's gross income on consumption and paying tax to the government.

$$Y = C + S \qquad (1)$$

Y = gross income generated by the family in a year.

C = resources consumed by the family in a year.

S = resources contributed by the family in a year as tax.

In estimating the amount of money needed by the individual family for acquiring required inputs two problems may arise. Firstly, the quantity and quality of the required inputs differ from place to place and occupation to occupation. Secondly, in case of self-employment every member of the family of certain age group irrespective of his/her age and sex helps in carrying on with the economic activity undertaken by the family. Thus, the working manhours available in the family also differ from family to family. Therefore, it is very difficult to find out standard amount of money per family for all places and for all occupations. The solution to these problems demands to take one manhour as a unit for computing the gross income per working manhour (national average) and to find out separate by the amount of money for every area and every occupation. The amount of money required by an individual family of a particular area for raising the gross income up to the desired level can be estimated with the help of the following relationship :

$$K = AI \times UW \times CIR \qquad (2)$$

where,

K = amount of monetary resources required by the family for generating the desired amount of gross income in a year.

AI = amount of gross income per working manhour prevailing in the economy (national average).

UW = number of working manhours which are to be employed in a particular occupation.

CIR = amount of capital needed for generating one unit of gross income in the occupation in which UW working manhours are to be employed.

Resources for Allocation

Resources which are to be allocated include the amount of capital and land in use, the amout of unutilized/underutilized resources which are to be brought into the mainstream of production process during the whole year and the gross national income generated during the previous year. (In lieu of the quantity of goods and services consumed by the society it provides human resources in terms of labourers, managers and entrepreneurs for further investment. Therefore, consumption is a part of investment). The amount of resources which are available for allocation can be represented as below :

$$TR = AC + EC + ES + R \qquad (3)$$

where,

TR = amount of total resources which are to be allocated/distributed.

AC = amount of capital and land in use.

EC = amount of resources consumed/to be consumed by the society in any year.

ES = amount of resources contributed by the

people of the conutry as tax to the government in any year.

R = amount of unutilized/underutilized resources which are to be brought into the mainstream of production process during the year.

Allocation of Resources Based on a Family Plan

In allocating the available resources based on a family plan, two problems may arise. Firstly, it may or may not be possible to produce the desired quantities of different goods and services. Secondly, the available land, animal, material and energy resources may fall short of the amount to meet the requirements of every family. In a market economy, the first problem can be solved through import-export of goods. As regards the second problem, techniques which need capital per working person (2400 working manhours) more than national average and which generate gross income per working person less than national average need to be checked.

Keeping the above aspects in view, the available resources are to be distributed in different activities and economic units. To ensure that every family gets the required amount of money, the working manhours are also to be distributed in the proportion in which other resources are distributed in different activities. Creating and maintaining the desired facilities and services including defence services and carrying on R and D activities need community support. Individual family or economic unit can't sustain and manage these activities in isolation. They are to be supported through the resources contributed by the people of the country as tax to the government. It is observed that about 20 per cent of the total resources is needed for creating and maintaining the desired facilities and services including defence services and carrying on R and D activities at different levels. This statement can be represented as below :

$$TR = I + G \qquad (4)$$

where,

I = amount of resources which are invested for producing the desired quantity of goods (80 per cent of the total resources).

G = amount of resources which are invested for creating and maintaining the desired community facilities and services including defence services and carrying on R and D activities.

Allocation of 'G' Resources in Geographical Units

Village (mohalla), cluster of villages (mohallas) block, district, state and nation are geo-nomic units among which 'G' resources are to be distributed as per work and responsibilities assigned to them. For illustration purposes, distribution of these resources is assumed as in Table 1.

TABLE 1 **Distribution of 20 Per cent of TR**

S.No.	Name of the unit/Level	Per cent
1.	Village/mohalla	7
2.	Cluster of villages/mohallas	4
3.	Block	1
4.	District	4
5.	State	2
6.	Nation	2
	Total percentage of TR	20

To reduce the unproductive expenditure on collection and distribution of 'G' resources and ensure the active participation of the local people in the process of development, the responsibility of collecting 20 per cent of the gross income from all the families of the area and spending it's share directly may be given to the village/mohalla panchayat. Cluster level administrative unit will utilize the resources for creating and maintaining the facilities and services which are commonly used and connecting all the villages of the cluster with it's head office. Block unit will use it's resources for creating and maiataining the facilities and services consumed by the people of the block. District unit will use one per cent for R and D activities related to the district area which will be carried out at technical institutions, one per cent for removing the disparity in

infrastructural facilities and services within the district and two per cent for creating and maintaining the facilities and services consumed by the people of the entire district. State and national level administrative units will utilize the resources for meeting their administrative expenses and creating and maintaining the facilities and services at state and national levels.

Allocation of 'I' Resources in Activities and Areas

Once investment-plan for every family of the area is prepared, there may not be much problem in allocating the 'I' resources for different activities and areas. This involves occupationwise and areawise aggregation of the investment-plans of different families of the area. As per equation (2) given earlier, preparation of investment plans for the families of a particular area is a very easy task.

Methodology

For preparing the investment-plan for every family of the area, one needs information about the gross income per working manhours prevailing in the economy, working manhours of different families which are to be employed in different activities and capital-output ratios for all the occupations carried out in the area. This further needs the raw data in respect of working manhours, capital and gross output available in the area. For collecting this data, 460 families of ten villages of Roorkee Block were interviewed in 1978. To identify the sample units a two stage stratified sampling design was adopted. The first stage consisted of the selection of the villages and the second stage comprised the selection of households. Out of 113 revenue villages of Roorkee Block, ten villages were selected as per probability Proportional Sampling (PPS) technique. Due to time and cost constraints, it was decided to cover only 460 families (about 30 per cent of the total 1512 families of ten villages). The information in respect of the total families, and numbers of families selected from each village are given in Table 2. For identifying the households which were to be interviewed, the Circular Random Sampling technique was followed. In sample units, 189 families were farmers. Out of these farmers, 18 families were having tractors. To avoid inconsistency in capital and income per unit of land and labour, these farmers were replaced by other agriculturists. For collecting the required data a self-designed duly pretested interview schedule was administered.

TABLE 2 **Households and Sample Units**

Village	Total Households	Actual Sample	Drawn Sample size
1. Asafnagar	122	38	50
2. Barampur	117	38	50
3. Bharapur	198	60	80
4. Ibrahimpur	181	52	70
5. Mazari	119	35	40
6. Matalabpur	109	32	40
7. Mehwerkhurd	198	60	80
8. Poohara	144	45	60
9. Sherpur	97	32	40
10. Tanshipur	227	68	90
Total	1512	460	600

Working Manhours

In rural areas, every member of certain age-group irrespective of his/her age and sex helps in carrying on economic activity undertaken by the family. The working manhours devoted by a family member to an economic activity may not constitute a full working person (Working unit). Therefore, for estimating the human resources available with the family, a different methodology was followed as given in Table 3. Village-wise and occupationwise details of the available working manhours have been given in Table 4.

Gross-Income

Gross-Income of every family has been estimated by deducting the expenditure incurred on direct inputs, like, hired labour, seeds, fertilizers, irrigation, pesticides, depreciation, cost of borrowed capital etc. from the sale value of the produce or services. Village-wise and occupation-wise information about the gross-income of interviewed families is given in Table 5.

TABLE 3 **Norms to arrive at working-manhours**

Category of Family members	Assumed Working manhours available with the family in a year
1. Non-school going male members of 15-59 years age group.	Number of working persons × 2400 = 'A' working manhours
2. Non-school going female of 15-59 years age group engaged in household activity.	Number of women × manhours as per reporting × 300 = 'B' working manhours.
3. Non-School going female doing services in the organized sector.	Number of women × 2400 = 'C' working manhours.
4. School going male/female members of 12 or more years of age.	Number of family members × 2 × 300 = 'D' working manhours.
5. Non-school going male/female of 12-15 years of age group.	Number of family members × 4 × 300 = 'E' working manhours.
6. Total working manhours available with the family in a year for economic activities (MA).	A + B + C + D + E working manhours.

TABLE 4 **Working-manhours Available with 460 Families of Roorkee Block in 1978-79 (in thousands)**

Activity	Araf-nagar	Baram-pur	Bhara-pur	Ibra-him-pur	Mazari	Mata-lab-pur	Mehwar-khurd	Poohana	Sher-pur	Tan-shi-pur	Remo-vable unemp-loyed	Total	Percen-tage
1. Agriculture	47.9	53.8	118.6	99.9	47.7	43.5	131.7	61.4	58.4	156.8	472.8	1292.5	50.00
2. Agriculture labourer	16.2	15.6	34.6	27.6	22.8	32.4	33.6	28.8	22.8	45.2	43.2	322.8	12.49
3. Barbery	4.8	2.4	4.8	—	2.4	—	2.4	2.4	2.4	7.2	14.4	43.2	1.67
4. Business & Commerce	7.0	2.7	5.8	4.6	2.3	3.0	12.0	5.1	5.1	6.6	24.0	78.2	3.02
5. Carpentary	6.0	2.4	3.6	6.3	3.6	2.4	7.2	2.4	4.8	—	31.2	69.9	2.70
6. Dairy	15.0	21.3	17.2	15.6	10.2	3.9	4.5	7.5	3.9	16.4	24.0	139.5	5.40
7. Masonary	—	2.4	2.4	4.8	4.8	2.4	2.4	2.4	4.8	—	21.6	48.0	1.86
8. Piggery	1.8	7.8	4.4	—	—	2.7	7.8	4.5	2.7	2.4	15.6	49.7	1.93
9. Pottery	3.6	3.0	4.0	3.0	3.0	3.6	6.0	—	—	3.0	13.2	42.4	1,64
10. Service	19.2	19.2	17.2	21.6	12.0	16.8	19.2	24.0	14.4	26.6	72.0	262.2	10.14
11. Sheep and Goat	4.8	6.3	—	1.5	—	4.2	2.4	8.1	6.0	8.4	4.8	46.5	1.80
12. Tailoring	5.2	2.4	2.4	2.4	2.4	2.4	4.8	4.8	4.8	2.4	16.8	50 8	1.96
13. Transpor-tation	2.4	2.4	8.0	12.9	9.2	8.7	8.5	12.6	8.4	14.4	14.4	101.9	3.95
14. Weaving	2.4	2.4	2.4	2.4	2.4	2.4	—	2.4	2.4	2.4	15.6	37.2	1.44
15. Removable unemployed	48.0	70.8	110.4	103.2	50.4	46.8	103.2	69.6	61.2	120.0	783.6	—	—
Total	184.3	214.9	335.8	305.8	173.2	175.2	345.7	236.0	202.1	411.8	—	2584.8	
Percentage	7.13	8.13	12.99	11.83	6.70	6.78	13.38	9.13	7.82	15.93		—	100

TABLE 5 Gross-income of 460 Families of Roorkee Block in 1978-79 (in thousand Rs.)

Activity	Asaf-nagar	Baram-pur	Bhara-pur	Ibrahim-pur	Mazari	Matalab-pur	Mehwar-khurd	Pooh-ana	Sher-pur	Tanshi-pur	Total	Per-centage
1. Agriculture	102.0	107.0	245.5	196.8	99.6	93.9	260.7	128.3	113.8	360.4	1708.0	47.43
2. Agriculture labourer	13.3	12.6	32.3	24.5	19.2	28.9	29.0	23.3	19.5	38.5	241.1	6.70
3. Barbery	6.0	3.3	5.7	—	3.0	—	2.8	2.8	2.8	10.3	36.7	1.03
4. Business & Commerce	18.9	7.9	18.5	18.8	9.3	9.1	35.5	13.8	13.1	19.2	162.1	4.52
5. Carpentary	10.1	4.4	7.8	13.0	7.1	4.8	14.0	5.0	8.9	—	75.1	2.09
6. Dairy	30.8	41.8	34.3	32.0	21.0	7.9	10.0	22.4	10.0	42.4	252.6	7.03
7. Masonary	—	7.2	6.9	14.4	13.9	6.6	7.2	6.9	13.8	—	76.9	2.14
8. Piggery	2.7	11.4	6.3	—	—	3.9	11.7	6.5	4.0	3.7	50 2	1.39
9. Pottery	3.8	2.9	3.9	2.8	3.0	3.8	5.7	—	—	3.3	29.2	0.81
10. Service	56.1	54.1	50.2	61.9	34.2	47.1	54.2	68.6	39.1	73.7	539.2	14.97
11. Sheep & Goat	17.2	21.5	—	5.3	—	14.6	8.3	27.3	20.7	28.1	143.0	3.96
12. Tailoring	3.1	2.1	2.0	2.0	2.1	2.0	4.2	4.2	4.1	2.0	27.8	0.77
13. Transportation	6.9	6.5	20.5	35.2	26.8	24.9	23.8	30.0	23.4	40.7	238.7	6.63
14. Weaving	1.9	2.2	2.0	2.2	2.0	2.1	—	2.3	2.0	2.2	18 9	0.53
Total	272.8	284.9	435.9	408.9	241.2	249.6	465.1	341.4	275.2	624.5	359.95	
Percentage	5.78	7.92	12.11	11.36	6.70	6.94	12.92	9.48	7.65	17.34	100	

Capital-in-Use

Capital-in-use includes the cost of land, equipments and implements being used in production activities and the cost of raw materials needed for running the economic activities. Village-wise, and occupation-wise information about the amount of capital available with the 460 families of ten villages of Roorkee Block in 1978-79 is given in Table 6.

Per-Working Manhour Gross-Income

The gross-income per working manhour in different villages and occupations is given in Table 7. Overall gross-income per working manhour in 460 families comes to Rs. 1.39. While estimating the amount of capital needed by individual family this level of gross-income per working manhour was taken as national average. According to this a working person (2400 working manhours) was expected to generate gross income of Rs. 3340/- annually.

Capital-Gross-Output-Ratio

The amount of capital needed to generate one unit of gross output in different villages and occupations is given in Table 8. On overall basis, capital gross output ratio comes to Rs. 4.97. According to this, an enterpreneur is not to be allowed to use capital more than Rs. 16,600/- at 1978-79 prices per working person.

Total Resources

As per equation 3, total resources include four components—AC, EC, ES and R. Village-wise and occupation-wise information about AC is given in Table 6. EC and ES are the components of

TABLE 6 Capital Available with 460 Families of Roorkee Block in 1978-79 (in thousands Rs.)

Activity	Asaf-nagar	Baram-pur	Bhara-pur	Ibrahim-pur	Mazari	Mata-labpur	Mehwar-khurd	Poohana	Sher-pur	Tanshi-pur	Total	Per-centage
1. Agriculture	1058	1026.7	2423.1	1767.3	928.0	942.4	2435.5	1275.6	1152.5	3669.9	16679.1	93.51
2. Agriculture labourer	—	—	—	—	—	—	—	—	—	—	—	—
3. Barbery	0.4	0.2	0.4	—	0.2	—	0.2	0.2	0.2	0.6	2.4	0.01
4. Business & Commerce	17.9	6.6	17.2	11.3	5.7	4.4	25.8	11.4	10.3	7.4	118.0	0.66
5. Carpentary	9.7	4.1	7.6	12.4	7.1	4.4	13.0	5.2	7.3	—	70.8	0.39
6. Dairy	66.7	84.7	72.0	66.0	44.3	16.8	20.1	46.8	20.5	81.4	519.3	2.90
7. Masonary	—	0.2	0.2	0.4	0.4	0.15	0.15	0.15	0.37	—	2.02	0.01
8. Piggery	3.7	13.3	8.4	—	—	5.9	15.2	8.2	5.6	6.0	66.3	0.37
9. Pottery	1.4	1.4	2.8	1.4	1.4	1.4	2.8	—	—	1.4	14.0	0.07
10. Service	—	—	—	—	—	—	—	—	—	—	—	—
11. Sheep & Goat	18.1	12.0	—	6.2	—	9.1	6.1	29.7	20.2	22.9	124.3	0.70
12. Tailoring	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.9	1 0	0.9	6.8	0.04
13. Transportation	2.2	1.4	21.0	30.8	25.2	23.3	22.7	34.2	23.5	33.5	217.8	1.22
14. Weaving	1.9	2.1	1.9	2.1	2.0	2.0	—	2.2	2.1	2.1	18.4	0.12
Total	1180.4	1153.2	2555.1	1898.4	1014.8	1010.35	2542.55	1414.55	1243.57	3826.1	17839.02	
Percentage	6.59	6.44	14.28	10.60	6.00	5.64	14.20	7.90	6.95	21.40		100

TABLE 7 Gross-Output Per-Working Manhour of 460 Families of Roorkee Block in 1978-79 (in Rs.)

Activity	Asaf-nagar	Baram-pur	Bhara-pur	Ibra himpur	Mazari	Mata-labpur	Mehwar-khurd	Poohana	Sher-pur	Tanshi-pur	Total
1. Agriculture	2.13	1.99	2.07	1.97	2.09	2.16	1.98	2.09	1.95	2.30	1.32
2. Agriculture labourer	0.82	0.81	0.94	0.89	0.84	0.89	0.86	0.81	0.86	0.85	0.75
3. Barbery	1.26	1.41	1.20	—	1,25	—	1,18	1.17	1.20	1.44	0.86
4. Business & Commerce	2.71	2.95	3.21	4.10	4.05	3.06	2.80	2.7I	2.58	2.92	2.08
5. Carpentary	1.69	1.86	2.17	2.07	1.98	2.03	1.95	2.11	1.86	—	1.08
6. Dairy	2.05	1.97	2.00	2.06	2.06	2.04	2.24	3.00	2.58	2.59	1.81
7. Masonary	—	3.00	2.86	3.00	2.91	2.75	3.00	2,86	2.88	—	1.60
8. Piggery	1.49	1.47	1.43	—	—	1.44	1.50	1.45	1.47	1.55	1.01
9. Pottery	1.05	0.96	0.99	0.94	0.99	1,06	0.95	—	—	1.09	0.69
10. Service	2.92	2.82	2.92	2.86	2,85	2.80	2.82	2,86	2.72	2.77	2.05
11. Sheep & Goat	3.58	3.41	—	3.51	—	3.47	3.46	3.37	3.44	3.34	3.07
12. Tailoring	0.59	0.85	0.84	0.84	0.87	0.85	0.87	0.87	0.85	0.81	0.54
13. Transportation	2.89	2.73	2.56	2.73	2.91	2.86	2.80	2.38	2.79	2.83	2.34
14. Weaving	0.79	0.91	0.83	0.90	0,88	0.88	—	0.98	0.84	0:90	0.51
Total	1.48	1.33	1.30	1.34	1.39	1.43	1.35	1.45	1,36	1.52	1.39

TABLE 8 Capital Gross-Output Ratio in 460 Families of Roorkee Block in 1978-79

Activity	Asaf-nagar	Baram-pur	Bhara-pur	Ibra-himpur	Mazari	Mata-labpur	Mehwar-khurd	Poohana	Sher-pur	Tanshi-pur	Total
1. Agriculture	10.37	9.59	9.87	8.98	9.91	10.03	9.34	9.94	10.12	10.18	9.80
2. Agriculture	—	—	—	—	—	—	—	—	—	—	—
3. Barbery	0.07	0.06	0,07	—	0.07		0.07	0.07	0.07	0.06	0.06
4. Business & Commerce	0.94	0.83	0.92	0.60	0.62	0.48	0.77	0.83	0.78	0.38	0.72
5. Carpentary	0.95	0.91	0.97	0.95	0.99	0.90	0.93	1.03	0.82	—	0.93
6. Dairy	2.16	2.02	2.10	2.06	2.10	2.11	1.99	2.08	2.03	1.92	2.05
7. Masonary	—	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.03	—	0.02
8. Piggery	1.36	1.16	1.34	—	—	1.52	1.30	1.26	1.42	1.62	1.32
9. Pottery	0.37	0.48	0.71	0.50	0.47	0.37	0.49	—	—	0.43	0.48
10. Service	—	—	—	—	—	—	—	—	—	—	—
11. Sheep & Goat	1.05	0.56	—	1.17	—	0.62	0.73	1.09	0.98	0.82	0.87
12. Tailoring	0.17	0.24	0,24	0.25	0.25	0.25	0.24	0.23	0,24	0.46	0.25
13. Transportation	0.31	0.22	1.02	0.87	0.94	0.94	0.96	1.14	1.01	0.82	0.91
14. Weaving	0.98	0.96	0.97	0.97	0.96	0.95	—	0.94	1.04	0.96	0.97
Total	4.32	4.04	5.86	4.64	4.45	4.04	5.46	4.14	4.51	6.12	4.97

gross-output. Village-wise and occupation-wise information about the gross-output is given in Table 5. As regards R, out of a total of 984.4 acres of land, 549.0 acres was unirrigated. Unirrigated land was used by the farmers for one crop in a year, whereas the irrigated land was used for two to three crops in a year. By providing irrigation facilities in the unirrigated land, it was possible to use this land for a second crop also. As reported by the villagers Rs. 2,000/- per acre was adequate for providing the irrigation facilities. The total amount required for providing irrigation facilities in 549.0 acres of land came to Rs. 10.98 lakhs.

Besides this, if the juice extraction efficiency of animal driven cane crushing device is raised, the diversion of bagasse from the present use to more economical ones may be recommended. Thus. the entire sugarcane (about 8000 tonnes) can be crushed in animal driven crushing units at village level and the sugarcane juice may be processed in large/meduim scale sugar plants. The energy which is presently used for cane crushing in the large/medium/small scale sugar plant, may be utilised for boiling the sugarcane juice. As such, 8000 tonnes of sugarcane and about 2000 tonnes of bagasse will be available for processing at village level. The bagasse can be used for making hand-made paper. The available quantity of bagasse can sustain two units of handmade paper. Taking these things into consideration total resources available with the interviewed families have been estimated and given in Table 9.

Investment-Plan

The total resources available with the interviewed families in 1978-79 were to the tune of Rs. 225.39 lakhs. Distribution of 20% of this among different geographical units has been given in Table 10. Based on family plans, village-wise and occupation-wise distribution of 80 per cent of the total resources has been given in Table 11.

TABLE 9 **Total Resources Available with 460 Families of Roorkee Block in 1978-79 (in thousands Rs.)**

Activity	Asaf-nagar	Baram-pur	Bhara-pur	Ibra-himpur	Mazari	Mata-labpur	Mehwar-khurd	Poohana	Sher-pur	Tanshi-pur	Total
1. Agriculture	1285.3	1223.3	2769.6	2053.9	1119.9	1145.6	2820.7	1503.1	1353.1	4211.1	19485.5
2. Agricultural labourer	13.3	12.6	32.4	24.6	19.3	28.9	29.0	23.3	19.5	38.5	241.4
3. Barbery	6.5	3.6	6.2	—	3.2	—	3.0	3.0	3.1	11.0	39.6
4. Business & Commerce	36.9	14.6	35.8	30.2	15.1	13.6	59.4	25.2	23.5	26.6	280.9
5. Carpentary	19.8	8.4	15.4	25.4	14.2	9.3	27.0	10.3	16.2	—	146.0
6. Dairy	97.5	126.5	106.4	98-1	65.3	24.8	30.2	69.2	30.5	123.9	772.3
7. Masonary	—	7.4	7.1	14.9	14.3	6.7	7.3	7.1	14.2	—	78.9
8. Piggery	6.3	24.7	14.7	—	—	9.8	26.9	14.8	9.6	9.7	116.5
9. Pottery	5.2	4.3	6.8	4.2	4.4	5.2	8.5	—	—	4.7	43.2
10. Service	56.1	54.1	50.2	61.9	34.2	47.1	54.2	68.6	39.1	73.7	539.2
11. Sheep & Goat	35.3	33.5	—	11.4	—	23.6	14.4	57.0	40.8	51.0	267.0
12. Tailoring	3.6	2.5	2.5	2.5	2.6	2.5	5.2	5.1	5.0	2.8	34.3
13. Transportation	9.1	8.0	41.5	66.0	52.0	48.2	46.5	64.2	47.0	74.2	456.7
14. Weaving	3.8	4.3	3.9	4.3	4.1	4.1	—	4.6	4.1	4.3	37.5
Total	1578.7	1527.7	3092.5	2397.3	1348.6	1369.4	3132.3	1855.4	1605.7	4631.5	22539.1

TABLE 10 **Distribution of 20% of Total Resources (in thousands Rs.)**

Village	20% of T.R.	Distribution of 20% of T.R. among different geographical units					
		Village 7%	Cluster 4%	Block 1%	District 4%	State 2%	Nation 2%
1. Asaf Nagar	315.718	110.501	63.143	15.786	63.144	31.572	31.572
2. Barampur	305.597	106.959	61.119	152.808	61.119	30.560	30.560
3. Bharapur	618.471	216.465	123.694	30.924	123.694	61.847	64.847
4. Ibrahimpur	479.436	167.802	95.887	23.972	95.887	47.944	47.944
5. Mazari	269.725	94.404	54.945	13.486	53.946	26.972	26.972
6. Matalabpur	273.906	95.867	54.781	13.695	54.781	27.391	27.391
7. Mehwar Khurd	626.457	219.260	125.291	31.323	125.291	62.646	62.646
8. Poohana	371.083	129.879	74.217	18.554	74.217	37.108	37.108
9. Sherpur	321.157	112.405	64.232	16.058	64.231	32.115	32.115
10. Tanshipur	926.298	324.204	185.260	46.315	185.260	92.630	92.630
Total	4507.849	1577.746	901.569	225.393	901.570	450.570	450.850

TABLE 11 **Distribution of 80% of Total Resources (in thousands)**

Activity	Asaf-nagar	Baram-pur	Bharapur	Ibrahim-pur	Mazari	Matalab-pur	Mehwar-khurd	Poohana	Sher-pur	Tanshi-pur	Total
1. Agriculture	704.5	672.4	1730.0	1264.9	568.0	580.6	1916.9	828.2	753.7	2835.7	11854.9
2. Agriculture labourer	186.8	184.0	267.6	206.5	200.8	205.0	234.7	206.9	172.1	322.7	2187.1
3. Barbery	5.2	2.9	4.9	—	2.6	—	2.4	2.4	2.5	8.8	31.7
4. Business & Commerce	29.5	11.7	28.6	24.1	12.0	10.9	47.5	20.2	18.8	21.3	224.6
5. Carpentary	15.8	6.8	23.0	20.3	11.4	7.4	21.6	8.2	13.0	—	127.5
6. Dairy	78.0	101.2	85.1	78.5	52.2	19.8	24.1	55.4	24.4	99.1	617.7
7. Masonary	—	5.9	5.7	11.8	11.4	5.4	5.9	5.7	3.3	—	55.1
8. Piggery	5.0	19.8	11.8	—	—	7.8	21.5	11.8	7.7	7.8	93.2
9. Pottery	4.1	3.4	5.4	3.4	3.5	4.2	6.8	—	—	3.7	34.5
10. Service	44.9	43.3	40.1	49.5	27.3	37.7	43.4	54.9	31.3	59.0	431.4
11. Sheep & Goat	28.2	26.8	—	9.1	—	18.9	11.5	45.6	32.7	40.8	213.6
12. Tailoring	2.9	2.0	2.0	2.0	2.1	2.0	4.1	4.1	4.0	2.3	27.5
13. Transportation	7.3	6.4	33.2	52.8	41.6	88.5	37.2	51.4	37.6	59.4	415.4
14. Weaving	3.0	3.4	3.1	3.4	3.3	3.3	—	3.6	3.3	3.4	29.8
15. Sugarcane crushing	13.2	20.1	25.5	17.8	16.4	7.8	21.4	19.0	18.7	27.4	184.3
16. Hand-made paper	86.6	67.2	147.8	116.7	78.2	51.2	52.9	125.1	122.7	141.9	990.3
17. Cow-dung processing	48.0	45.0	63.0	57.0	48.0	45.0	54.0	42.0	39.0	72.9	513.0
Total	1263.0	1222.3	2473.8	1917.8	1078.6	1095.5	2505.9	1484.5	1284.8	3705.3	18031.5

Impact of the Proposed Family-Plan Based Resource Allocation

Implementation of the family-plan based allocation of resources may help not only in decentralising the decision taking powers, but also in making every unit self-sufficient. This will also ensure the participation of the masses in exploiting the locally available resources for raising their standard of living. The data given in Table 12 indicate that implementation of the proposed allocation of resources can solve the problem of unemployment fully. Poverty and income-disparity can be reduced from 46.95 per cent to 9.78 per cent of the total population and from Rs. 8075 to Rs. 7725 respectively.

TABLE 12 **Impact on Unemployment, Poverty and Income-disparity**

S.N.	Item	Present	Expected
1.	Percentage of unemployed working manhours to the total working manhours	39.64	0.00
2.	Percentage of the families living below the proverty line to the total families	46.95	9.78
3.	Disparity in per capita net annual income in Rs.	80.75	7725

NOTE : As per government norms, monthly per capita expenditure (income) of Rs. 76 at 1979-80 prices is the poverty line for rural India.

Policy-Implication

Implementation of the proposed strategy of resource allocation needs a great change in the policies and programmes. The concept of development is to be defined in terms of average gross income which is to be estimated by dividing the gross national income with the total working force in the country. The objective of social justice is to be achieved through growth in production and not through taxation and expenditure policy. There is a need to introduce a single tax system in the place of present multiple tax system. Every unit of gross income of a family irrespective of it's occupation is to be considered for estimating the tax amount. The responsibility of collecting the tax amount from different families of a village/mohalla and spending it's share directly has to be given to the village/mohalla panchayat. The proposed strategy of resource allocation also needs a change in the organisational structure. There is a need to introduce an organisational structure in which technoiogical, financial and managerial expertise can play a participative role in running an economic activity in the villages.

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A Goal-Oriented Weighted Multi-Factor Productivity Index

Khalil F. Matta

This paper presents a weighted Multi-factor Productivity Index which monitors the performance of an organisation and which indentifies the productivity problems. The key resource factors are identified and a weighting technique is presented. The productivity index is dynamic and responsive to the changing needs of an organisation.

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Introduction

The productivity in some U.S. manufacturing industries, such as automobiles and steel, has not, during the past decade, been increasing at the same rate as its counterparts in Japan and Germany. The reasons for the relatively modest increases in industrial productivity in the seventies are numerous. This has created an increasing pressure on U.S. manufacturing managers to positively influence the overall productivity of their production facilities. Their efforts have been hampered by the lack of an effective, accurate and sensitive means to measure the efficiency of their manufacturing operations. In a recent survey published in May 1981, only 41.4% of the manufacturing firms in the USA reported using partial productivity indicators, and the percentage dropped to 1.4 for those using a total factor productivity indicator (Sumanth, 1981).

Definitions

Productivity is the ratio of outputs produced to the input resources utilized in production. For trend analysis, the productivity index is formulated as (Salvandy, 1982).

$$\frac{\text{AOMP/RIMP}}{\text{AOBP/RIBP}} \times 100$$

where AOMP = Aggregated outputs, measured period
RIMP = Resource inputs, measured period
AOBP = Aggregated outputs, base period
RIBP = Resource inputs, base period

The outputs can, in most cases, be easily indentified

and measured as the dollar value (inflation adjusted) of steel produced or the tons of steel produced. The input variables are more complex to identify and quantify since contribution to the final product come from different departments and production lines. Partial productivity is the ratio of gross or net output to one type of input. Some examples are labor productivity, energy productivity, capital productivity, etc. Total productivity is the ratio of gross or net output to all inputs such as the following one developed by the American Productivity Center (1981).

$$\text{Productivity} = \frac{\text{Output}}{\text{Labor} + \text{Material} + \text{Energy} + \text{Capital} + \text{Others}} \quad (2)$$

Use of Productivity Measures

In order to identify those desirable characteristics in a productivity measure, it is crucial to identify the use of such a measure. The following are three :

Trend analysis : Measuring the productivity of a firm in relation to the previous years or a base period. The choice of a base period is important (usually chosen to be one of the better performance years).

Comparison analysis : Comparing the productivity of a firm with others in the same field.

Goal analysis : Comparing the actual productivity of a firm with the anticipated productivity.

Goal analysis is, by far, the best technique for utilizing a productivity index. The first two methods are important, for, they describe the productivity of a firm as either a function of time or in relationship to others. The information presented in the first two methods is dependent to some extent on data beyond the control of management, such as competitors' performance if available and previous managerial decisions. The third technique, goal analysis, is based on the concept of management by objectives. Competitive firms performance and previous productivity gains and losses should be incorporated in the productivity goal setting of the firm. This gives the managers the responsibility for defining goals, setting guidelines for achieving those goals and analyzing the results attained.

A productivity index is, however, only a partial measure of the performance of a firm, and, thus, must be viewed as such. It attempts to measure the quantity of resourses used per unit of output. Other measures include profitability and capacity utilization. An increase in productivity might not necessarily result in an increase in profitability due to inflationary effects, such as rising energy costs in the past 10 years or a decrease in unit selling price such as that of personal computers in recent years. Also, a productivity index reflects no information on the present utilization of plants (capacity ratio).

Desirable Characteristics of a Productivity Index

The following is list of characteristcs desirable in a productivity index :

1. Show the productivity status of an organization as compared to previous years and to others producing the same or similar product.
2. Identify the production areas having productivity problems.
3. Be sensitive to the changing needs of an organization. The needs of an organization are dynamic and, thus, a productivity index must be dynamic and flexible.
4. Monitor the efforts to attain goals and objectives.
5. Should be spared the effects of inflation.
6. Must be easily quantified (calculated).

When considering the input variables, the following questions should be asked.

*Is the factor being considered a primary goal or concern of management ?

*Can this input be controlled and managed ?

* Are data available or must more data elements be collected ?
* Can this input be easily quantified ?
* Can their data be easily manipulated to falsely indicate improvements ?

A need existed at the National Standard Company, the prime producer of wires in the United States, to develop a measure of its productivity. The managers at NSC wanted a single productivity index to compare the internal productivity of their various plants, to compare the productivity of their company with others in the same manufacturing discipline and to identify productivity problems. The productivity index developed for NSC is described next. In order to facilitate the discussion, a numerical example is presented. The data utilized in this example was masked, and the productivity values generated *did not* correspond to the actual productivity at NSC during the specified period of time.

Weighted Multi-Factor Productivity Model

The productivity index developed is a weighted multi-factor index.

It offers a manager a multi-dimensional view of productivity and is goal oriented. The general form of the weighted multi-factor productivity index (W.M.F.P.I.) is :

$$\text{W.M.F.P.I.} = \sum_{i=1}^{n} w_i f_i \qquad (3)$$

where n is the number of input resources influencing the productivity index,

w_i is the weighting factor associated with resource. The weighting factor will be dsicussed in detail in the following section.

f_i is the partial productivity factor associated with resource i.

This model has two significant features :

* A partial productivity measure is developed for each resource. This enables the manager to monitor the changes caused by each input and their effect on the total productivity index. Charts can be drawn showing such relationships. Isolating those resources causing a decline in productivity is the essential first step towards identifying the reasons for such a decline and addressing that problem.
* Each partial productivity measure is multiplied by a weighting factor. This provides the manager with the flexibility to modify the productivity index. The productivity index can, then, be formulated to reflect the goals set by managers and will retain the capability to change as the organization needs change.

Key Input Resources

The resources mentioned in this section are by no means complete. Each organization must identify those resources based on its own needs.

$$f_i = \frac{\dfrac{\text{Sales}}{\text{Cost of Resource i}}_{MP}}{\dfrac{\text{Sales}}{\text{Cost of Resource i}}_{BP}} \qquad (4)$$

Where MP and BP stand for measured and base period, respectively. The partial productivity of i in the base period will be one. This representation permits both trend and comparison analyses. Measuring both the output and the input in terms of dollars eliminate, to some extent, the effects of inflation even though historically wages have increased at a higher rate than other prices and costs. Techniques for calculating the cost associated with the resources mentioned previously can be found in William (1983).

Q-Factor

Less than 5% of the time is spent by an item, since it enters as raw material and leaves as the final product, on the production line being worked on. The remaining 95% of the time is spent in transport or on in process inventory. Managers have traditionally concentrated on methods for reducing the production time and ignored such factors that might lead to the reduction of waiting time as more commonly known as the time in the queue. The time in the queue is

unproductive during which no value is added to the item, and additional costs such as rework, scrap, insurance, strorage space, material handling, etc. are incurred. Sandman and Hayes (1980) highlights the effects of Queue Time on productivity and defines the time in the queue as ;

$$\text{QUEUE TIME} = Q \times \text{Work Time.}$$

where

$$Q = \frac{(A \times I \times T \times E) - M}{M} \qquad (5)$$

and

$$\text{Work Time} = \frac{M}{I \times N \times E} \qquad (6)$$

A = Orders Live/Day

I = Man-Hours/Man-Day

T = Work Days/Year

E = Number of Men Per Typical Order

M = Direct Labor Hours/Year

N = Total Order/Year

Measuring the productivity as a function of Queue Time is important for the following reasons :

1. Establishment of quantified goal for reducing product cycle time.
2. Eliminating avoidable time in queue can improve productivity without additional investment in machinery or manpower.
3. This factor is controlled essentially by plant managers and. thus, can be easily influenced.
4. Substantially reduce the costs of inventory, material handling and insurance and adds to the efficiency of the overall production operation.

The Q-Factor is defined as :

$$\text{Q-Factor} = \frac{\text{QUEUE TIME BP}}{\text{QUEUE TIME MP}} \qquad (7)$$

The measured period queue time is placed in the denominator so as a decrease in the time in the queue will positively influence the productivity.

The sales during the 1978 fiscal year (1978 is used as a base period) were 150 million dollars. The costs were 25, 18, 20, 10, 15, 5, and 7 million dollars distributed on direct and indirect labor, raw material, energy, capital, Q-Factor and others respectively. The costs of the six key resources are monitored for the next four years, and the changes are tabulated in Table 1. In order to simplify the analysis it is assumed that the dollar value of sales remains constant over that period (the analysis does not change if sales did vary). The partial productivity factors can be calculated using equations 4 and 7, and a plot is generated (Figure 1) to identify trends and facilitate comparisons.

TABLE 1 Cost Changes From 1979-1982

Factors	Year			
	1979	1980	1981	1982
1. D.L.	+10%	+15%	+8%	−10%
2. I.L.	+ 7%	—	−5%	−15%
3. R.M.	+ 8%	+10%	+5%	+ 2%
4. E	+ 3%	− 2%	−5%	−10%
5. C	+ 2%	—	−5%	− 8%
6. Q	—	—	110%	−20%

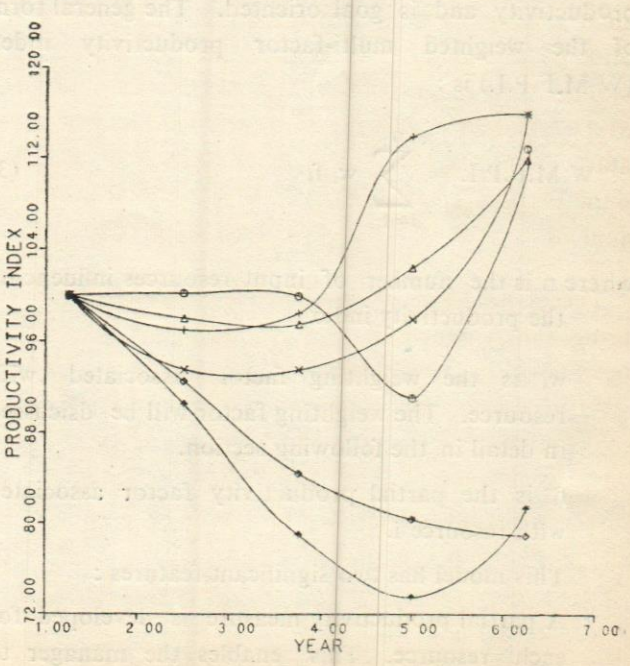

Fig. 1 Partial Productivity Index

From the partial productivity values, the two main problem areas are labor and raw material. Raw material productivity has declined each year. Labor productivity has declined steadily, however an increase in productivity is recorded in the last year. This indicates, that even though the absolute labor productivity is still substantially below the base year, the step taken during 1981 to reverse the trend have been effective and should be continued. The same cannot be said for Raw material productivity.

Weighted Ranking Technique

A weighting technique was developed to systematically rank important productivity indices, both objectively and subjectively. This could, then, be combined algebraically into a single, unique PI able to encompass all important productivity factors and satisfactorily measure productivity.

The subjective ranking is produced by a weighted-ranking technique in the from of a matrix that develops "factors of importance coefficients" (FIC). The basic approach involves considering every factor versus every other factor and assigning a value of one to the factor considered more important and a value of zero to the one considered less important. If a decision cannot be made regarding relative importance then it is possible to assign to both the factors a value of one-half. This can be generalized to a continuing space between zero and one, if need be. After all factors have been compared, the sum of the values should equal N(N-1)/2, and this number will be the F I C. The summation of the F I C.'s should equal one.

Three decision-making criteria should be applied during the assignment of zero/one values. These are :

(1) Is there potential for improvement by the plant manager ?

(2) What is the relative importance of the factors regarding organization and management goals ?

(3) Costs should not be taken into consideration when assigning relative importance. The reasoning behind this criteria concerns the use of costs in the objective weighting of the indices.

Although the technique appears subjective in nature, this ranking technique allows for flexibility which an objective cost ranking would not allow.

The most beneficial use of this technique, which may also be a drawback, is its ability to be easily manipulated as corporation and/or management goals change. Although, the weights that are developed as a base must remain the same to allow for a constant comparison, new weights and, thus, a modified model to monitor efforts to meet new goals can be generated if management wishes to redefine its goals. (Note that since this model can be stored/implemented on a personal computer, historical data can be retrieved to generate the new models performance as a function of time).

The next step in the weighting process is to apply the objective weighting. The objective weighting technique concerns the application of percentages of total costs of each index to their F I C. For each index, except for the Q-factor index, cost data can be calculated.

To figure a cost for the Q-factor, an accounting procedure can be developed to determine how much money can be saved if the time in the queue was decreased by a certain percentage (for example a reduction of queue time by 10% might result in a 2% reduction in total cost). The percentage reduction in cost can be determined by :

$$\%\ \text{Q-COST} = \frac{\text{Change in-process inventory} \times \text{unit cost of carrying such inventory}}{\text{Totol Production Costs}} \tag{8}$$

The weighting factors can, then, be formulated as :

$$w_i = \frac{(\text{FIC})_i \times (\%\text{Cost})_i}{\sum_{j=1}^{n} [(\text{FIC})_j \times (\%\text{Cost})_j]} \times 100 \tag{9}$$

Substituting the previously mentioned input factors in the productivity index, equation 3 can be rewritten as :

$$\text{W.M.F.P.I.} = \omega\text{DL}(\text{D.L. Factor}) + \omega\text{I.L (I.L Factor)} + \omega\text{R.M. (R.M. Factor)} + \omega\text{E (Energy Factor)} + \omega\text{C (Capital Factor)} + \omega\text{Q (Q-Factor)} \quad (10)$$

In a meeting headed by the Vice President of Production, managers of the various departments are asked to evaluate the relative importance of key cost factors and develop factors of importance coefficient (FIC) matrix. The matrix representing the average FICs is shown in Table 2. By summing each row, the FICs are determined and placed in the right hand side column. Using equation 9, the individual weighting factor for each resource can be determined and the general productivity equation becomes :

$$\text{W,M.F.P.I.} = 30.9\,(\text{D.L. Factor}) + 11.1\,(\text{I.L Factor}) + 21.6\,(\text{R.M. Factor}) + 9.3\,(\text{Energy Factor}) + 2.09\,(\text{Capital Factor}) + 6.2\,(\text{Queue Factor}) \quad (11)$$

Note that the sum of all weighting factors will equal to I00. The above equation will combine the information generated by the partial productivity factors (Figure 1). For any year, the partial productivity index of each factor can be obtained from figure 1 and placed in previous equation to obtain a single overall productivity measure.

Figure 2 shows the total productivity indices using the weighting factors generated by the 5 managers (Table 3) and the average of those weighting factors (represented as a solid line in the figure). The following observations can be made :

* The productivity index, whether total or partial, and irrespective of weighting factors utilized, has a value equal to 100 in the base period.
* The general trend of the total productivity index is the same irrespective of the weighting factors

TABLE 2 Sample Matrix Formulation*

Factors																					F.I.C.
D.L.	1	0	1	0	1	1															4
I.L.	0						0	1	0	0	1										2
R.M.		1					1					.5	0	0	1						3.5
E			0					0				.5				1	.5	1			3
C				1					1				1			0			.5	1	4.5
Q					0					0				0			.5		.5	1	4
D*						0					0				0			0		0	0

*A dummy matrix is utilized in order to prevent any cost factor from having zero FIC.

TABLE 3 Manager's F.I.C.

Factor	1	2	3	4	5	Average
D.L.	6	4	3	4	3	4
I.L.	2	2	1	2	3	2
R.M.	2.5	3.5	3	4	4.5	3.5
E	3	2	6	1	4	3
C	3.5	6	4.5	5.5	3	4.5
Q	4	3.5	3.5	4.5	4.5	4

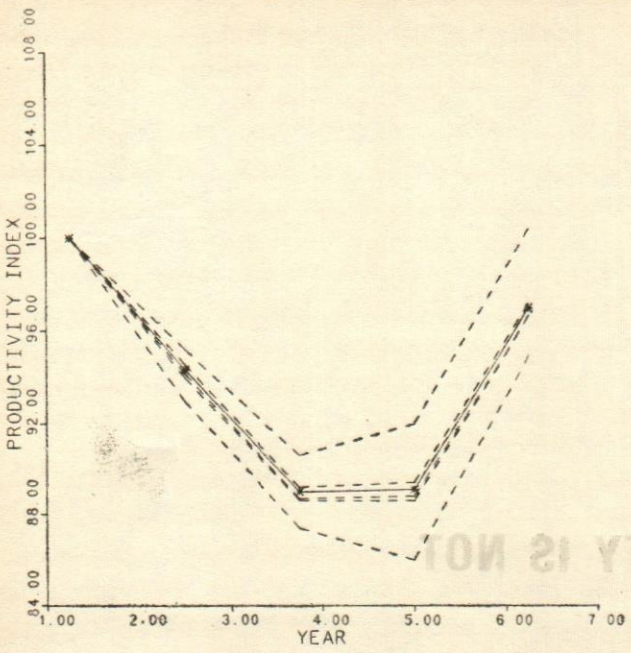

Fig. 2 Total Productivity Index

used. The weighting factors will mainly influence the magnitude of decrease and increase in productivity.

* The two figures for the partial and total productivity measures respectively convey different, yet complementary observations. The first identifies the produciivity problem areas, namely, raw material and direct labor, while the second is the base to compose the internal and external productivity of the organization, set and monitor goals shaped by information from partial productivity factors.

Conclusion

Gold (1982) states that very few manufacturing firms have effective systems for measuring changes in productivity relationships and even fewer firms have effective means of analyzing the specific causes of changes in productivity relationships. The weighted multi-factor productivity index measures the performance of an organization. By measuring the partial productivity of key resources, productivity problem areas can be identified. By multiplying each partial productivity factor by a unique weight, management can set productivity goals and measure the progress of their efforts towards attaining those goals.

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PRODUCTIVITY IS NOT

SOMEBODY ELSE'S RESPONSIBILITY

IT IS EVERYBODY'S CONCERN

LET US MAKE PRODUCTIVITY

A WAY OF LIFE

Productivity Trends in Electrical Machinery Industry in India

N.P.C. Research Cell

Electrical Machinery is one of the most important segments of India's industrial sector. The industry contributed to about 8 per cent of the total value added of the manufacturing sector, accounted for about 4.5 per cent of industrial employment and 4 per cent of the industrial investments in the country. In this paper an attempt has been made to analyse the productivity performance of this sector in terms of such aspects as labour productivity, capital productivity and total productivity.

This paper is prepared by N.K. Nair, Director (Research) and A.K. Burman, Asst. Director (Research), National Productivity Council, New Delhi.

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Introduction

Electrical machinery is one of the most important segments of the industrial sector of the country. In addition to producing capital goods such as generators, transformers, wires and cables, batteries etc. the electrical machinery industry also produces a variety of consumer durables like fans, bulbs, iron, heaters, radio and television sets, etc. The importance of the electrical machinery sector can be gauged from the fact that it contributed about 8.2 per cent of the total value added of the manufacturing sector during 1985-86. This industry also accounted for about 4.5 per cent of the employment and 3.9 per cent of the invested capital of the total manufacturing sector in the country. Of late, the development of electronics like computers had broadened the Indian industrial base. The seventh Five Year Plan (1985-90) expected that the electronics sector would grow by about 25 times (1984-85 base) by the turn of the century. In this paper an attempt has been made to measure and analyse the productivity performance of this sector in terms of such aspects as labour productivity, capital productivity and total productivity. The attempt has been to comment on the performance of the total electrical machinery industry and its various sub-groups.[1]

1. Under the Electrical Machinery sector (Industrial group 36 according to the National Industrial classification) there are 9 three digit industrial classifications. These are listed in Appendix I.

Variables and Their Measurement

For the purposes of productivity measurement, output has been measured by gross value added at 1980-81 base prices. The commonly used single deflation method has been resorted to while converting the gross value added at current prices into its constant price counterparts. The gross value added is arrived at after deducting the total value of intermediate inputs from the gross value of production.

The factor inputs considered for measurement of productivity are two, viz., labour and capital. Labour is measured in terms of number of persons employed. It is a well known phenomenon that there is no entirely satisfactory or universally acceptable way of measuring capital stock. Golder (1981) provides a very useful review of both conceptual problems and shortcomings of various existing estimates of capital stock in the manufacturing sector. We have taken gross fixed assets at 1980-81 base prices instead of the net fixed assets to represent capital stock. This is because of the fact that it is not possible to devise an ideal measure of economic depreciation. The depreciation provision in the ASI is known to be gross overestimates of the true capital consumption. In fact the depreciation allowances are derived from either the tax-based accounting concepts or based on certain thumb rules (Ahluwalia, 1985). The measurement of economic depreciation is a very complex exercise and requires detailed information on the economic life of the assets, which among other things depends on technological growth in the industry. It is, therefore, preferable to work with data on gross capital stock. Gross fixed capital stock at constant 1980-81 prices for this study was derived through the perpetual inventory accumulation method.

The indices. for gross value added, employment and gross fixed assets, thus, worked out taking 1980-81 as base are shown in Appendix II for total electrical machinery sector. The corresponding indices of gross fixed assets employment and gross value added are shown in Appendices III, IV & V respectively, for different industry groups at disaggregated levels.

Prices and Price Indices

The Price indices for the respective products (base 1970-71) which were used in order to deflate the value added at current prices to the respective base values were not available directly from the source, viz, Index Number of Wholesale prices in India for all categories of products under review. The price indices of major products in each category, wherever available, were combined using the weightages given at the source in order to arrive at the required price deflators. These weightages are shown in Appendix VI. In the case of capital input, however there are no separate price deflators available either for the industry as a whole or for different sub-groups. The wholesale price index relevent for the group 'transport, machinery and equipment' was used in order to convert capital additions during each year to values at 1980-81 base prices. The price deflators, thus used are given in Appendix VII.

Nature and Sources of Data

The data for arriving at the partial productivity ratios and total productivity are taken from the Summary Results of the Annual Survey of industries for the Factory Sector. The data related to the period from 1960 to 1984-85 for the Electrical Machinery Sector (total) and from 1973-74 to 1984-85 for different sub-groups.

Pre 1973-74 years could not be considered for different groups because these groups were categorised into one i.e, Electrical Machinery, Apparatus and Appliances till 1973-74. These were classified into 9 sub-groups during the later period. Data for the post 1984-85 years are yet to be published by the ASI and therefore, could not included. We did not cover the industry group 365. i.e., Manufacture and Repair of Radiographic X-Ray Apparatus and Tubes and Parts because of the non-availability of appropriate price indices for deflating the value added. The data for this sub-category of the industry also showed wide fluctuations in different periods, probably because of coverage variations over time.

Partial and Total Productivity Indices

The labour productivity has been measured in

terms of value added at 1980-81 base prices per person employed where as capital productivity has been measured in terms of value added per rupee of fixed capital at 1980-81 base prices.

The total productivity indices have been arrived at using the following formula[2] :

$$ITP_t = \alpha_o IKP_t + \beta_o ILP_t$$

where

ITP_t = Index of total Productivity

IKP_t = Index of capital Productivity

JLP_t = Index of Labour Productivity

α_o = Share of capital in value added during the base period, i.e. 1980-81.

β_o = Share of Labour (Total emoluments) in value added during the base period i.e. 1980-81.

o, t are the subscripts for base and current periods respectively.

Results

The indices of partial productivity and total productivity for Electrical Machinery (total) sector are shown in Table 1 and the growth pattern of different time periods are shown in Table 2. The following could be observed :

1. The labour productivity has increased at 8.4 per cent per annum compound during the period 1960 to 1984-85. However the capital productivity has shown a decline at the rate of 1.6 per cent compound per annum during the same period. The increase in total productivity came to 1.4 per cent compound in the mean time.
2. During the period 1960-1970 the labour productivity has shown an increase of 4.6 per cent annum compound, whereas capital productivity

2. This is similar to the Arithmatic Index (also known as Kendrick Index). See also National Productivity Council (1988).

TABLE 1 **Indices of Labour Productivity, Capital Productivity and Total Productivity in Electrical Machinery (1980-81=100)**

Years	Capital Productivity	Labour Productivity	Total Productivity
1960	155.6	49.1	111.7
1961	172.4	53.7	123.5
1962	114.0	46.0	86.0
1963	112.3	53.9	88.2
1964	102.7	54.4	82.8
1965	107.7	59.8	88.0
1966	88.0	60.2	71.8
1967	75.9	60.2	69.4
1968	71.7	58.5	66.3
1969	79.2	62 5	72.3
1970	78.8	77.1	78.1
1971	87.2	81.8	85.0
1973-74	103.0	87.4	96.7
1974-75	82.2	78.2	80.5
1975-76	86.7	82.6	85.0
1976-77	90.7	88.6	89.8
1977-78	103.4	102.6	103.1
1978-79	95.4	94.0	94.8
1979-80	92.8	89.3	91.4
1980-81	100.0	100.0	100.0
1981-82	97.9	104.2	100.5
1982-83	111.3	122.5	115.9
1983-84	108.8	129.5	117.3
1984-85	125.0	153.0	136.5

TABLE 2 **Compound growth rate of Capital Productivity, Labour Productivity, Total Productivity, and Capital Intensity in Electrical Machinery Sector**

Year	Labour Productivity	Capital Productivity	Total Productivity	Capital Intensity
1960-70	4.6	(—) 7.0	(—) 3.7	12.0
1970 to 1980-81	2.6	2.4	2.5	0.2
1980-81 to 1984-85	11.2	5.7	8.1	5.2
1960 to 1984-85	8.4	(—) 1.6	1.4	10.2

has declined at the compound rate of 7 per cent per annum. The total productivity showed a decline at the rate of 3.7 per cent per annum compound.

3. The growth in labour productivity, though slowed down during the period 1970 to 1980-81 (2.6 per cent per annum), the capital productivity showed a growth of 2.4 per cent per annum leading to an improvement in total productivity at the rate of 2.5 per cent per annum.
4. Both labour and capital productivity have shown very high growth rates during the period 1980-81 to 1984-85, i.e. at the compound rate of 11.2 and 5.7 per cent per annum respectively. The total productivity correspondingly showed an increase of 8.1 per cent per annum during this period.

The productivity growth across various groups in the Electrieal Machinery Sector has been however, uneven during the period 1973-74 to 1984-85. (Table 3, 4 and 5). The pattern of growth of partial and total productivity are shown in Table 6. The following conclusions are arrived at :

1. The labour productivity growth has been positive for all the groups between 1973-74 and 1984-85. The lowest growth rate (2.7 per cent per annum) has been recorded by the Manufacture of Electrical Industrial Machinery and Apparatus and Parts such as electrical motors, generators, transformers etc. (industry group 360). The highest rate of growth in labour productivity (7.3 per cent per annum) is shown by the Electronic Computer Sector (industry groups 366 and 367) followed by Manufacture of Radio, Television, Wire and Wireless sets etc. (industry group 364).
2. All industry groups showed a negative rate of growth in capital productivity (Table 4) except the Electronic Computer Sector (industry groups 366 and 367) where it increased at the rate of 5.3 per cent during the period.
3. The total productivity declined in the case of two groups i.e. Manufacture of Electrical Machinery and Apparatus not Elsewhere Classified (industry group 369) and Manufacture of Electrical Machinery and Apparatus and Parts (industry group 360). The rate of decline in the case of these two industry groups are 1.4 per cent per annum and 0.7 per cent per annum respectively. The highest rate of growth in capital productivity (6.2 per cent per annum) is observed in the case of Electronic Computer Sector (industry group 366 and 367).

TABLE 3 **Indices of Capital Productivity in Electrical Machinery (1980-81 = 100)**

Industry Groups	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85
360	130.1	86.3	100.8	107.2	101.8	98.4	88.9	100.0	89.4	98.9	97.6	94.5
361	84.7	79.4	68.9	68.3	68.4	82.3	85.0	100.0	84.8	83.4	83.9	70.6
362	123.2	83.8	93.0	102.7	110.3	115.6	102.2	100.0	118.8	115.7	122.3	117.0
363	112.9	73.8	72.0	83.1	89.7	86.1	99.3	100.0	110.8	110.2	92.8	94.8
364	160.6	141.6	123.8	119.3	139.2	127.7	122.3	100.0	94.7	122.7	123.1	127.6
366, 367	70.5	76.0	89.6	79.1	81.6	95.7	92.6	100.0	110.4	135.8	118.1	158.3
369	188.4	135.1	102.9	124.7	112.4	95.1	115.0	100.0	168.7	161.7	120.2	177.8

TABLE 4 Indices of Labour Productivity in Electrical Machinery (1980-81=100)

Industry Groups	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85
360	90.2	78.7	90.2	98.5	98.6	94.6	86.7	100.0	97.2	118.1	115.5	121.0
361	66.3	68.9	60.8	58.7	62.0	76.4	78.9	100.0	95.4	103.6	117.7	109.0
362	86.4	70.1	79.5	105.8	119.4	124.1	104.9	100.0	119.0	143.2	147.6	164.0
363	79.8	65.9	66.1	83.8	89.7	85.7	98.8	100.0	110.0	115.7	127.9	136.7
364	89.6	85.8	87.0	88.1	103.6	100.9	100.1	100.0	113.0	141.2	174.3	191.3
366, 367	76.3	84.2	83.9	86.8	80.4	88.0	92.9	100.0	102.9	142.8	154.0	186 2
369	103 6	97.7	67.6	74.1	73.6	91.5	95.2	100.0	144.0	159.1	145.1	186.8

TABLE 5 Indices of Total Productivity in Electrical Machinery (1980-81=100)

Industry Groups	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85
360	113.7	83.2	96.4	103.6	100.6	96.8	88.0	100.0	92.6	106.8	105.0	105.4
361	79.9	76.6	66.8	65.8	66.7	80.7	83.4	100.0	87.6	88.7	92.8	80.7
362	109.5	78.7	88.0	103.9	113.7	118.8	103.2	100.0	118.9	125.9	131.7	134.5
363	98.1	70.3	69.4	83.4	89.7	85.9	99.1	100.0	110.4	112.7	108.5	113.5
364	119.3	109.1	102.4	101.1	118.6	112.1	109.4	100.0	105.3	133.5	152.9	164.6
366, 367	73.0	79.5	87.1	82.4	81.1	92.4	92.7	100.0	107.2	138.8	135.5	170.3
369	150.0	115.0	86.9	101.8	94.8	93.5	106.0	100.0	157.5	160.5	131.5	181.9

Some Explanations

Our estimates of total productivity for the electrical mahinery sector (total) showed a negative growth during the pre 1970 period and a positive growth during the post 1970 period. Whereas an impressive rising trend was observed in labour productivity and capital intensity (Table 2) a significant falling trend was discernible in capital productivity during the 1960-70 period. However, during the seventies there was a fall in labour productivity and also a marked decline in capital intensity. The capital productivity also showed a positive rate of growth during this period. Capital deepening seemed to have slowed down appreciably after 1970. This trend was observed also for the total manufacturing sector by Golder (1986).

Except the electornics industries like radio and television, (Industry group-364) and computer (Industry groups 366 & 367), the performance of the remaining electrical machinery sector has not been very encouraging in terms of productivity (Table 6). The low growth of productivity in the remaining sectors of the industry can be attributed to many factors. The government policies like self-reliance or

TABLE 6 Growth Rate of Labour Productivity, Capital Productivity, Total Prodnctivity and Capital Intensity in Electrical Machinery Between 1973-74 and 1984-85

Industry Groups	Labour Productivity	Capital Productivity	Total Productivity	Capital Intensity
360	2.7	(—) 3.0	(—) 0.7	5.7
361	4.6	(—) 1.7	0.1	6.4
362	6.0	(—) 0.5	1.9	6.5
363	5.0	(—) 1.6	1.3	6.7
364	7.1	(—) 2.1	2.9	9.4
366, 367	7.3*	5.3*	6.2	1.9*
369	3.4*	(—) 4.6*	(—) 1.4*	8.0*

* Relates to period 1973-74 to 1983-84.

import substitution, regional dispersal of industries despite locational disadvantages etc. might have led to the inefficient use of resources due to the undue protection that entailed from such a policy. Decline in competition arising out of import control measures and domestic industrial licensing policies seemed to have protected the high cost firms from domestic and foreign competition, thereby leading to industrial in-efficiency (BICP, 1988 : Golder, 1988).

The problem of industrial in-efficiency is also related to the structure of the economy. How the structure of the economy and the dependence of the manufacturing sector on foreign technology have resulted in a near stagnation in demand for industrial goods, excess capacities—and technical and managerial in-efficiencies has been discussed by Shetty (1978). The electrical machinery sector is also no exception to this. The Report of the working sub-group on Electrical Equipment (1984) showed that in most of the industries like transformers, HT Circuit, powercapacitors etc. there existed excess capacities. In fact, in certain cases the existing capacity is enough even to meet the peak year demand during the VIIth plan as envisaged by the Central Electricity Authority. Also, the same report showed that most of the raw materials used by this industry had to be inported. Some studies also tried to put forward an explanation of industrial declaration based on low productivity (Desai, 1987). This may be the case even for the electrical machinery equipment other than from electrical goods sector. The low productivity growth during the 1960-70 also may have arisen from the unsteady demand by the State Electricity Boards for electrical equipment such as transformers. electric motors, switchgear etc. The Report of the Indian Electrical Manufacturers' Association (1969) submitted to the Planning Commission stated that the orders from the State Electricity Boards for transformers, cables, wires etc. did not flow evently. Sometimes the Boards placed orders for their requirements of two to three years and, thus, build up their inventories with the result that for the next two to three years, there were practically no orders.

As had been mentioned earlier, the productivity growth in electrical machinery sector during the period 1960-70 was negative. This is one of the sectors in which import substitution had been attempted on a large scale. This provides some support to the view of Bhagwati and Desai (1970), Frankena (1974), Bhagwati and Srinivasan (1975) that the import substitution strategy, though contributed much to the objectives of diversification and self-reliance, has led to serious inefficiency in the industrial sector (see also Golder, 1986).

Further studies by BICP (1988), revealed that Indian Industries suffered from in-efficient use of resource, thereby, leading to high cost economy mainly because of the small size of domestic plants, and their relatively high capital costs due either to delays during project implementation or high incidence of duties on imported capital goods even on items where there was no dometic production, inapproriate investment decisions and cascading impact of taxes and duties. The same study also revealed that as the degree of indigenisation increased because of the present phased manufacturing programme (PMP), the domestic cost expressed in terms of rupees per marginal dollar saved also increased. This was noticed in the case of electronic components and telecommunication equipment industries also.

The high growth of productivity in electronic sector (industry groups 366 and 367) was noticed mainly after 1980 (Table 5). The Government's New Electronics Policy of 1981-86 like liberalisation of licensing, unrestricted growth on capacities, unrestricted entry by both public and private sectors, liberalisation of duties and taxes etc. has led to high competition among various units and, thereby, efficient use of man, machine and matrials (BICP, 1987; Indian Investment Centre, 1986).

Conclusions

A review of the factor and total productivity indices relating to the total electrical machinery sector showed that there was an impressive increase in labour productivity and capital intensity and a significant fall in capital productivity during the decade 1960-70. However, during the next decade, the growth in labour productivity seemed to have slowed down; but capital productivity showed an increase. The capital intensity marked a decline during this period. The total productivity though declined during the decade 1960-70, recorded a positive growth during 1970-80 period. At the disaggregated levels, it was observed that all the industry groups showed a positive and impressive growth in labour productivity during the period 1973-74 to 1984-85. However, capital productivity had declined at low to moderate rates for all the industry groups except the electronic computers. In most of the cases the total productivity showed positive growth rates. Where as the total productivity increased at impressive rates in the electronics sector (industry group 364, 366 and 367) in the remaining sectors it recorded low growth rates during the period. The policy objectives like self-reliance or import substitution, delays in project implementation, unstable demand from the state electrieity boards, limited size of the plants leading to diseconomise-of-scale etc. were found as major reasons leading to stagnant productivity levels or their slow growth in these industries. The high growth in productivity in the electronics sector, particularly after 1980, could be attributed mainly to the liberalised policies adopted by the government, thereby, leading to efficient use of resources.

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APPENDIX I

List of Three Digit Industry Groups Under Manufacture of Electrical Machinery, Apparatus, Appliances and Supplies and Parts

Group	Description
	Manufacture of Electrical Machinery, Apparatus, Appliances and Supplies and Parts
360	Manufacture of electrical industrial machinery and apparatus and parts (such as electrical motors, generators, transformers, electromagnetic clutches and brakes etc.)
361	Manufacture of insulated wires and cables
362	Manufacture of dry and wet batteries
363	Manufacture of electrical apparatus, appliances and other parts such as lamps, bulbs, tubes, sockets, switches, fans, insulator (except porcelain), conductors, irons, heaters, shavers, cleaners, etc., excluding repairing
364	Manufacture of radio and television transmitting and receiving sets including transistor radio sets, sound reproducing and recording equipment including tape recorders, public address system gramphone record and pre-reeorded magnetic tapes, wire and wireless, telephone and telegraph equipment, signalling and detection equipment and apparatus, radar equipment and installations, parts and supplies specially used for electronic apparatus classified in this group.
365	Manufacture and repair of Radiographic X-ray apparatus and tubes and parts.
366	Manufacture of Electronic Computers, Control Instruments and other Equipment.
367	Manufacture of electronic components, and accessories not elsewhere classified.
369	Manufacture of electrical machinery, apparatus, appliances and supplies and parts not elsewhere classified.

APPENDIX II

Indices of Employment, Capital and Gross Value Added in Electrical Machinery, Apparatus and Appliances (1980-81=100)

Years	Employment	Gross Fixed Capital	Gross Value Added
1960	27.0	8.5	13.3
1961	28.7	8.9	15.4
1962	34.7	14.0	16.0
1963	38.8	18.6	20.9
1964	44.4	23.6	24.2
1965	49.4	27.4	29.5
1966	53.1	40.0	32.0
1967	55.2	43.8	33.2
1968	56.6	46.2	33.1
1969	58.5	46.2	36.6
1970	67.8	66.3	52.3
1971	71.1	66.7	58.2
1973-74	78.6	66.7	68.8
1974-75	79.3	75.4	62.0
1975-76	81.3	77.5	67.1
1976-77	83.2	81.3	73.7
1977-78	85.3	84.7	87.6
1978-79	88.7	87.4	83.4
1979-80	97.9	94.3	87.5
1980-81	100.0	100.0	100.0
1981-82	97.8	104.0	101.9
1982-83	106.1	117.0	130.2
1983-84	106.0	126.2	137.4
1984-85	111.1	136.0	170.0

APPENDIX III

Indices of Gross Fixed Assets (1980-81 = 100) in Electrical Machinery

Industry Groups	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85
360	59.4	76.0	77.4	79.4	86.2	88.5	93.9	100.0	107.5	120.9	117.5	139.2
361	61.0	61.0	68.5	65.4	71.2	73.2	86.8	100.0	112.6	124.8	145.6	147.6
362	66.1	79.4	78.2	91.7	94.3	94.6	91.4	100.0	98.1	108.8	118.7	130.3
363	67.6	86.2	78.3	83.2	86.3	83.5	94.4	100.0	115.6	120.6	195.2	165.2
364	45.4	52.1	59.2	68.3	68.4	76.0	93.2	100.0	92.1	136.2	155.9	176.8
366, 367	22.3	43.6	48.4	60.0	60.5	72.1	89.9	100.0	96.1	119.4	152.5	147.6
369	33.9	36.4	55.2	67.9	73.2	107.6	95.3	100.0	120.2	118.8	157.6	186.7

APPENDIX IV

Indices of Employment (1980-81) = 100) in Electrical Machinery

Industry Groups	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85
360	85.6	83.4	86.5	86.3	88.8	92.1	96.3	100.0	98.9	101.2	99.3	108.8
361	78.0	70.3	77.7	76.0	78.5	79.0	93.6	100.0	100.1	100.4	103.8	95.7
362	83.8	84.4	81.3	79.1	77.4	78.3	79.1	100.0	87.1	78.1	87.5	82.6
363	95.7	96.5	85.3	82.5	86.3	83.9	94.9	100.0	116.6	114.8	119.8	114.6
364	81.4	85.9	84.3	92.5	91.7	96.2	113.9	100.0	77.2	118.4	110.1	117.9
366, 367	20.6	39.4	51.6	54.6	61.3	78.4	89.7	100.0	103.0	113.5	116.9	125. 5
369	61.6	54.2	83.9	114.3	111.7	111.9	115.2	100.0	140.7	120.5	132.4	177.6

APPENDIX V

Indices of Gross Value Added (1980-81=100) in Electrical Machinery

Industry Groups	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85
360	77.3	65.6	78.0	85.1	87.7	87.1	83.4	100,0	96.1	119.6	114.7	131.6
361	51.7	48.5	47.2	44.6	48.7	60.3	73.9	100.0	95.5	104.0	122.2	104.3
362	81.5	66.6	72.7	94.1	104.0	109.4	93.4	100.0	116.6	125.9	145.3	152.4
363	76.4	63.6	56.3	69.1	77.4	71.9	93.8	100.0	128.3	132.9	153.2	156.6
364	72.9	73.8	73.3	81.6	95.3	97.1	114.1	100.0	87.2	167.1	192.0	225.5
366, 367	15.7	33.1	43.3	47.4	49.3	69.0	83.3	100.0	106.1	162.1	180.1	233.7
369	63.8	49.1	56.8	84.8	82.2	102.4	109.6	100.0	202.7	192.1	189.5	331.9

APPENDIX VI

Price Indices and Their Weightages

Industry Groups	Price Indices	Weights
36	1. Electrical Machinery Apparatus and Appliances	1.00
360	1. Electric Motors	0.370
	2. Motor Starters	0.055
	3. Transformers	0.397
	4. Switchgear	0.109
	5. Oil Circuit Breaker	0.069
361	1. Cables and Wires	1.000
362	1. Dry Cells	0.600
	2. Batteries	0.400
363	1. Electric Lamps	0.318
	2. Electric Fans	0.455
	3. Switchboard Panel	0.227
364, 366, 367	1. Radio Receiver/ Television	1.000
369	1. Electrical Machinery Apparatus and Appliances	1.000

APPENDIX VII

Price Indices for Various Industry Groups of Electrical Machinery Apparatus and Appliances and Transport, Machinery and Equipment (1970-71=100)

Industries	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85
1. Electric Motors	123.2	178.7	176.5	141.7	168.9	178.0	195.8	211.5	248.7	258.0	244 5	271.5
2. Motor Starters	129.0	192.2	192.8	192.8	192.8	206.0	236.7	284.5	297.7	293.2	310.8	334.2
3. Transformers	120 3	154.4	168.5	170.8	165.9	175.2	209.5	221.9	225.3	229.8	270.8	294.4
4. Switchgear	100.4	132.2	140.0	133.2	134.3	140.9	156.4	180.8	210.9	228.9	239.6	258.7
5. Oil Circuit Breaker	145.5	186.4	218.4	218.4	220.6	227.6	270.6	278.0	331.5	385.2	434.8	524.0
6. Cables and Wires	109.4	155.1	178.9	172.6	168.0	177.7	204.1	205.9	206.0	206.3	215.9	222.0
7. Dry Cells	123.2	158.6	166.3	166.9	165.8	169.8	183.4	189.6	205.7	257.8	261.2	260.9
8. Batteries	130.9	163.4	171.9	171.7	176.5	189.4	243.3	259.7	281.0	292.6	289.7	294.7
9. Electric Lamps	115.6	146.3	153.6	153.6	153.6	161.4	179.9	203.5	221.1	229.4	231.6	238.0
10. Electric Fans	105.3	130.7	121.8	110.8	114.3	122.2	142.6	150.5	150.5	158.7	157.4	156.4
11. Switchboard panel	157.6	221.4	261.4	261.4	264.0	272.4	339.4	351.4	351.4	359.9	374.1	418.9
12. Radio Receiver/ Television	108.6	140.9	144.4	141.6	143.2	144.8	154.8	162.2	169.0	175.2	171.8	166.6
13. Total for Electrical Machinery	116.7	158.1	169.5	162.4	164.8	172.9	199.8	208.8	221.1	230.3	239.6	253.2
14. Transport, Machinery and Equipment	122.7	156.4	172.6	170.1	172.5	183.9	215.9	239.4	265.1	279.9	289.4	303.6

Source : Index Number of Wholesale Prices in India, Various Issues.

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MAINTENANCE

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BOOK REVIEW

Productivity, Vol. 29, No. 2, July-September 1988, 213-220

LABOUR-MANAGEMENT GOURT BATTLES—THE MANOEUVRING GAME, By Manik Kher. The Times Research Foundation, Pune, 1987, 126pp, Price Rs. 115/-

This slim volume is the third produced by the author for the Times Research Foundation set up by the Bennet, Coleman and Co. Ltd. in 1979. This particular study deals, mostly, with the court battles arising from the various provisions of the Maharashtra Recognition of Trade Unions and Prevention of the Unfair Labour Practices Act, 1971. In fact, all but one chapters deal with this legislation and are written on the basis of court records in Maharashtra, indeed most of the cases located in and around Bombay city. The last chapter dealing with the Payment of Bonus Act does not really belong to the book inasmuch as it bears no logical connection with the Maharashtra legislation and merits a separate and fuller treatment. Had the author compared the working of the Maharashtra Act with the I.D. Act, 1947 a work of greater importance would have possibly emerged. The Government of Maharashtra has been a pioneer in legislating on the two crucial problems of union recognition and unfair labour practices. The Centre has practically incorporated the Schedule II dealing with the unfair practices in the Maharashtra Act into the Fifth Schedule of the I.D. Act The proposed central legislation titled, the Trade Unions and the Industrial Disputes (Amendment) Bill, 1988 may also succeed in making some more progress in the intractable sphere of union recognition than has been possible so far.

In this book the author seeks to analyse the Judges interpretation of law in respect of i) unfair labour practices, ii) recognition of trade unions and iii) an individual employee and iv) the management. In addition, there is a chapter on social implications of the Act (MRTU & PULP ACT) which, while summing up the findings also contains introductory materials and, needlessly, repeats some points made in earlier chapters. In fact most of the contents of this chapter could be more usefully incorporated in the introductory chapter itself. There are issues on which the author finds herself at odds either with the provisions of the Act or with judicial pronouncements. She finds fault with "the Court's interpretation of violence as a wrongful act only if committed by an individual member in his individual capacity" on the ground that it is not only narrow but disputable too (p. 89). Likewise, she finds it strange that in the Act "non observance of a settlement, or failure to implement it is an unfair labour practice only for employers." If unions do not abide by the terms and conditions of a settlement, it is not an unfair practice. She does not cite examples, however, nor does she explain as to what options employers would have if unions did contravene the provisions of a settlement to which they had been signatories.

On the working of the Act the author says that the two parties to industrial disputes usually ignore the spirit underlying the legislation and display all the legal knowledge they can mobilise to raise quibbles, delay proceedings and seek opportunities to engage in fights whether under the provisions of the Act or besides them. She concludes from the cases studied "that it is not the law but the parties who are responsible for pushing the social objectives of the law into doldrums. If the parties engage themselves in playing with the legal terminology and delaying tactics, one cannot help

distortions being ushered in", (pp. 96-97). One hopes the Government will allow for opportunities for tripartite reviews of the proposed Bill, particulary those dealing with amendments to the Trade Unions Act, 1926 before securing its passage by the Parliament.

One last word about the book must be addressed to the sponsors of this work. Many publications suffer from defects in English language, grammar etc. The solution lies in ensuring that every manuscript is routed through a professionally trained editor before being sent to press. This book would have improved considerably if it had been edited for language and style.

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PLANNING FOR IMPROVED ENTERPRISE PERFORMANCE, By Robert Abramson & Walter Halset, Sterling Publishers Pvt, Ltd., 1987, Price Rs. 100/-

In the context of changes in the economic policies in India leading to pressures on the organisations to be in competition, any literature focussing on approaches for improving performance is welcome. This book was originally published by the International Labour Office in 1979 and this Indian Edition has been brought out by M/s Sterling Publishers Pvt. Ltd. This book assumes added importance when Indian planners are pitchering their sights at achieving the double digit growth rates. The achievement of the proposed level of the growth rate will also depend upon how best we can use the assets already created for meeting the demand for goods and services by our expanding economy and growing population through improving productivity and efficiency.

This book is addressed to all those managers, consultants, government officials, trainers and others who are interested to improve the performance and productivity of the organisation with which they are associated. The book gives guidelines and methodologies for improving performance based on many years of pratical work and field experience. The main purpose is to provide the practical information and guidance on performance improvement methodologies for producing results in both developed and developing countries. Examples include number of organisations where these approaches have been tested and tried.

The Part I (Chapter 1-5) deals with subjects relating to organisation development and performance improvement planning, with emphasis on developing a comprehensive and planned change strategy. This part explains the basic model of performance improvement consisting of five major phases; preliminary diagnosis, management orientation, organisational diagnosis and action planning, implementation, review and revision. These introductory chapters in addition to defining the objectives, features performance improvement process also.

These chapters also indicate conditions necessary for developing and implementing a successful organisational change strategy. The pressure for change, commitments of top management and praticipation of different levels of management are some of the major conditions mentioned in this context. The reader is being rightly cautioned that sufficient and adequate conditions must exsit to provide reasonable chance for success and a large scale exercise should not be attempted to start with. The following conditions should receive due attention:

(i) Are there enough pressures both external and internal for change which would motivate and sustain such efforts? The experience is not a very happy one in this regard. It is hoped that with increased liberalisation and opening of the economy enough external pressures will be created on Indian organisations to opt for a comprehensive process of improving performance as outlined.

(ii) Do the present day top management feel itself committed to such a process ? The process needs investment of both time and money on the part of top management to make it a success. The management must feel adequately committed so as to enable it to ask uncomfortable and searching questions

on matters within the control of the organisation to implement the strategy. In case, they are going for soft options and seek governmental and other outside help for changes favourable to them, this book will not be of great help.

(iii) The process necessarily involves active participation on the part of various management levels in the organisation. Do we have a managerial style and work culture to permit such participation ? The improvement process starts with, as usual, critical examination of the objectives and diagnosis of the problem areas, organising workshops to orient different levels of management, formulation and implementation of action plans and monitoring. Our organisations will have to expand their vision and concentrate on clarifying their role in the societal context rather than limiting their role to providing few products and services and thereby generating profits.

The part II (Chapter 6-12) concerns itself with the process of implementation. It emphasises the need for systems approach which is both quantitatively as well as behaviouraly oriented. It includes case illustrations to clarify how the techniques of programme management and MBO can be applied in the implementation process. It also points out the contribution of various quantitative and analytical tools such as net-work analysis, operation research, programme budgeting etc.

Finally part III (Chapter 13) refers to prcatical experience of OD/PIP applications in various countries. Attempts have been made to assess the key factor that influence the results. In addition to improving quantitative results, this approach has contributed towards building more effective team work and gaining commitment from various levels of management to the process of improvement. This could be one of the major advantages of applying these techniques in the Indian environment, where team effort, communications and focus on results need considerable improvement.

The appendix contains complete specimen of performance improvement instrument—main diagnostic and planning tool for formulation action plans, management team rating forms and a brief guide on introducing such programmes in a country or an organisation. The usefulness of the book lies in providing readymade tested material which can straightway be used with adaptation in our environment.

The approach as outlined is comprehensive and elaborate and can prove to be a success provided the conditions laid down are satisfied. First and foremost we must examine closly our sincerity and hoesty of purpose before launching such a process of improvement, since improving performance is a serious business requiring both financial and other resources. The book is a good blend of academic and practical experience and can serve as a practical guide to all those who feel sufficiently committed to the process of improvement. The broad framework is universally applicable, however, there is a need to adapt it to suit the Indian socio-economic environment and the specific needs of an organisation.

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INDIAN AGRICULTURE : A POLICY PERSPECTIVE, By B.M. Bhatia, Sage Publications, New Delhi, 1988, 191 pp, Price Rs. 140/-

This book is with a clear message and for a just cause; but with avoidable repetitions, needless exhortations and dispensable and lengthy quotations. Spread into 8 chapters, the book tries to prescribe a blend of policy shifts and high technology options to move towards agriculture in the twenty first century. The author repeatedly reiterates the known fact that agricultural growth not only affects, but actually governs the fortunes of the national economy. The scope of Book is not limited only to economics of Indian agriculture alone but extends to cover the endemic problems of rural poverty and unemployment.

The author argues that in the peculiar circumstances of India, a developmental model based on accelerated growth of the industrial sector could not have worked and has not actually worked. The much vaunted trickle down effect has not materialised. Rural India, except the irrigated agriculture, remains poor. The green revolution, although has solved the food problems of the country, has not touched the rainfed and dryland agriculture due to the fact that the HYV-fertilizers technology based strategy is not relevant to the 70 per cent of Indian agriculture. This strategy has also produced large imbalances in the cropping pattern and wide regional disparities. "It has helped to produce burdensome surpluses in some crops and painful shortages in others"; huge buffer stock of wheat and crippling shortage of oil seeds, for instance. "Thus, income disparities between the developed and under-developed agricultural regions of the country have become so palpable that we can talk today of the Indians, agriculturally; one, dynamic and progressing, the other backward and stagnating. It is in the latter little dent has been made into the basic problems of peverty undernourishment and destitution". As if this were not enough, the Seventh Plan has run into difficulties on the resources front. Budget deficits and adverse trade balances have risen to untenable levels. The capital output ratio continued to rise disconcertingly. Thus, it has become necessary to have a fresh look at the development strategy and the place that is to be accorded to agriculture in the development process.

The country should now change over to a broad based 'unimodel' pattern of agriculrural development, characterised by gradual but widespread increases in productivity by small farmers, adopting technologies appropriate to labour-abundant—capital scarce-factor endowement situation; according to the author. Instead of a target oriented production growth the policy goal, henceforth, should be to secure the modernisation of agriculture as a whole. From food self sufficiency the attention of the policy makers should shift to improving the lot of the small and marginal farmers and landless agricultural labourers.

Although not altogether novel, the authors' new strategy for agriculture rests on the following :—

1. An intensive R & D effort to evolve high yield varieties of crops in the rainfed, semi-arid and dry regions.
2. Special attention to small and marginal farmers in the supply of farm inputs, through the coversion of the on going IRDP.
3. Provision of financial support for construction of minor irrigation works and water conservation measures in the dry and arid regions.
4. Leaving the developed agriculture to its own resources; public outlays in the agriculture being devoted exclusively to building an infrastructure in the backward agricultural regions.
5. Delinking the issue of agriculture prices from those relating to cheap food supplies by limiting the scope of procurement and supplies through the public distribution system.

The development strategies in agriculture for the next 15 years should be oriented towards greatly narrowing the development level gaps, crop-wise and region wise. This would necessitate making the resource allocations area and crop specific. This would also necessitate that various special programmes relating to development and poverty alleviation are combined into a single comprehensive programme. The guiding policy objective will be to optimise employment and incomes of the poor and reduce gradually the wide disparities existing between the modern and traditional parts of the economy. This pattern of growth will be far less capital intensive and, therefore, for more efficient in terms of output and employment growth in the existing circumstances. The composition of industrial production would change in favour of production of mass consumption goods. The appreciable fall in the capital output ratio expected from the changed growth pattern would release a considerable portion of the public sector plan outlays from the manfacturing, mining, transport and construction sectors for deployment elsewhere.

The central plan proposed by the author becomes an indicative plan whereas detailed planning will be passed on to the district levels, having its own planning machinery. The DC becomes the development commissioner of the district assuming overall charge

of the development administration. A District Development Council with representatives of the people on it as members would be created in order to formulate and implement the plan. The strategy at the macro level must be to ensure that the market intervations by the state is indicated in the interest of protecting farm incomes against erosion caused by factors beyond the farmers control.

The author has dealt with, in some details, a few interesting technological aspects like genetic engineering, biofertilizers, scientific farm management etc. Then, there is a very useful chapter on the ecological aspects which also gives some dirccticn to the land use policy in the future.

Although the essential logic of the thesis(es) developed by the author is not new to a careful observer of the emerging literature since last one decade or so, the book certainly merits the attention of the policy maker for its clarity and commitment. There are occasions when the author strayed away into the academics of proposing and opposing at the same breath, particularly when citing quantitative evidences. The book suffers from long quotes (even the chapter on summary is not an exception) and multi-stage repetitions. One cannot but remark that the purpose could have been safely served by, at best, two thirds of the pages. This definitely is not to either understate the achievement of the author or to underestimate his efforts but to remind that the meat is overcooked.

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TRANSFORMATION OF PUNJAB AGRICULTURE, By Inder Sain, B.R. Publishing Corporation, New Delhi, 191 pp, Price Rs. 125.

Punjab is a leading agricultural state and it has witnessed a remarkable increase in its agricultural production. The book 'Transformation of Punjab Agriculture' examines the role of various factors in the pattern and growth of agricultural production in Punjab and evaluates their contributions. The author has rightly used a Cobb-Douglas model alongwith the Translog Production Function and Multi-Factor Analysis. The shifts in the resource structure and its use, cropping pattern, and the productivity of crops have also been examined in details with the help of suitable statistical tests.

There is a comprehensive review of literature in this area at macro as well as micro level. Besides presenting a brief and concise summary of the study, certain action implication have also been suggested.

Increase in agricultural production, however, is not a function of economic and technological factors alone. There are certain social and psychological variables which also play an important role. Similarly, the functions of extension agencies can also not be undermined. It is always desirable to examine all the factors for deducing meaningful generalizations. The author might have excluded these factors as the study was done in the field of economics. These, however, need not be overlooked by the planners, policy makers and administrators while formulating a strategy for increasing farm production. Similarly, the validity and utility of the findings would have increased significantly, had the data been collected from an agriculturally backward state also for comparison. However, such limitations are not uncommon with any research work.

While quoting the references in the text, the author has mentioned the year as well as serial number of the reference. The general practice is to have either of the two.

Printing of the book is highly appreciable.

It is felt that the research workers and the students working in this area would find the book highly useful. It would also be of much interest to the persons engaged in the task of agricultural development.

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SMALL SCALE ENTERPRISES IN INDUSTRIAL DEVELOPMENT—THE INDIAN EXPERIENCE, Edited by K.B. Suri, Sage Publication, New Delhi, 1988, 348 pp, Rs. 195/-

"I believe this volume can contribute to the evolution of a more informed and sound industrial policy in India". These words of I.M.D. Little, in the Foreword very aptly describe the significance of the publication of this volume.

It contains fifteen papers written by eminent economists on various issues related to small scale industries. These papers are the revised versions of some of the papers presented at a Conference on "Small Scale Industry Development," sponsored jointly by the Institute of Economic Growth, Delhi and the World Bank, during March, 1985. The papers have been divided into five parts, namely, Data Base, Relative Efficiency, Industry Studies, Factor and Product Markets and Linkages, and Government Policy.

Data Base

This section, consisting of contributions by G. Ramachandran, M.R. Saluja, K. Sundaram and S. Tendulkar, is a significant contribution of this volume. It focuses on the data base for the VSSI, the conceptual and methodological inconsistencies and hence the problems that arise from the data sources in conducting research in this field to assess their performance. K. Sundaram and Tendulkar have for the first time tried to work out the size and structure of manufacturing industry in India, covering the entire range from the tiny household units to the factory establishments. The section thus, is of special interest to researchers, and gives a signal to policy makers to concentrate on availability of data for this sector without which a reasonable assessment of any important aspect of their industrial policy remains highly unsatisfactory.

Relative Efficiency

The most important aspect of study in the field of SSI is technology related to which is the question of efficiency of small vis-a-vis large scale units. The policy of supply side intervention in favour of SSI is based on the widely prevalent belief that small units are more employment generating and capital saving.

Biswanath Golder compares for 137 Indian industries the technical efficiency of small and large scale industries and infers that the modern small scale sector is inefficient. He also points out that the relative efficiency of SSI varies directly with capital intensity, so that the SSI cannot be relied upon as a source of efficient employment generation.

Ian Little studies the relation between factor productivities, intensities and employment size of the firm for the five industries in India. The conclusion arrived at is interesting. While at the aggregate level, the hypothesis that "larger the size, greater is the capital intensity and labour productivity and lower is the capital productivity, by the large, holds at the disaggregated level it fails". Little also agrees with Indian formulae for defining the small (scale industries) but finds faults with the fact that size distributions are not published on this basis. According to him "Employment size is a poor indicator even of labour intensity, which itself is a poor indicator of social advantage. Labour intensity is far better spotted by observing the technique used." It goes to the credit of I.M.D. Little that he has brought out the significance of a basic conceptual flaw in the various analysis conducted in the field of SSI that of using employment as a basis for defining SSI. The thread needs to be picked up both by researchers and policy makers.

Industry Studies

The third section dealing with specific industry studies, is an extension of the analysis of implications of size and technology variations. Based on the proven fact that aggregate analysis cannot bring out meaningful conclusions, this section focuses attention on separate studies of five industries, viz, leather shoe manufacturing, sugar processing, electric fan and Laundry soaps done by J.G. Weardenberg, H.H.de Haan, Nirmala Banerjee and K.B. Suri. The papers cover a number of aspects ranging from factor intensities, efficiency and other socio-economic aspects

to the question of co-existence of various size groups, scope of intermediate technology, the economic rationale of the ancilliary relationships etc.

Factor and Product Market and Linkages

The fourth section concentrates on the question of factor and product markets and linkages. Dipak Mazumdar, examines the extent to which wage differentials exist between small and large enterprises and also the reasons, economic or institutional, to which these can be attributed. He also studies the role played by product differenciation in the co-existence of different technologies and size groups. V.S. Patvardhan, has taken up a review of the role played by the institutional finance in the growth of SSI. While S.R. Hashim addresses himself to the role of SSI as an instrument of regional dispersal and diffusion of ownership and entrepreneurship.

Government Policy

Evaluating the government support programme for the SSI sectors, specially those relating to long term finance, the reservation policy, other incentive schemes and industrial estates, J.C. Sandesara comes to the conclusion that almost none of these measures have increased the efficiency. Arun Ghosh traces the historical evolution of government policies on small scale industries and tries to focus on factors which have acted as a constraint to their growth. He concludes that inadequacy of demand is the single most important factor. Dipak Mazumdar's analysis of government policy towards the SSI is centred around the textile industry. According to him, government's policy has inhibited the growth of this industry, specially in the mill sector.

This volume, as can be seen, covers a vast number of questions regarding the role of small scale industries in economic development and the policy that the government can adopt towards their growth. Some authors have done intensive study and made a great contribution in this field. As such this volume is of immense value to researchers in this field, industrial economists and policy formulators, and gives an indepth insight into the issues connected with the growth of the small scale sector.

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'MANAGEMENT PERSPECTIVE ON SALES FORCE DEVELOPMENT', By Davinder K Vaid, Commonwealth Publishers, 1987, 239 pp, Price Rs. 175/-

The process of field sales force development which is concerned with imporving the performance of the sales personnel in a systematic manner, is becoming increasingly important in the pharmaceutical industry, where the personal selling is the key element in the promotion mix. The auther has presented a comprehensive view of the present practices with regard to selection, training, compensation and motivation in certain selected companies in the pharmaceutical industry. The study examines to what extent the field sales personnel feel satisfied with the present practices in their respective organisations. The author in this book has introduced a concept of 'Devetopment Index' to analyse the impact of sales force development on the sales performance of an organisation.

The author has, while discussing selection, training, compensation and motivation, broken each of these factors into small modules and has at each level, included the medical representatives' view point along with those of the management and has, thus, brought into sharp focus the differences in their respective perceptions regarding the present management practices. These findings have been illustrated in the form of tables for easy comprehension and understanding. However; the impact of the organization has been dealt to some extent only in the chapters on compensation and motivation. While elaborating motivation, the author has carried out an indepth analysis of different need factors which influence the behaviour of the salesmen-need fulfilment and satisfaction. Though the difference between 'need

fulfilment' and 'need satisfaction' has not been vividly brought out the aspects of identification of different needs factors and their importance have been given a detailed treatment. The analysis of these two aspects reveals the facts which are important for the practitioners in the present context for desiging, selection, training, compensation and motivation programmes.

As a logical step to the discussion in the book, the author has developed a 'Development Index' to present an integrated analysis of the results to measure the level of devolopment of the sales force in the organisation and relate it to the sales performance of the organisation. To do this, the author has isolated the factors that are expected to influence the level of development. He has, however not adequately covered the compensation factor. Though the author has considered the effect of each individual factor on the sales performance in the second part of this chapter and has concluded the relative importance of some factors being more important than the others, he has not expounded the weightage of those factors while calculating the average value of the level of development in the first part of this chapter. The author, with help of the 'development Index' and relationship between the different factors of development and sales performance' provides a useful framework for designing the sclection, training, compensation and motivation programmes, which will help to improve the sales performance of an organisation. It is the distinguishing feature of the book, as it provides the guidelines to the practitioners for estimating the level of development in their respective organisations and for making efforts at improving upon it.

The practical usefulness of the recommendations made by the author can hardly be exaggerated for he has tried to incorporate the perceptions of MRs, who form the salesforce, that is to be developed. However the recommendations are broad in their nature. For example, the author talks about making the job contents more challenging without hinting the defferent ways of doing it under different situations.

On the whole the book is a good attempt wherein all the four major aspects of salesforce development viz. selection, training, compensation and motivation have been studied and analysed in detail. While dealing with the concept of development index, the author has well conceived the concept and has given a good idea to the practitioners regarding the relationship between the level of development and sales performance. The book is useful and directional for the practitioners, researchers and students of sales management.

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BOOKS IN BRIEF

Productivity, Vol. 29, No. 2, July-September 1988, 221-224

Agricultural Research Systems and Management in the 21st Century

By K.V. Raman, M.M. Anwer and R.G. Gaddoginath. Hyderabad, National Academy of Agricultural Research, 1988, 212p, Rs. 150.

This is a collection of papers presented at an International Seminar on "Agricultural Research Systems and Management in the 21st Century". The papers are presented in four different sections :

(i) Prejecting the future demand of food and fibre for the 21st century.

(ii) Developing technological innovation to meet the challenges of the 21st century.

(iii) Reviewing the current agricultural research and educational systems in the century.

(iv) Developing appropriate national agricultural research systems to meet the need of the 21st century.

The publication may be useful to all those scientists working in the area of organisational structure in the Indian agriculture.

American Business : A Two-Minute Warning

By C. Jackson Grayson Jr. and Charle O'Dell. New York, Free Press, 1988, 368 p, $24.95.

A ten-part "Agenda for Adjustment" is presented to revive American Productivity, and bolster the quality of American products and services. Case studies examine how hundreds of companies are responding to the competitive challenge. Recommendations for improvements in areas from operating systems and organization structures to employment stability and compensation systems are made.

Banks and Customers—A Behavioural Analysis

By Sushila Singhal. New Delhi, Shri Ram Centre, 1988, 234p, Rs. 125.

The book aims at the systematic analysis of the job behaviour of bank employees and the customer service by drawing on the managerial and socio-psychological perspectives. It makes a commendable effort in offering specific insights into the nature of the problem and generate issues which may have far reaching implications for the banking industry as a whole.

Capital Formation and Output in the Third World

By V.R. Panchamukhi. New Delhi, Research & Information System (RIS), 1988, 100p, Rs. 100.

This book presents some issues of vital interest to our economic and financial administrators, e.g. relationship between public and private sactor and also sectoral levels of capital output ratio. The nature of tradeoff between current consumption and investment has been analysed for select countries.

Computer Based Information Systems

By D. Walker. Oxford, Pergamon Press, 1988, 384p.

This book is an introductory study of computer

based information systems. The author's emphasis is upon actual and practical applications, rather than hardware and programming—and this emphasis brings to life the complex and previously confusing fields.

Essential Guide to dBase III + in Libraries

By Karl Beiser. London, Meckler Ltd. 1987, 276p, £19.50.

With dBase III new readily available to many libraries, the instruction of the updated version, d Base III +, makes general purpose data manipulation easier and more efficient. It is a marvelous tool for all those concerned with data base management. This book demonstrates the concepts involved for those interested in applying the facilities of dBase III + to the real life and often frustrating, demands of libraries.

Entrepreneurship Development Under Trysem

By Anuradha Prasad. 1988, 171p Rs. 25.

Training of Rural Youth for Self-Employment (TRYSEM) is an anti-poverty programme of the Government of India primarily meant to develop entrepreneurship among the rural youth. In this study, TRYSEM is viewed in the context of the specific needs, limitations and aspirations of the rural youth. The case studies reported by the author vividly demonstrate the cumbersome precedures and inflexible action-orientation of the programme and the way this effects the final objective i.e. developing entrepreneurship in rural areas.

Generating Technological Innovation

By Edward B. Roberts. New York, Oxford Univ. Press 1988, $18.95.

Technology management has been universally recognized as a key element in nearly all industries, encompassing concerns for effective product and process design, development, and implementation. Here are 16 invaluable articles on the subject including "Has a Customer already Developed Your Next Product" ? "Enterpreneurs, Champions, and Technological Innovation", "Government Intervention and Innovation in Industry," and "Staffing the Innovative Technology-Based Organization."

Human Resource Development : The Indian Experience

By D.M. Silvers. New Delhi, News India Publications 1988, 196p, Rs. 200.

The book presents a broad spectrum of theortical and conceptual developments in the field of HRD in India and abroad. It reviews the overall man management science in the country and presents studies of companies which have been chosen on the strength of their excellent HRD practices and their overall success. The companies include : Hindustan Lever, SAIL, TISCO, BHEL, Larsen and Toubro, ITC, Crompton Greaves, Taj Group, Maruti Udyog, NTPC, HDFC, IAAI, Voltas, Indian Airlines, Neyveli Lingnite, Petrofils etc.

Human Resource Development and Productivity: New Perspectives

By G.K. Suri, New Delhi, National Productivity Council, 1988, 203p, Rs. 75.

This book deliberates on a few critical areas of human resource management and development in the Indian context with special reference to productivity, related to creation of climate, motivation and reward pattern, employee's influence on managerial decision, work-ethic and commitment, technology management and organising for productivity. It is a useful reference material for those who are concerned with productivity and human resource management.

Management of Economic Development, New Horizons

By Ram Prakash. New Delhi, Criterion Publications, 1987, 211p, Rs 150.

This book is based on the talks delivered and discussions at the top level training seminar on "Management of Economic Development : New Horizons" held during April 11-14, 1983 at New Delhi. It

contains expositions on several significant current policy issues as well as suggestions of practical utility for development planning. It also contains Statistical Tables containing selected basic information on economic development.

Managing New Products

By Thomas D. Kuchzmarski. Englewood Cliffs, Prentice Hall, 1988, 304p, $24.95.

Success patterns of new product launches are presented through a description of the ten key success factors, a technique for conducting a diagnostic audit, the development of a new product strategy, and the management of the new product process. The motivation of new product superachievers is described, and the role of new global products in future competition is outlined.

Optimal Expenditure on Social Services in India

By P.N. Mishra. Delhi, B.R. Publishing Corpn. 1988, 197p, Rs. 125.

This book is on public expenditure policy. The approach illustrated in the text resolves several problems faced in the implementation of zero-base budgeting. The approach not only provides a way to multi-level planning and expenditure decisions but made such decisions compatible to the needs of constituent micro regional economics.

Planning Strategies That Work

By Arnoldo C. Hax. New York, Oxford University Press, 1988, $18.95.

Many organizations are in dire need of guidance on how to build strong strategies and plans for the future. The 12 articles in this book provide an integrative, up-to-date perspective of strategic planning from a practicing manager's point of view and include "The Leadership Challenge—A Call for the Transformational Leader," "What Does 'Product Quality Really Mean ?", "Information Technology : A New Competitive Weapon," and "Strategic Management in Multinational Companies."

Productivity, Innovation, Management and Development

By P.N. Rastogi. New Delhi, Sage Publications, 1988, 263p, Rs. 185.

This book attempts to answer a number of important questions relating to productivity, innovation and management systems. Some of these are ; What causes productivity differentials across enterprises and nations ? How have some countries, which lack natural resources, been able to dominate global markets ? Why are most organisations in the poor nations chronically beset with inefficiency, in effectiveness and corruption ? What role do values and vision play in the productivity of individuals, organisations and nations ? The author explores the phenomenon of productivity and innovation in depth and elucidates its close linkage with management.

The Art of Managing Human Resources

By Edger H. Schein. New York, Oxford University Press, 1988, $ 18.95.

In today's fast-paced business world, managing organizational change and culture has become an urgent matter for managers who want to build stable organizations. In 15 articles ranging from "The problem of Moral Education for the Business Manager" to "Does Japanese Management Style Have a Message for American Managers ?," this book probes the complex and elusive issues surrounding human resource management from both a historical and a practical perspective.

The Just—In Time Breakthrough : Implementing the New Manufacturing Basics

By Edward J. Hay. New York, John Wiley, 1988, 227p, $24.95.

The volume deals with management issues as well as the technical concerns involved in the implementation of JIT. An approach to creating the organizational climate favourable to the introduction of JIT is presented. Examples of successful installations at Hewlett-Packard and other companies are offered.

The New Unionism : Employee Involvement in the Changing Corporation

By Charles C. Heckscher. New York, Basic Books 1988, 302p, $22.95

The experiments in both union and non-union settings now under way to increase employee representation are described. The author argues for a new system of "Associational Unionism" that offers representation to a broader range of groups. He also favours a more decentralized and flexible system of collective bargaining.

The Strategic Use of Information Technology

By Stuart E. Madnic. New York, Oxford University Press 1988, $18.95.

The 12 articles here go beyond the usual superficial anecdotes to show managers how to better plan for the strategic use of information technology, thus enabling them to seize the advantage in an increasingly competitive business environment. Among the articles are "The Changing Role of the Information Systems Executive : A Critical Success Factors Perspective," "Engaging Top Management in Information Technology," and "Management Policies and Procedures Needed for Effective Computer Security."

Trigger Points : Now to Make Decisions Three Times Faster, Innovative Smarter, and Beat your Competition by Ten Per cent (T Aint Easy).

By Michael J. Kami. New Delhi, Tata McGraw-Hill, 1988, Rs. 322.

The book provides the chart that top executives need to map their courses over the next five years and beyond. The book tells you how to position the business for fiexibility and trigger—fast responses to changes that will result in a dramatic increase in profits and protect against unexpected downslides. It contains 12 absorbing case studies on winning and losing strategies concerning corporate leaders such as IBM, SONY, Eastman, Kodak, Procter & Gamble, Hasbso, Commodors, Harley-Davidson etc.

Women and Information Technology

By Marityn J. Davidson and Cary L. Cooper. New York, John Wiley, 1988, 283p, $57.95.

This is a collection of readings focusing on the impact of technology on women at work. A variety of perspectives is included covering Europe, the United States, and an overall international view. Information technology is examined for its cross-cultural effects, its effects on women in industry, and the psychological impact.

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