# Management of Technovation

**P.N. Rastogi**

*Technological innovation is the basis of industrial strength and economic advancement of nations. It is however, a complex, messy, disorderly, and uncertain process. Its management is as difficult and problematic as it is crucial. This paper discusses the requirements of organization culture, managerial style and practices, critical functions and organization structure, managerial policies, and venture business approach in this context.*

*P.N. Rastogi is a Professor in the Deptt. of Humanities & Social Sciences at the Indian Institute of Technology, Kanpur.*

Industrial strength of nations and economic advance of human civilization depend on the creation of new and improved materials, products, processes, systems and services. Their creation originates from technological innovation or technovation. Technovation leads to a hyper-amplification of productivity, but differs from productivity. For any given technique or mode of production, limits on the growth of productivity are set by its technology base. Management efforts to increase productivity through improved labour force, economies of scale, structural reorganization, additional investment, better maintenance of equipment, and optimal scheduling cannot transcend the technological limitation of animal-driven carriages as a means of transport, of oil lamps as a means of illumination, or mud and grass as building materials. Economic advance, and growth of technology would cease in the absence of technovation.

Technology refers to a corpus of knowledge about techniques, and the embodiment of this knowledge in an operating physical system and process of production. Technovation is the process of advancement of knowledge, and the conversion of this advanced knowledge into creation of new and superior operating system(s) and process(es) of production.

The process of technological innovation is however, a complex, messy, disorderly, and uncertain process. Its arbitrary character arises from the exceedingly complex interfaces between changes in science and technology, and markets. Enterprises seeking to manage these shifting interfaces are as much the masters as the slaves of this change.

## Organizational Steering of Technovation

For the foregoing reasons, the management of technovation is exceedingly difficult. Its difficulty is exceeded only by its crucial importance. For the alternative to technovation is the stagnation, decay, and decline of enterprises, and of national economies. Its steering by organizations, requires a set of matching, concomitant, and facilitative conditions and arrangements. These conditions and

arrangements are vitally necessary for the effectiveness of efforts toward technovation but are not sufficient to assure their success owing to disorderly, arbitrary, and random nature of the process. Technovation is concerned with the creation of new and improved technology(ies); marginal and incremental improvements in products, processes, and systems though important do not come under this category. The conditions and arrangements for steering the process of innovation in enterprises may be specified as follows:

### I. Organizational Culture

In the absence of a strong organizational culture supportive of technovation endeavours, the process of technological innovation may not take off.

### II. Managerial Style and Practices

Managerial style and practices nurturant of creativity are necessary for sustaining and strengthening the innovative elan of organizations. They are a reflection and translation of the cultural values and beliefs of organizations.

### III. Critical Functions and Role Apparatus

Technovation effort requires the fulfilment of a set of critical functions. These functions are carried out by a cognate set of roles. The role of creative scientist/engineer is a basic one, but is only one of the several roles required in this context. These roles are conceptually distinct from the usual types of statuses and roles depicted in organization charts.

### IV. Managerial Policies

Technovation process is facilitated by a set of factors, and impeded by others. Managerial policies should be so designed as to strengthen the facilitating factors, and removing the impeding ones.

### V. Organizational Location of Technovation Business Unit

Successful consummation of technovation efforts generates new production and business activities. These new activities need to be aligned and separately located in an organizational setting. The location of new technovation-based business or venture unit may assume several forms and modes. The most appropriate ones among them need to be identified by the technovating organisations.

The items I to V, constitute an interrelated structure of technovation management. In what follows, these structural elements are briefly discussed one by one.

### Organizational Culture[1]

Culture refers to a set of values, dominant beliefs, and guiding norms, of a people. It denotes a set of important understandings or 'mental programmes' implicitly shared by members of a community. Culture of an organisation analogously refers to the shared values, norms, beliefs, and understandings of its members. The extent to which they are widely diffused and shared throughout the organisation, its culture serves to strengthen and integrate its strategy, policies, structure, operations and performance. A strong and integrative culture, provides the basis for the innovative elan and ethos of an organisation. A confused, dissonant, divisive and parochial value system on the other hand, is reflected in the form of internal disharmony, low productivity, poor work ethics, weak morale, and dismal performance.

The 'excellent' companies are obsessed by their concern for being the best in terms of quality, reliability, customer service and employee performance. Such a concern and obsession are diffused throughout these organisations. They find expression in the form of myths, legends, anecdotes, sense of pride, excitement and achievement orientation pervading the enterprises (Peters and Waterman, 1982). According to Khandwalla (1984), an innovative organisation requires for the successful implementation of innovations, a culture in the rank and file of achievement, innovation and knowledge-based decisions. Such a culture, according to him, is best built by management sharing with the rank and file, goals and mission of the organisation; opportunities and threats faced by the organisation, and its current operating problems; and by encouraging the rank and file to come up with suggestions and take initiative in solving problems.

Top managers of an innovative firm serve as exemplars and role model for the young. They inspire others through their achievement drive; through their creative, competent and knowledge-based approach towards persons and problems; and through their ability, dedication

[1] For a detailed discussion of the national and organisational cultures of productivity, see Rastogi (1988).

and hard work. Their role is crucial in the development and institutionalisation of organisational culture. Managers as leaders shape the content of organisational culture through their creation of symbols, ideologies, language, beliefs, rituals, and myths (Pettigrew, 1976). Organisations are viewed as "systems composed of ideas, the meaning of which must be managed" (Martin, 1980). Rich networks of legends and parables of all sorts pervade top performing institutions (Ibid). Adoption of an unique and inspiring mission by the organisation also serves to foster an innovative culture.

The specific content of the dominant beliefs (i.e., culture) of the 'excellent' companies includes just a few basic shared values as follows (Peters and Waterman, 1982):

(I) A belief in being the "best"

(II) A belief in the importance of the details of execution.

(III) A belief in the importance of people as individuals.

(IV) A belief in superior quality and service.

(V) A belief that most members of the organization should be innovators and its corollary, the willingness to support failure.

(VI) A belief in the importance of informality to enhance communication and

(VII) An explicit belief in and recognition of the importance of economic growth and profits.

The 'excellent' enterprises believe that a worker is capable of doing his best, that every product can be of highest quality, that service can and should be maintained at a high level for every customer and that a regular flow of useful products through innovation is possible. Their value-set focusses on informality and innovative problem solving in support of customers (Ibid). The ethos of culture here is primarily oriented towards economic objectives. It engenders a mobilization of the achievement orientation of enterprise personnel.

Management of an enterprise creates, sustains, and strengthens the organisational culture in the following ways:

* Creating, diffusing, and sharing a vision of organisation's mission and future.
* Communicating openly, clearly, and persuasively towards securing and sustaining shared perceptions and understanding.
* Providing an environment of supportive, and authentic interpersonal relationships.
* Exhorting and coaching towards high standards of achievement and performance.
* Praising and recognising accomplishments through symbols, rituals, and ceremonials.
* Resolving conflicts skillfully through its accumulated resources of mutual trust, goodwill, and respect.
* Tolerating failures, and praising dedicated work involved in the failed efforts.
* Balancing uncompromising standards and high expectations with sympathy, understanding and help.
* Reconciling creativity with resource constraints.
* Matching the breadth of vision with attention to details.

Organisational culture provides the benevolent ambience within which the technovative individuals are enabled to orchestrate the creative process by organising the flow of communication, resources, and cooperation around it. A strong and integrative culture supportive of inherent risk and failure associated with technovation, is the first and foremost condition for an organisation's effective steering of the process.

**Managerial Style and Practices**

Apart from a supportive culture, an innovation-oriented firm requires a distinctive managment style, and organisational practices that engender, sustain and reinforce the creativity in individuals, and of their work. Based on a number of researches in this area, a summary of their findings may be given as follows (Kao, 1989):

Managerial style and practices should

* Create an open, decentralised organisational structure.
* Support a culture which provides leverage for creative experimentation
* Encourage experimental attitudes
* Circulate success stories
* Emphasize the role of the champion
* Provide the freedom to fail

* Stress effective communication at all levels
* Make resources available for new initiatives
* Ensure that new ideas cannot be easily killed
* Remove bureaucracy from the resource allocation
* Provide appropriate financial and non-financial process rewards for success
* Ensure a corporate culture which support risk taking and questioning
* Minimize administrative interference
* Provide freedom from surveillance and evaluation
* Loosen dead lines
* Delegate responsibility for initiating new activity

And so on.

The foregoing requirements of managerial style and practices are vital for the effective pursuit of technological innovation. A number of more specific critical functions however, need to be provided for in this context.

### Critical Functions and Role apparatus

It is usual to think of technovation primarily in terms of the role and work of a single or a few creative scientists and/or engineers only. The role and work of creative scientists/engineers though of crucial and basic importance, however, forms only a part of the total picture. The primary role of creative scientists/engineers is to create, formulate, and develop new ideas, and they are usually interested in them for the sake of research challenges. Their creativity however, needs to be channelled along the directions of an organisation's strategy and market needs. Apart from generation of new ideas and concepts, other critical functions are the development, progress, translation into hardware, toning of hardware into yielding marketable product, process, or service, and commercialisation of innovative ideas.

For fulfilling the foregoing critical functions, the organisational structure must facilitate the flow of timely, adequate, and relevant, information about technology and market into its R and D segment. Strong linkages between R and D and marketing functions need to be built for easing the transition of technovation(s) into commercial success. Technical plans pertaining to innovation also need to be integrated into the organisation's strategy and strategic planning. These functions need to be fulfilled through a staffing pattern of the following role type (Project SAPPHO[2], 1974; Langrish et al., 1972; Roberts, 1977):

I **Creative Scientist/Engineer** : He, as mentioned earlier, is the source of creativity and technovative ideas and concepts within the organisation.

II **Entrepreneur** : He champions a techno-scientific activity, and for this reason is also referred to as a 'product champion'. His zeal and passion catalyze the development of a technovative idea towards commercial success. His role is to match the technology and the market. He understands the user's needs better. He strives to ensure adequate technical, production, marketing, materials/machines, and financial resources for the development and launching of technovation.

III **Project Manager** : He manages the specifics of R and D work, and coordinates them into a continuous technovation process. He monitors costs and progress of the project.

IV **Sponsor** : He is usually a senior manager, who helps provide, and oversees the continuity of organisational support for the technovation project(s). He also protects and defends the creative engineers and entrepreneurs in case of difficulties.

V **Technological Gatekeeper**: He brings essential technical and market information into the organisation. He may also engage in or make use of technological forecasting. He provides an information base for the identification of technovative ideas and projects. He is a vital transceiver of technical and marketing information.

VI **Production Engineer**: He helps R and D and design personnel on their procedures for design, use of certain materials, and the planning and implementation of production process. He oversees the hardware aspect of technovation and rectifies production deficiencies before the commencement of commercial marketing.

Each of these role types is required for technovation effectiveness in organizations. In large organisations, the number of incumbents in each of these roles, may be more than one. In small firms, however, one individual may combine more than one role in

[2] Project SAPPHO involved the comparative analysis of 22 successful and 22 unsuccessful innovations in the chemical process industry, and 21 successful and 21 unsuccessful innovations in the scientific instruments industry (Rothwell et al., 1974).

himself. The different role types require different types of individuals. Each type needs to be recruited, managed, evaluated, encouraged, and supported differently. All these role types entail technical qualifications and competence, but their role requirements are different from that of the creative scientist/engineer. Their critical functions need to be integrated into a single operating entity.

Organisation structures for facilitating innovation are characterized by the following attributes of their communication systems (Peters, and Waterman, 1982):

(1) Communication systems are largely informal.

(2) Communication intensity is extraordinary.

(3) Communication is given physical support (blackboards, conference rooms for lunch meetings, stationary for use during discussions and demonstrations, display devices, and so on).

(4) Forcing devices/ mechanisms are widely utilized. These refer to various forms and modes for encouraging the innovative elan of their people by the excellent companies[3].

(5) The intense and informal communication systems act as a remarkably tight control system for innovative projects. Open and frequent discussions about how things are going, provide truly tight controls.

(6) Formal documentation in the form of reports, memos, records and compliance with procedures is scant. One page memos/summaries are the rule.

The 'intense and informal' communication is a primary characteristic of small groups only. Innovation teams/groups/task forces/skunkworks' are thence purposefully kept small in the 'excellent' companies. Such small task groups have been found to be regularly more innovative than fully equipped R and D and engineering groups with casts of hundreds. 'Excellent' companies promote internal competition between various small teams working on the same thing. They tolerate duplication and overlap of efforts in their new product development work. They encourage myriads of tiny task forces to engage in experimentation and learning from mistakes. Chances of achieving a break through are higher when small dedicated groups work independently on a given task and share their information and experience. Often 'chunking' i.e., breaking things up into small manageable units is resorted to in a purposive manner. In R and D work, beyond a small group size of 10 persons, diseconomies of scale are seen to set in.

In conventional estimates of scale economies, transaction costs' are often vastly under-estimated (Williamson, 1975). Transaction costs refer to the costs of communication, coordination, and decision making. With an arithmetic growth in the number of persons in a group, the requirements of interpersonal interaction and communication to get tasks done, increase in the geometric progression. Higher load of coordinating many more factors in a large group, increases the costs of coordination so much that the technologically determined economies of scale become diseconomies. Action oriented small groups engaged in innovation efforts are variously known as, 'product champions, teams, task forces, 'czars project centers, skunk works', bureaucracy busters' etc., in the American companies. Quality circles and employees' voluntary management teams in Japan also come under the same category. Besides their small size and intimate pattern of cooperation, they have another thing in common. They are never shown as parts of the organisation's formal structures and charts. But they help the enterprises remain flexible and fluid.

**Managerial Policies**

In the context of effective implementation of technovation efforts, the managerial policies need to focus specifically on the factors that impede or facilitate the process. Impeding factors should be overcome and facilitating factors promoted as the policy objectives. In what follows both the impeding and the facilitative factors are outlined one by one. The impeding factors termed as seven 'bureaucratic barriers' by Quinn (1985) may be listed as below.

*Factors Impeding Technovation*

(i) Top management's isolation from the factory floor and customers inhibits their thinking about technological innovation.

[3] IBM for example runs a 'fellow programme whereby dreamers, heretics, gadflies, mavericks and geniuses' are given virtually a free rein upto five years for their working on their notions, concepts and ideas. The role of a fellow is 'to shake up the system' Texas Instruments provides support to innovation through their Individual Contributor program. 3 M company does the same through its New Business Ventures Division. Harrison and United Technologies give numerous awards for excellence in inter-divisional technology transfer. Bechtel company urges that every project manager spends fully 20 percent of his time experimenting with new technologies. General Electric provides "toyshop" (a facility in which insiders could view/rent robots) to spur their move into the "factory of the future". Data-point organisation has installed "Technology Centers" for the same purpose. People from disparate disciplines get together in these centers for innovative endeavours. All the foregoing forms and modes are 'forcing devices' for promoting innovation into the organisations (Peters and Waterman, 1982).

(ii) large companies are often unreceptive to and intolerant of individuals who display a strong commitment to their ideas and concepts of innovation.

(iii) Short time horizons linked to profitable performance, provide another corporate disincentive. Managers' perceived need to report a continuous stream of quarterly profits conflicts with the long time spans that major innovations normally require.

(iv) Accounting practices of the firms assess all its direct, indirect, overhead, overtime and service costs against a project. These practices result in a display of much higher development expenditure as compared with the lone entrepreneurs working in very austere conditions. Perceptions of high development expenditure in absence of any tangible results over relatively short time span, create bias against R and D project(s).

(v) Excessive rationalism of the management provides another barrier. Managers seek orderly advance through early market research or planning in terms of Program Evaluation and Review Technique (PERT). Managing the inevitable uncertainties, and disorderly nature of the innovations, is difficult for them.

(vi) Excessive bureaucratic structures and controls lead to many time consuming procedures and requirements of approvals. They cause delays and frustrations.

(vii) Inappropriate incentives for the inventors and innovators serve as another barrier. When managerial control system neither penalizes the opportunities missed, nor rewards the risks taken, the results are predictable. They weaken the innovative elan of individuals and the organisation.

Besides the foregoing 'bureaucratic barriers', a number of other contingent and policy factors, also impede the successful consummation of innovation efforts. These factors may be outlined as follows:

(a) Constraints of communication between the R and D personnel and the operations personnel increase the difficulties of managing the technovation programs. Research scientists and engineers are often unable or unwilling to communicate their ideas in terms of the perspective and understanding of the operations personnel.

(b) Entrenched ideas and vested interests in the organisation, may lead to devaluation and neglect of technovation opportunities and/or projects.

(c) Rigidity and complexity of the market on the one hand, and the number, strengths, and actions of the competitors, on the other, may adversely affect the evaluation of potential benefits of the innovation(s).

(d) Competitive, legal, and government restrictions, may constrain a firm's access to and use of relevant technologies.

(e) Incapacity and/or inflexibility of the suppliers of machines, materials, equipment and parts, may retard the progress of R and D projects.

(f) Opposition of the labour unions to development and change may prove to be another source of difficulty.

(g) The commercial production phase of innovation development may be constrained by lack of adequate investment resources.

(h) No single social actor (government, policy makers, business managers, research scientists, and engineers, consumers, and workers) by itself can promote technovation, but any of them can impede it.

These eight factors along with the seven 'bureaucratic barriers' identified by Quinn are not meant to be an exhaustive enumeration of impediments to innovation. They only serve to indicate the variety of ways in which, the technovative efforts of enterprises may fail.

**Facilitating Factors of Technovation**

Factors facilitating the successful management of technovation in industrial enterprises have also been identified. Entrepreneurial spirit, vision, and approach are deemed to be indispensable in this context. (Drucker, 1985; Stevension and Gumpert, 1985; Quinn, 1985; among others). The facilitating factors may be enumerated as follows. They have been in fact referred to earlier also.

(i) High commitment of the apex level executives to innovation effort is absolutely vital for its successful consummation. This commitment is reflected in their management of the companys value system and creation of a supportive atmosphere for innovative activity.

(ii) Innovation effort must be oriented towards the market. For this purpose, mechanisms need to be evolved for ensuring interactions between technical and marketing personnel at lower levels.

(iii) Project teams should be small. Six to seven key persons seem to constitute a critical mass of skills while fostering intense and informal communication among team members.

(iv) Innovative enterprises move faster from paper studies to physical testing. When possible, they also encourage several prototype programs to proceed in parallel. Multiple approaches to R and D work are more promising than a single line of work.

(v) When plural competitive approaches reach the proto-type stages, their developmental testing under comparable conditions is necessary for comparable evaluation.

(vi) Diagnosis and solution of emerging technical problems are accomplished in a non-bureaucratic manner. Small teams of engineers, technicians, designers and model makers, are placed together with no intervening organisational and physical barriers to develop a new product from idea to commercial prototype stages. In innovative Japanese companies, top managers often work hand in hand on projects with young engineers.

(vii) Multiple outside sources of technology and information are tapped and interactive learning from academic and semi-academic channels is promoted.

Apart from the foregoing policy requirements for fostering technovation, major policy issues concern the organisational location of a new technovation business unit.

**Organisational Location of Technovation Unit**

Translation of a new technovative idea/ concept into commercial production, requires an organisational location where the activities of the new business may be carried out. The organisation or business unit is the vehicle for implementing the new technovation-based production process and leading it through from financing to marketing and sales.

A plurality of organisational arrangements referred to as 'new venture approaches' has emerged in this context. They may be briefly outlined as follows (Rothwell, 1975; Rothwell and Zegveld, 1982; among others):

I The organisation may retain its present form and encourage the technovators and entrepreneurs within its existing framework. Technovation effort may have multiple sponsors. Entrepreneur's own department may help him in terms of its plans to diversify into new areas. Or, the central research unit of a firm may sponsor a new venture. A firm's new business department may also support a new technovation venture. Depending on the success of technovation project, a new product team or venture group may be formed early. It may contain personnel from research and development, technical, production, finance, and marketing departments. The team members take a risk; in case of the venture's possible failure, they would return to their original departments losing their seniority.

II The technovation idea and the entrepreneur(s) originate in a firm's R and D laboratory, but the firm funds the new venture outside its traditional areas of interest. This approach is relatively simple to administer, since it requires only the firm's commitment of funds.

III The firm provides not only the funds, but also marketing, production, distribution and R and D support to the new venture. A relatively high level of the firm's involvement in the new venture, may given rise to problems of autonomy and policy differences.

IV The firm provides only some of the capital required by a new venture created out of technovation concept originating in its own R and D laboratory. The entrepreneurs and outside interests provide the remaining requirement of resources. This arrangement leads to a wider sharing of risk.

V Another arrangement involves a large firm/small firm tie up. The large firm provides finance as well as access to its production and marketing facilities if needed. The small firm provides technology and entrepreneurship.

VI A more common approach is to set up a new venture operation within the existing firm itself in order to benefit fully from the potential of a technovation. This approach involves the formation of a new department or a new product group within a division. The new unit may be staffed by a multi-disciplinary team and provided with a separate budget.

A firm may adopt one or more of the above new venture approaches depending on its size, current range of products, internal R and D capabilities, technological infra-structure, and future plans.

**Basic Premises of Technovation Management**

Management of technovation demands leadership and ingenuity of a high order. More than that, it involves

cultivation of a coherent mental set or world-view. The latter comprises a dynamic picture of the inter relationships between environmental and technological shifts, production apparatus and human motivation, consumer needs, and social concerns. The premises entering into the formation of such a world-view may be outlined as under (Moss, 1985; Rastogi, 1988):

(1) Concept of planning as a road map to the future, with a carefully laid out set of step and time tables is usually not applicable to real life strategies for technovation management. Instead, progress is often marked by the ability to respond quickly to unexpected opportunities, or to change directions quickly when unexpected obstacles or changes in external conditions are encountered. Planning system in the context of technovation should serve as an internal communication and sensory feedback mechanism i.e., as a way of allowing individuals and subunits of organisations to lay out and compare goals, perceptions of threats and opportunities, and ideas of strategies, as they are understood at a given point in time. It also becomes a system of gathering information on how these perceptions change over time, and of bringing that information into a continually adjusting strategy-forming process.

(2) Need for openness and honesty in internal communication, in the context of planning system as an information processing and feedback system, is far more important than conventional concerns for accuracy in seeing the future, or the mechanics of setting goals, or measuring their fulfilment.

(3) Keeping the planning system, plan, and planners, close to the concern of consumers of the product is a major requirement for success in technovation. Case histories across nations confirm this inference.

(4) Participating planning or building stake-holding on the part of employees is also crucial. In order to fully commit their energy to the goals of an organisation, individuals must not only be aware of plans and assumptions, but also feel a personal sense of satisfaction in meeting the goals and achieving organisation success. Building stake-holding involves sharing ideas and concerns with other members of a group.

(5) Technovation management requires that a research group have a delicate balance of independently creative scientific minds, and members who are able to interact with the needs of a larger organisation, drawing needed infomation in, and being able to effectively communicate it outward. A close linkage between organization's strategy and technical activities is also essential in this context.

(6) The conceptual steps from basic research results to advanced development application, manufacturing, and marketing, are complex and rich in human social interactions and need detailed attention.

(7) Human factors should be the first consideration in management of planning and organisational strategies before other so-called functional needs are considered. Goals of innovation and productivity must be wisely combined with the goals of human satisfaction and personal fulfilment. With the sense of stake-holding, individual or local ingenuity can take over to compensate for many failings in the management system or for resource lacks. Without it, even the best designed and supplied system is likely to perform sub-optimally.

(8) Multiplicity of barriers and check points on decisions are inhibiting forces in technovation. Systematic dismantling of such barriers should be a continuous process of management. Given lack of barriers and disincentives, humans tend naturally towards innovative behaviour. Often the most important element of innovation management is to remove these barriers and disincentives.

(9) For effective reward systems, for creation of goal identity and stake-holding, for understanding consumer pressures, and in almost every area of management, the maintenance of open communication is essential to the performance of the system. The organisation risks losing part of its sensory apparatus and blinding itself to important realities if its measures provide disincentives or inhibit effective and honest communication.

(10) Closely linked to the need for an open communication is the growing stress on team-building as a vital aspect of management for technovation. Openly communicating teams can be much more creative and effective than individuals in certain situations.

(11) Technovation is based on the understanding that a certain amount of failure is a natural consequence of taking risks. Experimentation must be a part of

a healthy management style and practices for innovation.

(12) Training programmes for innovative behaviour often find that the real challenge is to uncover the natural sense of individual responsibility and creativity that has too often been discouraged.

(13) The new paradigm is that of humans as the key sensory and idea-generating components in a communication system, and group endeavour. It is one in which they derive stimulation, training for new and expanded skills, and a sense of pride and personal satisfaction. It has not only been shown to be more effective in meeting the goals of productivity and innovation, but will be much more natural and satisfying t0 implement. This new paradigm brings the promise of an industrial management strategy which emphasizes the dignity and worth of each individual in society.

(14) The importance of organisational cultures in the context of developing and maintaining the innovative elan of the enterprises, is considerable. Dedicated and visionary leadership provided by the top management, helps build and sustain organisational cultures of innovation, achievement, and excellence.

Management of technovation is a highly complex, large, difficult, and demanding task. But its essence may be summarized simply: Create a work environment which evokes the exercise of human creativity and translates it into new and improved products, processes, services, and systems for use by men.

## REFERENCES


**Drucker, P.,** 'The Discipline of Innovation', Harvard Business Review, May-June, 1985.

**Kao, J.,** Entrepreneurship, Creativity and Organization, Prentice Hall, N.J., 1989.

**Khandwalla, P.,** Fourth Eye-Excellence through Creativity, A.H. Wheeler, Allahabad, 1984.

**Langrish, J.,** *et al,* Wealth from Knowledge, Macmillan, London, 1972,

**Martin, J.,** Stories and Scripts in Organizational Settings, Research Report No. 543, Graduate School of Business, Stanford University, 1980.

**Moss, T.,** Innovation Management in Developing Countries, UNIDO, Vienna, 1985.

**Peters, I., and Waterman, R.,** In Search of Excellence, Harper and Row, New York, 1982.

**Pettigrew, A.,** 'The Creation of Organization Cultures', Mimeo, 1976.

**Quinn, J.,** 'Managing Innovation : Controlled Chaos', Harvard Business Review, May-June, 1985.

**Rastogi, P.N.,** Productivity, Innovation, Management and Development, Sage Publications, New Delhi, 1988.

**Roberts, E.,** 'Generating Effective Corporate Innovation, Technology Review, Vol. 80, No. 1, 1977.

**Rothwell, R.,** *et al* 'SAPPHO Updated : Project SAPPHO Phase II', Research Policy, No. 3, 1974.

**Rothwell, R.,** 'From Invention to New Business via the New Venture Approach', Management Decision, Vol. 13, No. 1, 1975.

**Rothwell, R., and Zegveld, W.** Innovation and the Small and Medium Sized Firm, Frances Pinter, London, 1982.

**Stevension, H., and Gumpert, D.,** 'The Heart of Entrepreneurship' Harvard Business Review, March-April, 1985.


□

| | |
|---|---|
| **"A company cannot increase its productivity. People can."** | **"The only certainty is nothing is certain".** |
| *—Robert-Half* | *—Pliny the Elder* |

# A Fuzzy Decision Approach to Financial Ratio Analysis

**Shirin Rathore & K. Latha**

*The formal decision models based on a crisp classification of states or 'Correct' or 'Incorrect' are likely to result in less than optimal solutions. Such models are not capable of dealing with imprecision either. Fuzzy Set Theory is an attempt to provide an instrument for processing a type of imprecision that stems when the boundaries of classes under consideration are not sharply defined. In this paper the authors formulate two decision making models ; one for a situation when the states are fuzzy and the out comes are crisp and the second when outcomes as well as states are fuzzy. The application of these models has been demonstrated through the example of a liquidity decision, although they can be extended to other ratios also.*

*Shirin Rathore is a Reader in the Department of Commerce, University of Delhi, Delhi - 110007. K. Latha is a Lecturer in Deshbandhu (Evening) College, University of Delhi, Kalkaji, New Delhi - 110019.*

Use of financial ratios by conventional ratio analysis practises as inputs for formal decision making is beset with several limitations which seriously impair the utility of ratios as instruments of management decision making and control. Conventionally, ratio analysis focuses on comparing a given ratio with a certain standard. States of nature are inferred by comparing the variation between this standard value and actual value. Often the mean ratio of the industry is considered the ideal ratio or the standard of reference for making such comparisons. Firms tend to adjust their activities if it is observed that actual ratio is different from the 'ideal'. Empirical evidence also suggests that firms do modify their financial policies in the light of industry ratio (Lev, 1974). That is a comparison between the standard and the actual implies 'correction' of the behaviour so that the actual ratio is also the same as the standard ratio. Thus, like classical set theory, the traditional ratio analysis classifies the states of nature crisply into 'correct' or 'incorrect'. It does not admit of the possibility of a gradual transformation from 'correct' state to 'incorrect' state. For instance, generally the standard for quick ratio is 1:1, if the observed ratio of a firm exceeds the standard it is considered indicative of a poor cash management because a higher quick ratio implies a state of excess liquidity. Similarly, if the observed ratio happens to be less than 1:1, it also is considered indicative of a poor cash management because in this case, the lower ratio implies a state of under-liquidity. The formal decision models based on such a crisp classification of states are likely to result in less than optimal results. For, these models are distanced from reality that in actual practice managers interpret the information in an imprecise manner and often fail to define boundaries of states of nature sharply and precisely (Latha, 1990). If a manager is informed that the quick ratio of immediately preceding quarter is 1.4, he is quite likely to describe the state of cash position as 'good', 'poor', 'reasonably good' or 'very good'. Appending these objectives, implies that the manager is not classifying the states crisply. Here, the states are defined imprecisely and as such are fuzzy. The formal decision models based on

classical set theory are not capable of dealing with such imprecision. It is worth noting that in actual practice as illustrated above, the quantitative information given by the ratios is interpreted in verbal, linguistic terms. The literature on human information processing also shows that informational cues are interpreted by decision makers in linguistic terms (Zimmerman and Zysno, 1980). The classical decision models fail to incorporate such interpretation in linguistic terms formally and/or systematically. To the extent, these models do not take into consideration such interpretation their practical utility is reduced. Further, the interpretation of information is based on past experience as well as other relevant aspects that the interpreter may have. For example, the interpretation of quick ratio is quite likely to be influenced by such other information as say relationship with the commercial banks, possibility of realising bills receivables etc. Classical decision models fail to take this 'other relevant information' as inputs. Finally, classical decision models rely on historical data. As such, another limitation of these models arises from the *ex-post* nature of analysis i.e. there exists an implicit assumption of existence of certainty. In decision making contexts, one often does not know clearly and precisely the states of nature. One cannot always specify whether the state of nature is 'correct' or 'incorrect'. Moreover, it is difficult to talk about probability of being 'correct' or 'incorrect' also (i.e. uncertainty) because the probability distribution would itself emerge from previous historical data. There is only a possibility that a certain state of nature is implied by a given financial ratio (Latha, 1990). Therefore, possibility distribution rather than probability distribution appears to be of greater relevance for decision-making.

Thus, there is a need for an approach that may help overcome these limitations of conventional financial ratio analysis which also happen to be the weaknesses of classical decision models. Fuzzy Set Theory offers necessary tools for dealing with these problems.

## Fuzzy Set Theory

Fuzzy Set Theory is an attempt to provide an instrument of processing a type of imprecision that stems when the boundaries of classes under consideration are not sharply defined. The term fuzzy in the sense used here seems to have been first introduced by Zadeh (1962) in which he called for a mathematics of fuzzy or cloudy quantities not describable in terms of probability distributions. Technical exposition of such a mathematics now known as theory of fuzzy sets was made available three years later in Zadeh (1965).

Fuzziness is defined as that type of imprecision or vagueness that arises when one fails to define sharp boundaries of different classes. For instance, the classes like 'Companies with very low ROI', 'highly motivated employees' - are called FUZZY SETS and the membership of elements to these classes may not be all or nothing proposition or may not be either 'belongs to' or 'does not belong to' proposition; instead their membership may be a matter of 'degree'. Hence a fuzzy set can be viewed as a set in which transition from member to non-member is gradual and an element may have any grade of membership between, say, unit (full membership) and, say, zero (non-membership).

Consideration of graduality of progression from membership to non-membership implies that decision-maker considers various possibilities of a certain event. That is, he examines the possibility distibution of an event and not the probability distribution. In this sense, fuzzy set theory is different than the randomness. Moreover, such a consideration also allows subjectivity to be incorporated in the decision making paradigm. The ground rules for mathematical operations on fuzzy sets for decision making are given in Bellman and Zadeh (1970).

In recent years fuzzy theory has been used for various managerial applications like PERT method (Chanas and Kamburowski, 1981), investment problem (Tanaka, Okuda & Asai, 1976, 1979), personnel managemnet (Veethoven, 1977), security selection (Hammerbacher and Yager, 1981) and cost variances (Zebda, 1984). The present article demonstrates how fuzzy set theory can be used for financial ratio analysis.

## Fuzzy Decision Models

In the discussion that follows , two decision making models are presented. These models demonstrate how fuzzy set theory can be used to make financial ratio analysis based decisions. Model-1 is intended for a situation when the states are fuzzy and outcomes crisp. Model-2 deals with a situation when outcomes as well as states are fuzzy.

The application of these models has been demonstrated by taking the example of liquidity decision though the application can be extended to other financial ratios also. Liquidity and profits are two major problems in management today. Liquidity has been chosen for its relevance in management decisions and also because it allows concise and precise logic schemes and therefore the understanding will not be reduced by accounting conventions and rules on asset evaluation, allocation etc. For these reasons quick ratio can be considered as a liquidity decision tool.

**Model 1: Fuzzy States and Crisp Outcomes**

Inputs for this model are :-

(i) A (Alternative Actions)
(ii) S (States of Nature)
(iii) C (Pay offs)

and all except S are crisp. Also given are the ratios about financial position of an organisation that reveal fuzzy-data about S. It implies that at a period t (t = 1,... T) we obtain a set of ratios $R_t$ which makes S, a fuzzy set[1], $\tilde{S}_t$ i.e..

$$\tilde{S}_t = \left\{ s_i / \mu_{\tilde{S}_t}(s_i) \right\}_{\forall s_i \in S}^{i = 1 \ldots n} \quad (1)$$

and

$$\mu_{\tilde{S}_{R_t}}(s_i) = \text{'degree of compatability' of state } s_i \in S \text{ given by } R_t \quad (2)$$

Therefore, the decision-maker will have a pay off matrix as follows :

States of Nature

| | $s_1$ | $s_2$ | ..... | $s_n$ |
|---|---|---|---|---|
| | $\mu_{\tilde{S}_{R_t}}(s_1)$ | $\mu_{\tilde{S}_{R_t}}(s_2)$ | .... | $\mu_{\tilde{S}_{R_t}}(s_n)$ |
| $A_1$ | $C_{11}$ | ..... | | $C_{1n}$ |
| $A_2$ | $C_{21}$ | ..... | | $C_{2n}$ |
| . | . | | | . |
| . | . | | | . |
| Actions . | . | | | . |
| $A_m$ | $C_{m1}$ | ..... | | $C_{mn}$ |

(3)

To select an action from A, a number of a decision criteria can be used like :-

*(i)* ***Maximum Compatability Method***

In this method, the state with maximum degree of compatability is selected and in that an action with maximum benefit can be taken for a decision.

*(ii)* ***Method based on Support ($\tilde{S}$)***

The support set of $\tilde{S}$ will be a non-fuzzy set. For a suitable $\alpha$, a support of $\tilde{S}$ can be defined to eliminate those entries which are not a part of support of $\tilde{S}$. Then, we can use Maximax or Maximin principle or Hurwicz or the principle of Insufficient Reasoning. Using Maximax principle the decision space is defined by selecting maximum pay off of each action. Then, an action with maximum pay off in the decision space is selected. While using Maximin principle minimum pay off of each action is selected to define the decision space. An action with maximum pay off in the space is selected. In Hurwicz principle a Hurwicz co-efficient of pessimism is defined and a decision space is created by

$$D_h^* = h * \underset{j}{\text{Min}}\ C_{ij} + (1 - h) * \underset{j}{\text{Max}}\ C_{ij} \quad (4)$$

In the principle of Insufficient Reasoning for each $A_i$ pay off for decision space $D_{ir}^*$ is obtained by

$$\sum_{j=1}^{n} C_{ij} * 1/n \quad (5)$$

Then the action with maximum pay off is selected.

*(iii)* ***Expected Value Criterion***

It may be assumed that the degree of compatability represents the possibility of a state and a probability measure of state i can be derived as follows :

$$p(s_i) = \mu_{\tilde{S}_{R_t}}(s_i) \Big/ \sum_{i=1}^{n} \mu_{\tilde{S}_{R_t}}(s_i) \quad (6)$$

Expected Possible Value may be found using -

$$\sum_{j=1}^{n} C_{ij} * \mu_{\tilde{S}_{R_t}}(s_i) \Big/ \sum_{j=1}^{n} \mu_{\tilde{S}_{R_t}}(s_j), \quad i = 1, \ldots, m \quad (7)$$

Example : Consider following matrix

States

| | | $S_1$ | $S_2$ | $S_3$ |
|---|---|---|---|---|
| Actions | $A_1$ | 150 | 350 | 175 |
| | $A_2$ | 100 | 275 | 900 |
| | $A_3$ | 300 | 125 | 100 |
| | $A_4$ | 800 | 375 | 180 |

where

Fuzzy States
- $S_1$ = "not enough cash"
- $S_2$ = "cash is in control situation"
- $S_3$ = "over cash"

$A_1$ = Do nothing
$A_2$ = Purchase new raw material
$A_3$ = Ask for a short-term credit
$A_4$ = Negotiate with suppliers (increase cash)

Notice that these states $S_1$, $S_2$ and $S_3$ are fuzzy. Because the states of "not enough", "over" and "in control"

1 To make a distinction between a fuzzy set & a classical set '~' is used to show that it is a fuzzy set.

cannot be crisply defined. That is, we do not know exactly what do we mean by "not enough cash" or "over cash" or "cash in control".

Assume a quick ratio of 1.4 is obtained and the states $S_1$, $S_2$, $S_3$ are assigned degrees of compatability of 0.2, 0.8 & 0.7 respectively.

It gives the pay off matrix as :-

| States | $S_1$ | $S_2$ | $S_3$ |
|---|---|---|---|
| | 0.2 | 0.8 | 0.7 |
| $A_1$ | 150 | 350 | 175 |
| $A_2$ | 100 | 275 | 900 |
| $A_3$ | 300 | 125 | 100 |
| $A_4$ | 800 | 375 | 180 |

Using the criterion of maximum compatability our action will be $A_4$ because $S_2$ has maximum degree of compatability and in that $A_4$ gets maximum benefit.

Applying second criterion based on support for an assumed $\alpha = 0.5$, we obtain a reduced pay off matrix as given below :

| States / Actions | $S_2$ | $S_3$ |
|---|---|---|
| $A_1$ | 350 | 175 |
| $A_2$ | 275 | 900 |
| $A_3$ | 125 | 100 |
| $A_4$ | 375 | 180 |

Using Maximax, Minimax, Hurwicz and Insufficient Reasoning principles their respective decision spaces are obtained as shown below :

| | $D^*_{m\,max}$ | $D^*_{m\,min}$ | $D^*_h = 0.06$ | $D^*_{ir}$ |
|---|---|---|---|---|
| $A_1$ | 300 | 175 | 245 | 262.50 |
| $A_2$ | 900 | 275 | 525 | 587.50 |
| $A_3$ | 125 | 100 | 110 | 112.50 |
| $A_4$ | 375 | 180 | 258 | 277.50 |

Incidentally, in our example all four principles are suggesting the same action $A_2$.

If the third method of expected value criteria is used, given the possibility values of different states $S_1$, $S_2$, $S_3$ their probabilities $p(s_i)$ are found using (6)

$$P(s_1) = 0.2/0.2 + 0.8 + 0.7 = 2/17$$

$$p(s_2) = 0.8./0.2 + 0.8 + 0.7 = 8/17$$

$$p(s_3) = 0.7/0.2 + 0.8 + 0.7 = 7/17$$

Expected possible values are then calculated using (7) -

| | $S_1$ | $S_2$ | $S_3$ | |
|---|---|---|---|---|
| Possibility<br>Probability | 0.2<br>2/17 | 0.8<br>8/17 | 0.7<br>7/17 | Expected Possible Value |
| $A_1$ | 150 | 350 | 175 | 254.41 |
| $A_2$ | 100 | 275 | 800 | 511.76 |
| $A_3$ | 300 | 125 | 100 | 135.29 |
| $A_4$ | 800 | 375 | 180 | 344.70 |

The decision as per this method is $A_2$ because it has maximum expected possible value.

**Model 2: Fuzzy States & Fuzzy Outcomes :**

Inputs for this model are :-

- A (Alternative Actions)
- S (States of Nature)
- C (Pay offs)

in which A is crisp and S & C are fuzzy. To solve this model, the following methods are suggested :

*(i) Method 1*

In this method, an action $A_i$ is described by the associated returns $C_i$ (i=1,...m) and is perceived as $C_i = (C_{i1}$ & $s_1$ or $C_{i2}$ & $s_2$ or $C_{i3}$ & $s_3$ or ... or $C_{in}$ & $s_n)$ (8)

Using Min-operator for '&' and Max. operator for 'or', a decision space D may be defined as :-

$$D = \{A, C^*, \mu_A(C^*)\} \quad (9)$$

where

A = set of actions

$C^*$ = set of outcomes after '&' and 'or' operation for each action

$\mu_A(C^*)$ = set of degree of compatability of outcomes of $C^*$ for each Action.

$D^*$ may be one with maximum $\mu_A(C^*)$ or one may define a suitable $\alpha$ - set and then, pick up max. $C^*$.

To illustrate this method consider following decision matrix in which payoffs are described in linguistic terms as low (L), very low (VL) medium (M), high (H) and very high (VH):

| | $S_1$ | $S_2$ | $S_3$ |
|---|---|---|---|
| $A_1$ | L | H | L |
| $A_2$ | VL | M | VH |
| $A_3$ | H | L | VL |
| $A_4$ | VH | M | L |

(10)

For a given ratio, let compatability for S be defined as (0.4, 0.6, 0.7) and fuzzy outcomes translated as :-

| | Pay off Matrix | | | Resolution | |
|---|---|---|---|---|---|
| | $S_1$ 0.2 | $S_2$ 0.8 | $S_3$ 0.7 | $D^*$ | $D^*_{\alpha = 0.4}$ |
| $A_1$ | 150(.1) | 350(.4) | 175(.5) | 175(.5) | 175 |
| $A_2$ | 100(.1) | 275(.5) | 900(.6) | 900(.6) | 900 |
| $A_3$ | 300(.3) | 125(.8) | 100(.7) | 125(.8) | 125 |
| $A_4$ | 800(.5) | 375(.2) | 180(.2) | 375(.2) | - |

*(Figures in bracket are the degree of compatability of each pay off representing the value assigned to linguistic description)*

Using this method of selecting maximum degree of compatability, select $A_3$ Using $\alpha$ - set concept and $\alpha = 0.4$ (say) then select $A_2$.

*Method 2:*

In the previous method each pay off had only one compatability ratio, this method deals with a case when there are several levels of degree of compatability. This method may be used with any of the following three procedures :-

(i) choose an alternative which has the highest benefit irrespective of its membership grade;

(ii) choose an alternative with maximum membership grade irrespective of its amounts of benefits ;

(iii) choose an alternative keeping benefits & membership grades in consideration i.e. inter relate both the aspects, benefits as well as degree of membership.

Input requirements for this method are :-

- A (Alternative Actions)
- S (States of Nature)
- C (Pay offs)

in which A is crisp; S & C are fuzzy; S gets its membership depending upon the nature of liquidity ratios and for C, the membership degrees are predefined; S & C are given to decision-maker in the form of linguistic variables. Consider:

States

| | $S_1$ | $S_2$ | $S_3$ |
|---|---|---|---|
| $A_1$ | L | M | L |
| $A_2$ | VL | M | VH |
| $A_3$ | H | L | VL |
| $A_4$ | VH | M | L |

Compatability degrees of $S_1$, $S_2$ & $S_3$ are 0.4, 0.6, 0.7 respectively. To define C alongwith its compatability degree, we use -

$$C_i = \left\{ C_{ij}, \mu_{\tilde{S}_{R_t}}(s_i) \right\}$$

$$j = 1, \ldots . n$$

where $C_i$ represents payoffs with respect to $A_i$ (i = 1,..., m) and $\mu_{\tilde{S}_{R_t}}(s_i)$ represents compatability degrees of state $s_j$ (j = 1; ...n) defined by $R_t$. Also, if $C_{ij}$ appear several times with same or different grade of membership, then a reduction rule suggested by Jain (1977) may be used which states that if some x, say, X. appears L time with a grade of membership $\mu_1(x.)$, $\mu_2(x.)$, $\mu_3(x.)$,..., $\mu_L(x.)$ then, the grade of membership of X will be obtained using the reduction principle :

$$\mu(x.) = \mu_1(x.) + \mu_2(x.) + \ldots + \mu_L(x.). \qquad (12)$$

where

$$\mu_i(x.) + \mu_j(x.) = \left[\mu_i(x.) + \mu_j(x.)\right] - \left[\mu_i(x.)\, \mu_j(x.)\right]$$

Through (11) and (12) $C_{ij}$, $\forall$ i & j will get a degree of membership but still $C_{ij}$ is in a linguistic form. We now convert them into numeric values by using predefined functions for the linguistic variables and can define a new matrix $C_T$ (= C transformed) as follows :

$$C_T = \left\{ C_{ijT}\ \mu_{CT}\left(C_{ij}\right) \right\} \qquad (13)$$

$$\left.\begin{matrix} i = 1, \ldots, m \\ j = 1, \ldots, n \end{matrix}\right\} m \times n$$

where $C_{ijT}$ = a numeric value corresponding to a linguistic variable $C_{ij}$ and $\mu_{CT}(C_{ij}) = \mu_{\tilde{S}_{R_t}}(si)\ \wedge\ \mu_{Nc}(C_{ij})$ where $\wedge$ is a min-operator & $\mu_{Nc}(C_{ij})$ is the degree of compatability with a numeric value.

If there is a need, the reduction rule could be used .

If VL (= very low), L ( = low), M (= medium), H (= high) and VH (= very high) are defined as :-

VL = {(100,1.0), (200,0.3)}

L = {100, 0.6), (200,1), (300,0.4)}

M = {100, 0.1), (200,0.5), (500, 1.0), (600, 0.7), (700, 0.2)}

H = {(300, 0.5), (400, 0.7), (600, 0.8), (700, 1.0), (900, 0.2)}

VH = {(900, 0.70), (1000, 1)}

Using (11) we obtain C as follows :

$C_1$ = {(L, 0.4)@, (H, 0.6), (L, 0.7)@}

= {(L, 0.82), (H, 0.6)} (after using reduction principle)

@ Using reduction principle (12)

$\mu_c(L) = 0.4 + 0.7 - 0.4 \times 0.7 = 0.82$

$C_2$ = {(VL, 0.4), (M, 0.6), (VH, 0.7)}

$C_3$ = {(H, 0.4), (L, 0.6), (VL, 0.7)}

$C_4$ = {(VH, 0.4), (M, 0.6), (L, 0.7)}

Using (13) $C_T$ can be obtained as follows :

$C_{1T}$ = {(100, 0.6), (200, 1), (300, 0.4)/0.82 ; (300, 0.5), (400, 0.7), (600, 0.8), (700, 1), (900, 0.2)/0.60}

= {(100, 0.6), (200, 0.82), (300, 0.7)[$], (400, 0.6), (600, 0.6), (700, 0.6), (900, 0.2)}

$C_{2T}$ = {(100, 1.0), (200, 0.3)/0.4; (100, 0.1), (200, 0.5), (500, 1), (600, 0.7), (700, 0.2)/0.6 ; (900, 0.7), (1000,1)/0.7}

= {(100, 0.46)[$$], (200, 0.65), (500, 0.6), (600, 0.6), (700, 0.2), (900, 0.7), (1000, 0.7)}

$C_{3T}$ = {(300, 0.5), (400, 0.7), (600, 0.8), (700, 1.0), (900, 0.2)/0.4 ; (100, 0.6), (200, 1.0), (300, 0.4)/ 0.6 ; (100, 1.0), (200, 0.3)/0.7}

= {(100, 0.88), (200, 0.72), (300, 0.64), (400, 0.4), (600, 0.4), (700, 0.4), (900, 0.2)[$$$]

$C_{4T}$ = {(900, 0.7), (1000, 1)/0.4 ; (100, 0.1), (200, 0.5), (500,1), (600, 0.7), (700, 0.2)/0.6 ; (100, 0.6), (200, 1), (300, 0.4)/0.7}

= {(100, 0.64), (200, 0.85), (300, 0.4), (500, 0.6), (600, 0.6), (700, 0.2), (900, 0.4), (1000, 0.4)}

If a decision-maker wishes to consider only benefits, he may choose maximin or maximax rule. Using maximin rule, all actions become equally desirable as each results in 100. Using maximax, either $A_2$ or $A_4$ could be selected as each gives 1000 (maximax). But, if a decision-maker wishes to consider only degree of compatability, then highest of highest degree of compatability will be that of $A_3$ (i.e. 0.88).

But, if a decision-maker wishes to interrelate both (i.e. benefits & degree of compatability), a concept of maximizing set as suggested by Jain (1981) may be used. The maximizing set of a set, X, called M (X), is a fuzzy subset so that the grade of compatability of an element $x \in X$ in the set M(X) represents the degree reflecting that x approaches the supreme of X in any given case.

In our present model, X represents set of possible payoffs and

$$X = \bigcup_{i=1}^{m} S(C_{iT}) \qquad (14)$$

where S ($C_i$) is support of $C_i$ . Also, to define a maximizing set of all possible benefits, we invent a new matrix CM as follows:-

$$C_{iM} = \left\{ C_{ijT},\ \mu_{CM}(C_{ijT}) \right\} \forall J = 1, \ldots, n$$

where,

$$\mu_{CM}(C_{ijT}) = \left[ \left( C_{ijT} / C_{ijT\,(max)} \right) \right]^n \qquad (15)$$

$$C_{ijT\,(max)} = \text{Sup. } X$$

and n is a suitably defind parameter for an example.

$C_M$ utilises information about maximizing benefits and each element's degree of approaching maximum element and $C_T$ utilizes fuzzy degree of membership. To combine them, let

$$C_O = C_T \cap C_M = \left\{ C_{ijo},\ \mu_{C_o}(C_{ijo}) \right\} \qquad (16)$$

where

$$\mu_{C_o}(C_{ijo}) = \mu_{CT}(C_{ijT}) \wedge \mu_{CM}(C_{ijM})$$

Then, a fuzzy decision set (or space) is defined as :

$$D = \left\{ A_1,\ \mu_D(A_i) \right\} \qquad (17)$$

where

$$\mu_D(A_i) = \bigvee_k C_o(C_{ik})$$

Then, finally, the optimum decision $A^*_O$ is selected as one having maximum $\mu_D(A_i)$ i.e.

$$\mu_D(A^*_O) = \bigvee_i \mu_D(A_i) \qquad (18)$$

Using (14) and (15), for n=2 $C_M$ will be :

$C_{1M}$ = {(100, 0.01), (200, 0.04), (300, 0.09), (400, 0.16), (600, 0.36), (700, 0.49), (900, 0.81)}

$C_{2M}$ = {(100, 0.01), (200, 0.04), (500, 0.25), (600, 0.36), (700, 0.49), (900, 0.81), (1000, 0.1)}

$C_{3M}$ = {(100, 0.1), (200, 0.4), (300, 0.9), (400, 0.16), (600, 0.36), (700, 0.49), (900, 0.81)}

$C_{4M}$ = {(100, 0.01), (200, 0.4), (300, 0.9), (500, 0.25), (600, 0.36), (700, 0.49), (900, 0.81), (1000, 1.0)}

Where, possible payoff set

X = [100, 200, 300, 400, 500, 600, 700, 900, 1000] and sup. X = 1000.

Using (16) we obtain $C_o$ as

$C_{1O}$ = {(100, 0.01), (200, 0.04), (300, 0.09), (400, 0.16), (600, 0.36), (700, 0.49), (900, 0.2)}

---

[$] $\mu_1(300) = 0.4$; $\mu_2(300) = 0.5$; $\mu_{C_{1T}}(300) = (0.4 + 0.5) - (0.4 \times 0.5) = 0.7$

[$$] $\mu_1(100) = 0.4$; $\mu_2(100) = 0.1$ $\mu_{C_{2T}}(100) = (0.4 + 0.1) - (0.4 \times 0.1) = 0.5 - 0.04 = 0.46$

[$$$] After using reduction principle as per (12), illustrated in notes $ and $$ above

$C_{2O}$ = {(100, 0.01), (200, 0.04), (500, 0.25), (600, 0.36), (700, 0.20), (900, 0.7), (1000, 0.7)}

$C_{3O}$ = {(100, 0.01), (200, 0.04), (300, 0.09), (400, 0.16), (600, 0.36), (700, 0.4), (900, 0.2)}

$C_{4O}$ = {(100, 0.01), (200, 0.04), (300, 0.09), (500, 0.25), (600, 0.36), (700, 0.2), (900, 0.4), (1000, 0.4)}

Using equation (17)

$D = \{(A_1, 0.49), (A_2, 0.7), (A_3, 0.4), (A_4, 0.4)\}$

Therefore, $A^*_O$ i.e. optimal decision is $A_2$.

## Conclusion

The application of fuzzy set theory to financial ratio analysis is likely to help finance managers avoid problems beset with conventional ratio analysis. The fuzzy set theory permits the inclusion of subjective judgement in decision making process in a systematic way. Managers can use their past experience and complementary information to define degree of compatability, and thus introduce these factors in decision making formally. Besides, the apporach allows use of linguistic interpretation in decision process. Thus fuzzy set theory brings formal decision making closer to natural processes of human cognition. As such the decision making process becomes closer to reality and is likely to result in more efficient decisions. Moreover, it is possible to develop computerised decision support systems using fuzzy set theory, if managers find substantial uniformity in the nature of decisions taken by them.


## Acknowledgements :

The authors are thankful to Mr. C.P. Gupta of Shri Ram College of Commerce, University of Delhi for his useful comments on an earlier draft of this paper.


## REFERENCES


**Bellman, R.E. and Zadeh, L.A.** 'Decision-making in a Fuzzy Environment', Management Science 17 (1970).

**Chanas, S. and Kamburowski, J.** The use of Fuzzy Variables in PERT, Fuzzy Sets and Systems, 1981.

**Hammerbacher, J.M. and Yager, R.R.** The Personalization of Security Selection : An Application on Fuzzy Set Theory, Fuzzy Sets and Systems, 1981.

**Jain, R.** 'Analysis of Fuzzy Systems', In M. Gupta, G. Saridis and B. Gaines (Eds.) Fuzzy Automata and Decision Processes, North - Holland : New York. 1977.

**Jain, R.** 'Decision Making in the Presence of Fuzzy Variables', IEEE Transactions on Systems. Man and Cybernetics, 1981.

**Latha, K.** Fuzzy Set Thoery Approach to Financial Ratio Analysis. Unpublished M. Phil. Dissertation, University of Delhi 1990.

**Lev. B.** Financial Statement Analysis : A New Approach, Prentice Hall, Englwood Cliffs: NJ 1974.

**Tanaka, H., Okuda, T., and Asai, K.** 'Fuzzy Information and Decision in Statistical Model', In M. Gupta, R.K. Ragade and R.R. Yager (Eds.). Advance in Fuzzy Set Theory and Applications, North-Holland : Amsterdam : 1979.

**Tanaka, H., Okuda, T., and Asai, K.** A 'Formulation of Fuzzy Decision Problems and its Application to an Investment Problem', Cybernetics, 1976.

**Veethoven, G. Van.** 'Fuzzy Models in Personnel Management. In J. Rose and C. Bilciu (Eds.) Modern Trends in Cybernetics and Systems. Springer, Berlin and New York 1977.

**Zadeh, L.A.** From Circuit Theory to System Theory, Proceedings of the Institute of Radio Engineers, 1962.

**Zadeh, L.A.** 'Fuzzy Sets', Information and Control, 1965(8), 338-353.

**Zebda, A.** 'The Investigation of Cost Variances: A Fuzzy Set Theory Approach', Decision Sciences, Summer. 1984.

**Zimmerman, H.J. and Zysno, P.** Latent Connectives in Human Decision Making. Fuzzy Sets and Systems, 1980.


□

# Growth & Productivity of Indian Railways

**K.P. Sunny**

*This paper examines the nature and pattern of rail transport development under the planned regime in India. During the last four decades Indian railways had exhibited considerable operational improvement at various levels. The performance analysis based on partial and total factor productivity showed that the use efficiency of capital and the overall efficiency were not impressive. This paper hints at overhauling the present investment policies for better use of rail transport operation.*

*K.P. Sunny is a Research Scholar at the Centre for Development Studies, Trivandrum.*

Independent India had inherited an extensive railway network of about 53400 kms, the fourth largest railway system in the world, with capital at charge of Rs. 742 crores in 1947-48 (J. Johnson, 1963). In many respects, however, the system was dysfunctional in the context of planned economic development and consolidation of the home market in independent India. For, the development and expansion of railway network in British India had been based on the requirements of the colonial objectives such as the resource suction and maintenance of law and order. The main feature of the network expansion during the period 1853 to 1880 was that the railway lines started from the port towns and penetrated into the interior. There emerged on the economic map of India, a system of alignments which was incapable of establishing healthy linkages between different regions of the country. But considerable changes took place in the development of railway network since independence.

Under the Five Year Plans, India has been creating additional capacity and using the existing capacity more intensively. As a part of its modernisation programme to meet the growing transport demands, coal based locomotives are being increasingly replaced with diesel and electric locomotives. The technology of locomotives has also undergone considerable changes leading to an increase in its traction efficiency, and traffic capacity. Along with these modernisation programmes its energy consumption pattern has also undergone marked changes (Raju, 1985). This paper provides an overview of its growth and productivity performance since 1950-51.

## Development of Railway Network since Independence

At present the nation has a length of 61976 kms of railway routes of which 55 percent (33831 kms) is of broad gauge and the rest metre and narrow gauge lines (Railway Year Book, 1987-88). The opening up of new railway lines in independent India was based on the following three major considerations (Moonis Raza and Yash Aggarwal, 1986).

(a) railway lines for opening up backward areas

Second category of items is the staff employed. There is only a marginal increase in the case of employment generation while the cost incurred per employee consistently increased over the decades (estimated at current prices). One may argue that the wage increase is in correspondence to the price inflation. But it may be noted that the Wholesale Price Index for all commodities during the same period increased at an annual growth rate of 6.6 percent* while the cost per employee (wages) increased at the rate of 7.6 percent. It shows that the bargaining power of the employees improved over time and succeeded in pushing up the wage rate. It may also be argued that the wage escalation is due to changes in employment composition requiring more skilled labourers in the labour force over time.

Third category of items which requires special attention is the transportation output. It is clear from table 5 that almost the same rate of growth (1.8 percent) persists for the passen-

Table 5: Rate of Growth of various Heads of Accounts in Indian Railways 1950-51 to 1987-88 (Actuals)

| Category of Items | 1950/51-1959/60 | 1960/61-1969/70 | 1970/71-1979/80 | 1980/81-1987/88 | 1950/51-1987/88 |
|---|---|---|---|---|---|
| **I. Assets** | | | | | |
| (a) Capital at charge | 6.5 | 8.6 | 5.3 | 8.9 | 7.1 |
| (b) Total Investment | 8.2 | 8.6 | 9.5 | 9.9 | 7.8 |
| (c) Electric Route Kilometres | 3.9 | 15.0 | 2.9 | 6.7 | 9.2 |
| (d) Total Route Kilometres | 0.5 | 0.7 | 0.2 | 0.2 | 0.4 |
| (e) Electric Running Route Kms | 4.6 | 13.7 | 2.7 | 5.3 | 8.4 |
| (f) Total Running route Kms | 0.6 | 1.3 | 0.5 | 0.3 | 0.8 |
| (g) Number of stations | 0.9 | 0.8 | -0.1 | 0.1 | 0.5 |
| (h) Steam locomotives | -4.2 | -0.7 | -1.9 | -7.9 | -0.2 |
| (i) Diesel locomotives | 28.5 | 19.8 | 7.1 | 4.5 | 14.1 |
| (j) Electric locomotives | 3.2 | 15.3 | 5.7 | 4.6 | 9.5 |
| (k) Passenger Carriages | 4.0 | 1.8 | 0.9 | 0.2 | 1.9 |
| (l) Electric Multiple Unit coaches | 5.7 | 8.9 | 4.3 | 2.1 | 5.4 |
| (m) Rail Car | 4.4 | -3.6 | -3.2 | -10.2 | -2.7 |
| (n) Other coaching vehicles | 1.5 | 1.9 | -0.5 | -1.7 | 0.5 |
| (o) Wagons | 4.7 | 2.5 | 0.7 | -2.1 | 1.5 |
| **II. Staff Employed** | | | | | |
| (a) Number of employees | 2.9 | 1.9 | 1.3 | 0.4 | 1.6 |
| (b) Cost of staff | 6.2 | 8.5 | 11.0 | 15.9 | 9.2 |
| (c) Average cost per employee | 2.8 | 6.5 | 9.7 | 15.6 | 7.6 |
| **III. Transportation Output** | | | | | |
| (a) Passenger kms and propn. of mixed | 2.4 | 2.2 | 2.1 | 2.3 | 1.8 |
| (b) Goods kms and propn. of mixed | 3.7 | 2.6 | 0.7 | 2.4 | 1.8 |
| (c) Vehicle kilometres | 3.1 | 2.8 | 2.8 | 3.8 | 2.7 |
| (d) Wagon Kilometres | 5.7 | 4.7 | 1.9 | 5.1 | 3.4 |
| **IV. Volume of Traffic** | | | | | |
| Passenger traffic | | | | | |
| (a) Number of passengers originating | 2.3 | 4.3 | 4.9 | 0.003 | 3.5 |
| (b) Passenger Kilometres | 1.6 | 4.2 | 5.9 | 3.3 | 4.1 |
| (c) Passenger earnings | 2.4 | 8.1 | 10.9 | 13.1 | 8.5 |
| (d) Passenger lead Km | -0.4 | -0.1 | 0.9 | 3.4 | 0.9 |
| (e) Average rate (passenger) | 0.8 | 3.9 | 4.9 | 9.8 | 4.1 |
| **V. Goods Traffic** | | | | | |
| (f) Tonnes originating revenue earn. traffic | 4.8 | 4.0 | 2.6 | 5.1 | 3.4 |
| (g) Total traffic | 5.3 | 2.9 | 2.1 | 4.8 | 2.8 |
| (h) Net tonne revenue earning traffic | 7.5 | 4.8 | 3.6 | 5.6 | 4.5 |
| (i) Total Traffic (net) | 7.4 | 4.1 | 2.8 | 5.2 | 4.0 |
| (j) Earnings from goods carried | 7.2 | 8.0 | 10.7 | 17.3 | 9.7 |
| (k) Average lead km | 2.2 | 1.4 | 0.7 | 0.3 | 1.2 |
| (l) Average rate per tonne | 1.4 | 3.3 | 7.1 | 11.7 | 5.4 |
| **VI. Fuel Consumption** | | | | | |
| (a) Coal | 4.5 | -0.03 | -2.5 | -6.6 | -0.9 |
| (b) Diesel oil | - | 26.50 | 6.3 | 5.6 | 12.8 |
| **VII. Stores Purchased** | | | | | |
| (a) Indigeneous | 13.0 | 6.3 | 10.9 | 12.3 | 10.1 |
| (b) Total | 12.8 | 6.1 | 10.4 | 12.3 | 9.4 |
| **VIII. Operating Revenue and Expenditure** | | | | | |
| (a) Revenue and gross receipts | 5.4 | 7.9 | 10.7 | 15.6 | 9.3 |
| (b) Working expense | 5.7 | 8.9 | 10.8 | 15.6 | 9.7 |
| (c) Net revenue receipts | 3.8 | 3.6 | 10.0 | 17.9 | 6.7 |
| (d) %of net revenue to capital at charge | -2.6 | -4.9 | 4.7 | 9.1 | -0.4 |
| (e) Operating ratio | 0.2 | 1.1 | 0.4 | -0.008 | 0.5 |
| (f) Dividnet to General revenue (tax) | 5.6 | 10.9 | 6.3 | 9.2 | 8.2 |

Source : Estimated from the Annual Reports and Accounts of Indian Railways.

* Estimated from the *Revised Index Numbers of wholesale Prices in India, 1986*, Ministry of Industry, Government of India (Various issues).

ger and goods train kilometers during 1950-88 whereas a more than proportionate growth rate is observed in the case of vehicle and wagon kilometers. Considerable decline in the growth rate of wagon kilometers have been observed during 1970-80 period.

The growth rates of the fourth category of items, volume of traffic, shows some interesting patterns over the decades. The number of originating passengers almost stagnated during the 80s while the passenger kilometres registered a growth rate of 3.3 percent in the same period. The earnings from goods transport show a growth rate more than proportionate to that of passenger transport. This is true in the case of first and last decades in particular and for the entire period in general. Moreover, this difference is increasing over the years. In the eighties both passenger and freight rates exhibited very high growth rates.

The fifth category of items under consideration is the fuel consumption. Due to modernisation considerable decline has taken place in the case of coal consumption. At the same time diesel consumption registered very high growth rate especially when the initial decades are considered.

The sixth category i.e., stores purchased, also showed considerable increase in the growth rate over the decades. The last category of items in the present analysis is the operating revenue and expenditure. It may be observed that the working expenses and receipts are growing almost at the same pace over the decades. In general, we may say that the better performance obtained in the eighties is through hiking both passenger and freight rates simultaneously with the intensive use of existing capacity rather than making any significant improvements in the overall efficiency. For example, operating ratio increased from 80 percent in 1950-51 to 92.5 percent in 1987-88. An analysis of productivity trends would be more meaningful in commenting on the overall efficiency of railways.

**Partial and Total Factor Productivity in the Railways**

The Railways can be regarded as a regulated industry though it is a public utility (Kendrick and Vaccara 1980). Hence, the theoretical approaches to state enterprises are equally applicable in the case of Railways also. There are several characteristics that are unique to many regulated industries. These characteristics can be classified generally as supply-related and demand-related factors.

On the supply side, there are three basic technological characteristics that are essential towards the understanding and measuring of economic efficiency in the regulated sector (Cowing and Stevenson, 1981). The first is the possible existence of scale economies. The failure to account correctly for scale effects will lead to biased productivity measures in those regulated industries that are not characterised by constant returns to scale. A second basic technological characteristic of any production process is technical change, which results when the maximum or efficient output can be produced from any better techniques for producing output. A third feature of many regulated industries is the relative capital intensity of the production technology.

On the demand side, growth and pricing policies are important characteristics of many regulated industries. Economic growth makes it possible for the benefits of both economies of scale and embodied technical change to be realised in the form of lower average costs. Pricing in the regulated sector has generally been carried out on the basis of average historical or embedded costs, rather than marginal costs, thus giving rise to potential allocative distortion, which must be taken into account when assessing productivity growth. These characteristics, many of them unique to the special case of regulated industries such as Railways, are crucial to productivity measurement using either cross-section or time-series data.

The main productivity indicators in Rail transport i order of importance are partial productivity indices (capit and labour) and total factor productivity indices such a Kendrick, Solow and Translog (Goldar, 1986). Labour pro ductivity can broadly be defined as the ratio of output to the corresponding input of labour, measured in terms of the number of workers. It indicates the savings achieved in labour use as a result of overall productive efficiency of the factor substitution (Kendrick, 1956). Analogous to the concept of labour productivity, capital productivity is defined as output per unit of capital. Further, capital productivity measured in terms of output-capital ratio reflects not only the use efficiency of capital but also the level of technology in use. Estimates of total factor productivity are designed to provide an indication of the changes in the overall efficiency with which the resources are utilized in the production process. In a multi-product case, the total factor productivity growth is the difference between the rate of growth of aggregate output and the rate of growth of the sum of the weighted inputs (Goldar, 1986).

Labour productivity in Indian railways, as compared to other railways of equal size and output, measured in terms of transport units per person employed, is rather low (Times Research Foundation, 1986). No attempts so far have been made to improve labour productivity on a systematic and scientific basis. But such attempts have been made on a large number of railways which were

facing continuous deficits and consequent financial crisis, due to keen competition from road transport.

Many foreign railways, due to the overall shortage of labour for executing physically tiring but unskilled jobs, logical level and tractive efficiency through dieselisation and electrification of Railways (Raju, 1985). Though railways started showing signs of improvement, the over all growth performance of Indian Railways does not provide

**Appendix 1: Labour Productivity, Capital Productivity and Total Factor Productivity Growth in Indian Railways**

| Years | Labour | Capital | Kendrik | Solow | Translog | Kendrik 5 year Average | Solow 5 year Average | Translog 5 year Average |
|---|---|---|---|---|---|---|---|---|
| 1951/52 | 0.109 | 4.459 | 2.643 | 2.643 | 3.643 | | | |
| 1952/53 | –3.024 | –17.323 | –11.352 | –11.430 | –15.586 | | | |
| 1953/54 | –2.501 | 4.490 | 1.571 | 1.636 | 2.584 | | | |
| 1954/55 | 3.187 | –5.167 | –1.679 | –1.853 | -5.008 | –2.204 | –2.251 | –3.592 |
| 1955/56 | 3.568 | –4.709 | –1.253 | –1.583 | –5.263 | | | |
| 1956/57 | 5.889 | 11.967 | 9.429 | 9.736 | 10.638 | | | |
| 1957/58 | 4.068 | –0.960 | 1.140 | 0.779 | –2.393 | | | |
| 1958/59 | -1.995 | –5.251 | –3.891 | –4.175 | –6.284 | | | |
| 1959/60 | 7.012 | 5.673 | 6.232 | 6.115 | 5.551 | 2.331 | 2.175 | 0.450 |
| 1960/61 | 6.065 | 6.692 | 6.430 | 6.492 | 6.612 | | | |
| 1961/62 | 2.730 | –5.758 | –2.214 | –2.918 | –6.368 | | | |
| 1962/63 | 4.624 | –0.498 | 1.641 | 1.195 | –1.531 | | | |
| 1963/64 | 1.114 | –1.012 | –0.124 | –0.323 | –2.620 | | | |
| 1964/65 | –2.524 | –0.456 | –1.139 | –1.145 | –1.716 | 0.883 | 0.660 | –1.125 |
| 1965/66 | 5.056 | 5.355 | 5.230 | 5.257 | 4.532 | | | |
| 1966/67 | 0.531 | 8.653 | 5.261 | 5.982 | 8.405 | | | |
| 1967/68 | 2.815 | 8.950 | 6.389 | 6.861 | 9.004 | | | |
| 1968/69 | 4.369 | –1.548 | 0.922 | 0.379 | –1.309 | | | |
| 1969/70 | 3.091 | 4.229 | 3.754 | 3.859 | 4.118 | 4.311 | 4.467 | 4.950 |
| 1970/71 | –0.370 | 1.936 | 0.974 | 1.176 | 1.589 | | | |
| 1971/72 | 3.608 | 4.908 | 4.365 | 4.481 | 4.456 | | | |
| 1972/73 | 2.314 | 7.530 | 5.352 | 5.806 | 7.110 | | | |
| 1973/74 | –7.772 | 7.658 | 1.215 | 2.057 | 6.999 | | | |
| 1974/75 | 2.594 | 20.662 | 13.117 | 14.845 | 19.941 | 5.005 | 5.673 | 8.019 |
| 1975/76 | 11.097 | 4.939 | 7.510 | 6.906 | 4.546 | | | |
| 1976/77 | 5.707 | 4.901 | 5.238 | 5.150 | 4.485 | | | |
| 1977/78 | 3.653 | 4.499 | 4.145 | 4.225 | 4.034 | | | |
| 1978/79 | –1.477 | -4.110 | –3.011 | –3.196 | –4.789 | | | |
| 1979/80 | –0.023 | 8.628 | 5.016 | 5.632 | 7.922 | 3.780 | 3.743 | 3.240 |
| 1980/81 | 1.549 | 9.143 | 5.972 | 6.501 | 8.528 | | | |
| 1981/82 | 6.686 | 6.380 | 6.508 | 6.474 | 6.318 | | | |
| 1982/83 | 1.284 | –3.483 | –1.492 | –2.108 | –3.921 | | | |
| 1983/84 | –0.705 | 4.559 | 2.361 | 3.007 | 4.718 | | | |
| 1984/85 | 1.250 | –0.275 | –0.362 | 0.176 | –0.605 | 2.742 | 2.810 | 3.007 |
| 1985/86 | 9.416 | 6.478 | 7.705 | 7.327 | 6.084 | | | |
| 1986/87 | 7.498 | –0.787 | 2.672 | 1.532 | –1.333 | | | |
| 1987/88 | 3.252 | –0.172 | 1.258 | 0.721 | –0.635 | 3.878 | 3.193 | 1.372 |
| Average | 2.534 | 2.735 | 2.651 | 2.654 | 2.229 | | | |

**Appendix II**

An analysis in the line of Cobb-Douglas production function would give a rough estimate of the capital, labour and intermediary productivities in this sector.

$$Q = A K^{\alpha} L^{\beta} M^{\Gamma}$$

$$\text{i.e., } \ln Q = A + \alpha \ln K + \beta \ln L + \Gamma \ln M + u$$

Where Q = Composite index of passenger and Freight kms weighted with relative prices
K = Capital at charge
L = Number of Labourers
M = Total Stores purchases

Using this functional form we get the relationship as :

$$\ln Q = 5.78 + 0.46\ \ln k + 0.24\ \ln L + 0.05\ \ln M$$
(0.0422) (0.0725) (0.2167) (0.0309)

$R^2 = 99$

Figures in the brackets are standard errors

Here it is found that the Railways shows decreasing returns to scale because $\alpha+\beta+\Gamma<1$. If this summation is more than one we may conclude that there is increasing returns to scale.

# Interpersonal Communication in Organisation

**Anup R. Roy**

*In this study the author makes an attempt to consider communication behaviour from the interpersonal relation dynamics, style and credibility point of view of the persons involved. One hundred samples representing both management and non-management cadre were drawn from various functional units of one oil refinery. Different parameters of communication viz., information flow, focal person's communication style and credibility and interpersonal relations were studied using structured and standardised instruments.*

*Anup R. Roy is an Assistant Director, Human Resources Development Group, at the National Productivity Council, 9 Syed Amir, Ali Avenue, Calcutta 700 017*

Research studies in the field of organisational behaviour present considerable confusion and uncertainty regarding the relationship between communication behaviour and such variables as individual's pattern of interpersonal relations, communication style and credibility. Some of the variables have been found to be of considerable importance in determining the communication effectiveness. Inter-personal trust, for example, one of the most frequently researched variable, has been found to have influenced the quality, level, content (Zand, 1972) and directionality of communication (O'Reilly & Roberts, 1974). Similarly, trust has been found by others (Mellinger, 1956; Roberts & O'Reilly, 1974; Walton, 1962) as one of the important aspects of willingness to communicate. It has also been found to have affected perception of communication accuracy (O'Reilly & Roberts, 1976) and flow of upward communication (Read, 1962). Interpersonal proximity and communication effectiveness have also been reported. Triandis (1959) for example, obtained evidence which showed that cognitive similarity facilitated interpersonal communication and linkage. Griffin (1967) in his study established the relationship between effective communication and expertness, reliability, activeness and personal attraction of the communicator. Similar findings were reported by others (Berlo et al. 1970). However, it is evident that none of the studies have dealt with the interpersonal dynamics of the receiver-sender relationship within an organisational environment and made effort to establish the linkages between these and related variables with communication in a Gestalt fashion. In this exploratory research an attempt has been made to consider communication behaviour from the interpersonal relations dynamics, style and credibility point of view of the persons involved in a communication situation.

## Methodology

The study was conducted in one of the reputed and oldest oil refineries in the country. A total of 100 subjects working in management and senior supervisory cadres

participated in the study. Subjects were drawn randomly in equal numbers from four functional areas viz., production, maintenance, personnel & administration and finance. The organisation where the study was conducted had eight different grades both in management as well as non-management cadres. However, in the present study, samples were drawn only from four lowest management (A, B, C, D) and two top most non-management (supervisory) (7,8) cadres.

### Design of the Study

Literature on organisational communication has generally indicated to three major variabes viz; the context variable i.e., the status of the communicator, work group size etc., (Level & Johnson, 1978; O'Reilly & Roberts, 1976), the context-process variable i.e., the amount of information, direction of flow, quality, timeliness, channel characteristics etc., (Randolph & Finch, 1977; Katz & Tushman, 1979) and the effect variable i.e., the potential impact of communication on the attitude and performance of the individual as well as work group (Downs, 1977; Goldhaber et al. 1978). Hence, in the present research design parameters like trend of information flow, perceived communication style of the focal person and perceived credibility of the focal person were included and comparisons between different grades and functions with regard to these parameters were attempted in the light of interpersonal relations between grades.

### Instruments & Data

The Information Flow Measuring Inventory (Goldhaber, 1983) was used to measure the differences in an individual's perception between the amount of information expected and received from others as well as the amount of information actually sent and expected to be sent to others. The inventory was used in the present study in order to assess the flow of information regarding 'performance feedback', 'organisation's future', 'decision making style' and 'growth opportunity'.

Colleagues' Communication Survey Inventory (Klauss & Bass, 1982) was used to assess the "Communication Style' and 'Credibility of the Focal person' (the individual whose communication behaviour is the centre of concern). The different dimensions of the focal person's communication style measured were 'careful transmitter', 'open and two way communicator', 'frankness', 'careful listener', 'informality' and 'brief and concise'. The dimensions of credibility measures were 'trustworthiness', 'informativeness' and 'dynamism'.

Interpersonal relations in terms of individual's need for inclusion, need for control and need for affection was measured by the inventory called FIRO - B developed by Soutz (1965).

### Flow of Information

Analysis of data by grade as well as department indicated a general information deprivation in people operating at all the levels and functions. Although not statistically significant in all cases, the difference in the amount of information sent from one level and received at the next lower level was evident across all grades and functions, thus e.g., with regard to feedback on 'performance', the flow was perceived to be scanty by the grade 'B' officers, than what their immediate superiors (grade 'C') claimed to have transmitted (Table-1). Similar discrepancy between grades in the amount of feedback claimed and received with regard to issues like 'organisations future', 'growth opportunity' and 'decision making', was evident throughout (Tables 2, 3, 4,).

Table 1. Flow of Information from Superior to Subordinate Regarding Performance (By Grade)

| Amount of Information proposed to be sent | Amount of Information actually sent | Amount of Information received | Amount of Information expected |
|---|---|---|---|
| 3.29 (D) | 2.93 (D) | 2.75 (C) | 3.41 (C) |
| 3.33 (C) | 2.66 (C) | 2.11 (B) | 3.28 (B) |
| 3.17 (B) | 3.06 (B) | 2.39 (A) | 3.22 (A) |
| 2.94 (A) | 2.58 (A) | 2.97 (W) | 3.64 (W) |

Table 2. Flow of Information from Superior to Subordinate Regarding Future of the Organisation (By Grade)

| Amount of Information proposed to be sent | Amount of Information actually sent | Amount of Information received | Amount of Information expected |
|---|---|---|---|
| 3.64 (D) | 2.93 (D) | 2.50 (C) | 3.33 (C) |
| 2.75 (C) | 1.83 (C) | 2.22 (B) | 2.94 (B) |
| 2.94 (B) | 2.67 (B) | 2.22 (A) | 3.22 (A) |
| 3.06 (A) | 2.38 (A) | 2.14 (W) | 3.00 (W) |

Table 3. Flow of Information from Superior to Subordinate Regarding Growth Opportunity (By Grade)

| Amount of Information proposed to be sent | Amount of Information actually sent | Amount of Information received | Amount of Information expected |
|---|---|---|---|
| 3.64 (D) | 2.86 (D) | 3.16 (C) | 3.08 (C) |
| 3.17 (C) | 1.92 (B) | 2.28 (A) | 3.22 (A) |
| 3.00 (B) | 2.78 (B) | 2.56 (A) | 3.22 (A) |
| 2.94 (A) | 2.33 (A) | 2.67 (W) | 3.39 (W) |

Table 4. Flow of Information from Superior to Subordinate Regarding Decision Making (By Grade)

| Amount of Information proposed to be sent | Amount of Information actually sent | Amount of Information received | Amount of Information expected |
|---|---|---|---|
| 3.57 (D) | 2.78 (D) | 2.58 (C) | 3.42 (C) |
| 3.42 (C) | 2.58 (C) | 2.22 (B) | 3.11 (B) |
| 2.83 (B) | 2.83 (B) | 2.47 (A) | 3.12 (A) |
| 3.08 (A) | 2.83 (A) | 2.70 (W) | 2.83 (W) |

Rearrangement of data by functional departments showed a similar trend. Although statistically insignificant, the difference between feedback claimed and received was more in P&A (Table-5) followed by Production (Table-6). Discrepancy was minimum in Maintenance and Finance (Tables 7, 8).

Besides transmission-reception discrepancy, another interesting feature evident in the data, was the discrepancy between the 'proposed' amount of information feedback and 'actual' amount of information feedback down the line. It was evident throughout that people liked to pass on more amount of information than what they were passing on now and in certain cases the amount was more than what was expected by people below them.

Apparently this could be attributed to channel difficulty because of which people may possibly find it difficult to send the amount of feedback they propose to send. But analysis of individual variability in opinion regarding giving information to sub-ordinates showed significant inter-group differences; intragroup variability was highest among the Workers with regard to sharing all types of information

Table 5. Trend of Information from within Departments Regarding Perfomance

| Department | Amount of information received | Amount of information expected | Amount of information proposed to be sent | Amount of information actually sent |
|---|---|---|---|---|
| Production | 2.33 | 3.42 | 3.22 | 2.67 |
| Maintenance | 2.88 | 3.62 | 2.78 | 2.41 |
| P&A | 2.43 | 3.50 | 3.03 | 2.83 |
| Finance | 2.56 | 3.06 | 2.72 | 2.83 |

Table 6. Trend of Information flow within Departments Regarding Organisation's Future

| Department | Amount of information received | Amount of information expected | Amount of information proposed to be sent | Amount of information actually sent |
|---|---|---|---|---|
| Production | 2.50 | 3.25 | 2.97 | 2.22 |
| Maintenance | 2.22 | 3.22 | 2.72 | 2.31 |
| P&A | 2.10 | 3.17 | 1.80 | 2.40 |
| Finance | 2.22 | 2.94 | 2.72 | 2.39 |

Table 7. Trend of Information flow within Departments Regarding Growth Opportunity

| Department | Amount of information received | Amount of information expected | Amount of information proposed to be sent | Amount of information actually sent |
|---|---|---|---|---|
| Production | 2.50 | 3.06 | 3.00 | 2.14 |
| Maintenance | 2.50 | 3.31 | 2.53 | 2.13 |
| P&A | 2.53 | 3.50 | 3.20 | 2.60 |
| Finance | 2.89 | 3.44 | 2.66 | 2.83 |

Table 8. Trend of Information flow within Departments Regarding Decision Making

| Department | Amount of information received | Amount of information expected | Amount of information proposed to be sent | Amount of information actually sent |
|---|---|---|---|---|
| Production | 2.44 | 3.33 | 3.08 | 2.64 |
| Maintenance | 2.47 | 2.88 | 2.94 | 2.50 |
| P&A | 2.97 | 3.27 | 2.80 | 2.17 |
| Finance | 2.67 | 2.94 | 2.89 | 2.94 |

(Fig. A,B,). Grade 'A' officers showed highest variability regarding passing information on 'growth opportunity' (Fig. A), Grade 'B' showed highest variability in decision making (Fig. A) and Grade 'D' officers showed highest variability in 'performance feedback' (Fig. B). However, intragroup

variability regarding passing information was significantly lowest in Grade 'C' in all information areas covered (Fig. A,B).

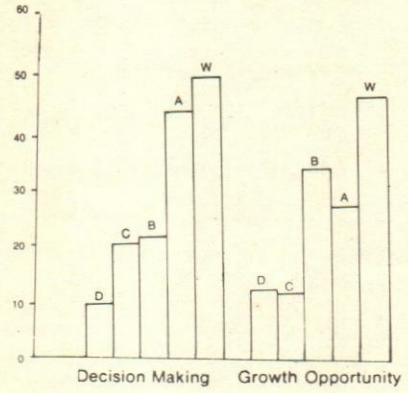



**FIG. A. GIVING INFORMATION TO SUBORDINATES INTRA GROUP RESPONSE VARIABILITY (%)**

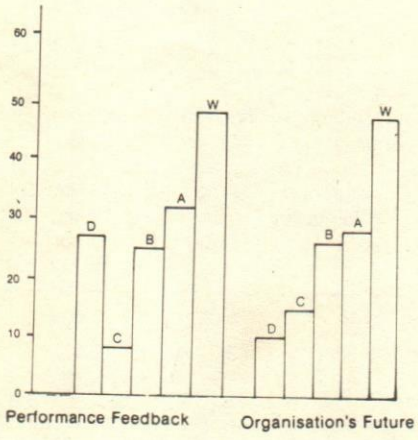



**FIG. B. GIVING INFORMATION TO SUBORDINATES-INTRA GROUP RESPONSE VARIABILITY (%)**

Again another interesting feature of the data was the negatively directed difference. The amount of information received by Grade 'B' was more than what 'C' had transmitted (Table 2). Similarly, with regard to growth opportunity, Grade 'C' reported to have received more information that what was transmitted by Grade 'D' people (Table 3).

Summarising

* The flow of information was not as spontaneous as claimed by people.
* Attitude towards open information sharing was poor.
* Significant intra-and intergroup variability with regard to information sharing indicated lack of peer group cohesiveness as well as intergroup conflict particularly at the junior officer and senior workman staff level.

  Negatively directed difference between claimed transmission and reception of information particularly regarding 'organisation's future', and' 'growth opportunity' in middle grade officers suggested existence of a potential 'grapevine'.

## Communication Style and Credibility

The assumption that people occupying senior management positions, generally show more effective communication style and earn credibility as a good communicator has been established by a number of studies. Mostly they have been found as careful listeners, open and two way communicators, informal, trustworthy, informative and dynamic (Burke, 1969; Rogers & Roeththisbleger, 1952). The present study, however, did not go in line with these observations. On the contrary, not only were the communication style and credibility relatively poor, but the difference between grades in style and credibility, as well as between the different dimensions of the style and credibility were found statistically not significant (Table 9, 10). Redistributing the samples by department, however, significant difference between departments in communication style and credibility was evident (Table 11, 12) but within department variation in dimensions of style and credibility was not significant (Table 11, 12). More effective communication style was evident in people in Production and Maintenance compared to their counterparts in Finance and P&A. This indicates existence of "Functional Specificity' in Communication Style (Johnston, 1976) and absence of an uniform communication climate in the organisation.

Table 9. Anova Showing Communication Style (By Grade)

| Source of variation | Sum of square | Degrees of freedom (N-1) | Mean square | F-ratio |
|---|---|---|---|---|
| Between Style | 1.80 | 5 | 0.36 | 0.36<br>0.25 = 1.44 |
| Between Grade | 0.67 | 4 | 0.17 | 0.17<br>0.37 = 0.68 |
| Residual | 5.00 | 20 | 0.25 | |
| Total | 7.47 | 29 | | |
| | F 4,20 | 5.80 = | 0.05 | |
| | F 5,20 | 4.62 = | 0.05 | |

Table 10 Anova Showing Communication Credibility (By Grade)

| Source of variation | Sum of square | Degrees of freedom (N-1) | | Mean square | F-ratio |
|---|---|---|---|---|---|
| Between Credibility | 0.93 | 2 | | 0.47 | 0.47<br>0.28 = 1.67 |
| Between Grade | 0.40 | 4 | | 0.10 | 0.10<br>028 = 0.36 |
| Residual | 2.27 | 8 | | 0.28 | |
| Total | 3.60 | 14 | | | |
| | F 2, 8 | 19.37 | = | 0.05 | |
| | F 4 ,8 | 6.04 | = | 0.05 | |

Table 11. Anova Showing Communication Style (By Department)

| Source of variation | Sum of frequency | Degrees of freedom (N-1) | | Mean square | F-ratio |
|---|---|---|---|---|---|
| Between Credibility | 1.00 | 5 | | 0.20 | 0.20<br>0.11 = 1.82 |
| Between Grade | 3.33 | 3 | | 1.11 | 1.11<br>0.11 = 10.09 |
| Residual | 1.67 | 15 | | 0.11 | |
| Total | 6.00 | 23 | | | |
| | F 3, 15 | 8.70 | = | 0.05 | |
| | F 5, 15 | 4.62 | = | 0.05 | |

Table 12. Anova Showing Communicator's Credibility (By Department)

| Source of variation | Sum of square | Degrees of freedom (N-1) | | Mean square | F-ratio |
|---|---|---|---|---|---|
| Between Credibility | 0.17 | 2 | | 0.09 | 0.08<br>'0..08 = 1.13 |
| Between Grade | 2.25 | 3 | | 0.75 | 0.75<br>028 = 9.38 |
| Residual | 0.50 | 6 | | 0.08 | |
| Total | 3.60 | 11 | | | |
| | F 2, 6 | 19.33 | = | 0.05 | |
| | F 3 ,6 | 8.94 | = | 0.05 | |

Although the difference was statistically not significant, the senior most officers (above Grade 'D') have been rated by their immediate subordinates (Grade 'D') as relatively less frank, one-way communicators and lacking brevity of expression (Figure C,D). The 'D' grade officers on the other hand, though have been rated by their immediate subordinates (Grade 'C') as relatively better in the above dimensions, rating on certain dimensions like 'informality' was found relatively poor.

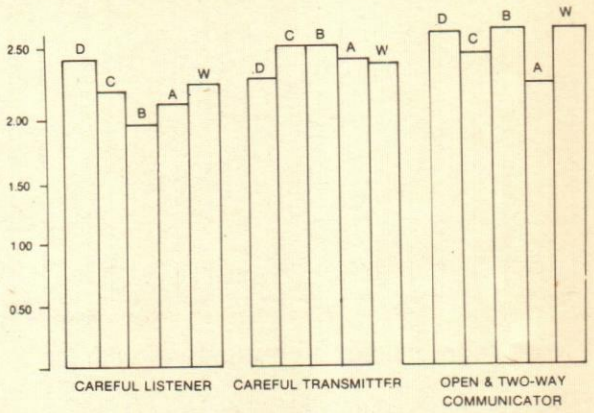



FIG. C FOCAL PERSON'S COMMUNICATION STYLE

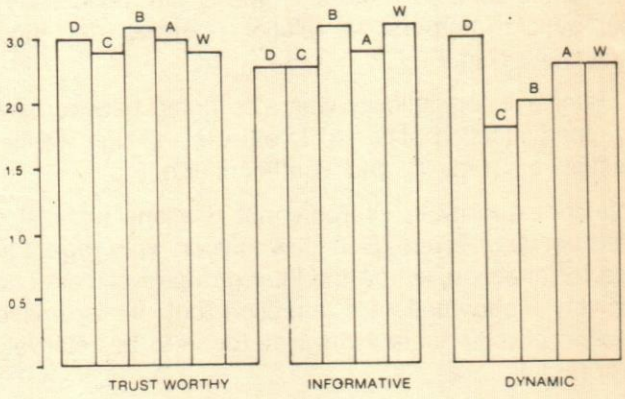



FIG. D FOCAL PERSON'S CREDIBILITY

Similar trend of perception was noted in the ratings of grade 'E' officers about Grade 'C' officers (Fig. C,D,E). Such a trend in the data could be indicative of a communication climate characterised by less informality and frankness in information sharing.

Summarising

* Functional specificity in communication style indicated non-existence of an uniform communication climate in the organisation.
* Though some departments came out with relatively better communication profile, the overall communi-

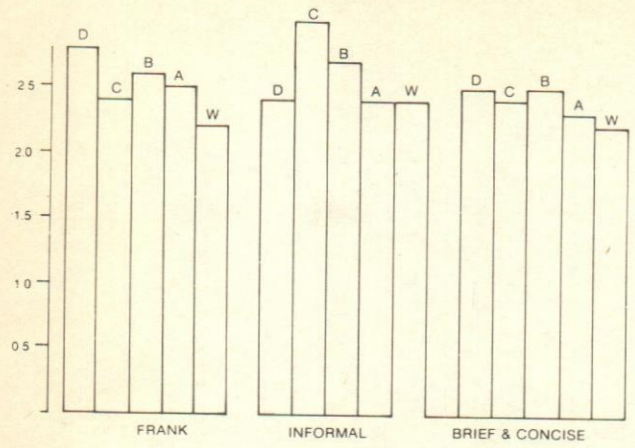



**FIG. E FOCAL PERSON'S COMMUNICATION STYLE**

cation style and the credibility level of both officers and senior workman/staff were not of a very high standard.

### Interpersonal Relations Orientation

Analysis of data on Interpersonal Relations showing high degree of 'extended control' in Grade 'D' officers and low 'wanted control' in Grade 'C' and 'B' officers indicated incompatible interpersonal relations between the functional levels (Fig. F).

Similar incompatibility was also noted between low 'extended affection' of Grade 'D' officers and high 'wanted affection' of Grade 'C' and 'B' officers (Fig. F).

Incompatibility in interpersonal relations were also noted between Grade 'B' and 'A' officers with regard to need for affection, where the later group of officers had relatively higher need for 'affection' but the extended affection of their supervisors was found to be relatively lower (Fig. F).

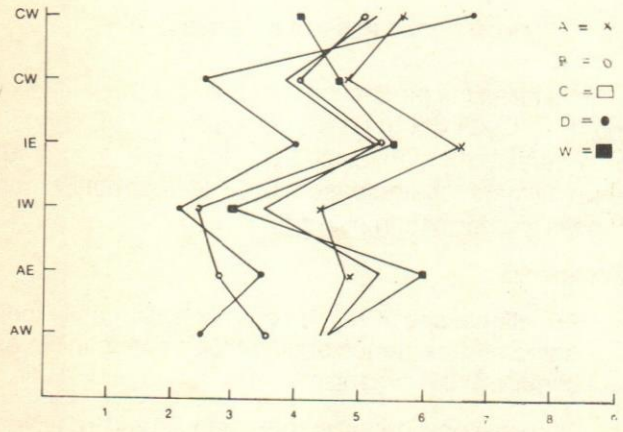



**FIG. F INTERPERSONAL RELATIONS ORIENTATION**

Such incompatibility in interpersonal need between people having superior-subordinate relationship in an organisation does not foster team spirit but confounds their perception of the style and credibility of the focal persons and may finally lead to the formation of an inappropriate communication climate.

Apart from its bearing on the communication climate of the organisation, impaired interpersonal relationship may bring about serious trouble for the individual as well as for the people around him. Thus, for example, an individual with a very strong need for 'control' and equally low desire for 'inclusion' can never get along with people (Schutz, 1958). Again people with significantly low need for inclusion, affection and control might become the victim of a similar catastrophe.

Summarising, between group incompatibility with regard to different interpersonal needs were evident throughout all the levels.

### Discussion

It was about a century ago when managements role was to establish efficient procedures and regulations that would specify exactly what and how workers were to do their job. Rigid adherence to scientifically developed procedures was seen as the key to higher production. Hence, people became an extension of the machinery and technologies around them, This was a form of organisation what Taylor (1911) called the 'classical organisation' where communication was only a formalised system for relaying commands or instructions in a downward direction from managers to subordinates with no concern for upward feedback. It was around that time, that the refinery where the study was conducted, was born.

However, this form of organisation did not last for a very long time as a major impetus to this line of thinking came from the Hawthrone studies (Rostulisbarger & Dickson, 1939) and subsequently the conern for the informal human dimension of the organisation started gaining recognition. Communication, which was perceived earlier only as a formalised system for relaying commands in a downward direction, was redefined and its role increasing organisational effectiveness was recognised.

Unfortunately, either because of locational disadvantages or the vested interests of the then management of the refinery, this new wave did not bring about any change in the structure and function of the organisation. This was evident from the management policies, promotion procedures and the communication system that existed in the company during those days.

After independence, certain amount of restructuring of the organisation was made and the new generation managers were taken in. But the fact, that such restructuring could hardly bring any significant change in the age old management philosophy and organisational character, it was confined to the trend of information flow between levels studied in the present research. Discrepancy between claimed transmission and reception was evident throughout all the levels. Not only that, significant intra level (occupational grade) variability with regard to amount of information to be given to the subordinate, signified lack of intragroup cohesiveness and the tendency to hold back information in some people who were possibly still under the hangover of 'classical communication' style that was in practice in the organisation even a few decades back. This contention received further support from the data on communication style and credibility level of people operating at various levels. None of the groups received very high ratings from their subordinates about their credibility and communication style. Furthermore, the senior officers were rated as highly formal, less informative and not enough dynamic as communicators.

Basis for this sort of perception could be found in the pattern of interpersonal relations between people in the organisation. One's perception of the communication style and the credibility of another depends more on the compatibility of their interpersonal relations rather than social or organisational identity. Data on interpersonal relations between people of different grades indicating significant incompatibility could perhaps be reason for perceiving others as poor and ineffective communicators. The findings go in time with those reported by Downe, (1977; Goldhaber, et al., 1978).

In short, lack of informal environment and existence of certain structural rigidity was affecting the communication system.

Interpersonal distance between people and lack of concern for open sharing of information affected the smooth information flow between levels.

## REFERENCE


**Berlo, D.K.; Lemst, J.B., & Mertz, R.J.**(1970) 'Dimension for evaluating the acceptability of message sources'., Public opinion Quarterly 33(4).

**Downs, C.W.**(1977). The relationship between communication and Job satisfaction. In R.C. Hussman, C.M. Logue & D.L. Freshley (Eds), Readings in interpersonal communication (3rd Ed). Boston: Holdbrook Press, Inc.

**Goldhaber, G.**(1983) Organisational Communication, Inbuque, IA, Brown,

**Goldhaber, G.M.; Porter, D.J., Yastes, M.P. & Lesinak, R.** (1978) 'Organisational Communication', Human Communication Research, 5(1),

**Griffin, K.**(1967) 'The contribution of studies of Source credibility to a theory of interpersonal trust in the communication process'. Psychological Bulletin, 68(2),

**Jhonston, H.R.**(1976) 'A new Conceptualisation of Source of Organisation climate', Administrative Science Quarterly, 21.

**Katz, R & Tushman, M.**(1979) 'Communication Patterns, Project performance and task characteristics: An empirical evaluation and integration in an R&D setting', Organisational Behaviour and Human performance, 23,

**Klauss, R & Bass, B.M.**(1982) Interpersonal Communication in Organisations, Academic Press Inc. N.Y.

**Level, D.A. & Johnson, L.**(1978). 'Accuracy of information flows within the superior/subordinate relationship', Journal of Business Communication, 15(2),

**Mellinger, G.D.**(1956) 'Interpersonal trust as a factor in Communication Journal of Abnormal and Social Psychology', 52,

**O'Reilly, C.A. & Roberts;** K.(1976) 'Relationship among components of credibility and communication behaviour in work units'. Journal of Applied Psychology, 61 (1),

**O'Reilly, C.A. & Roberts, R.H.**(1974) 'Information filtration in organisations; Three experiments', Organisational Behaviour and Human performance, II,

**Roberts, K.H. & O'Reilly, C.A.**(1974) 'Failures in upward Communication in organisation', Academy of Management Journal, 17,

**Read, W.H.**(1962) 'Upward Communication in industrial hierarchies', Human Relations, 15, 3-15.

**Randolph, W.A. & Finch, F.E.**(1977). 'The relationship between organisational technology and the direction and frequency dimensions of task communications. Human Relations', 30(12), 1131-1145.

**Rostulisbarger, F.J. & Dickson, W.J.** (1939). Management and the Worker Cambridge, Mass: Harrvard Univ. Press.

**Schutz, W.C.** (1958) FIRD: A Three Dimensional Theory of Interpersonal Behaviour, Rinehart & Company Inc.

**Triandis, H.C.** (1959) 'Cognitive similarity and interpersonal Communication in industry', Journal of Applied Psychology, 43(5), 321-326.

**Taylor, F.**(1911): Scientific Management, Harper, New York,

**Walton, E**(1962). 'Motivation to Communicate', Personnel Administration, 26(3),

**Zand, D.E.**(1972): 'Trust and Managerial problem solving', administrative Science Quarterly, 17(2),

# Industrial Engineering in Health Care Systems

**M. Bahauddin**

*This paper presents an outline of some applications of Industrial Engineering techniques at Cook Country Hospital, Chicago and a few other hospitals in USA. The basic objective of this paper is to provide health care practitioners and administrators in India, with the motivation to initiate and participate in the effective application of Industrial Engineering techniques for efficient utilisation of health care resources.*

*M. Bahauddin is with the Department of Mechanical Engineering in the College of Engineering and Technology. Aligarh Muslim University, Aligarh (U.P.).*

On April 7th 1990 we concluded celebrating 'World Health Day' and with if the commitment to provide health care to all by the year 2000. A noble intention, indeed. But where are the resources in this resource crunch era, one might ask and rightly so. And there lies the rub. It is our contention that unless there is a marked productivity improvement, our intentions would not be translated into deeds. To stretch our rupee, we must, of necessity, find ways to identify and prune unnecessary costs, improve utilisation of resources, and enhance the efficiency and effectiveness of the system.

We had been employing Industrial Engineering techniques in manufacturing industries since quite some time. But we have yet to effectively utilize these techniques in service industries in India. We believe that the techniques already in vogue can yield rich dividends, if implemented in earnest. Consequently the emphasis is upon application.

## Radiology Scheduling

*(Queueing Theory)*

As Murdoch (1978) has pointed out, manufacturing industry has paid far too little attention to the 'service units' while time has been lavished on production problems. And further to quote Murdoch: "The basic concepts and an understanding of modern queueing theory are requirements not only in the training of operational research staff, management scientists, etc., but also as fundamental concepts in the training of managers or in management development programmes. The efficient design and operation of service functions is one of the main problems facing management today and the understanding obtained from a study of queueing theory is essential in the solution of these problems"

Taking a cue from Murdoch, we approached the problem of queue snaking round the service area and

the frustrating and fluctuating experiences of radiologists and the consequent demand for more radiologists and equipments, with his prescription in mind.

To capture the underlying trend of patient arrivals, frequency of arrival during half hours' interval by patient category was gathered. While emergency and outpatients followed a random arrival pattern, in-patients arrived in bulk during early hours of the day, disrupting traffic intensity $\left(\frac{\lambda}{\mu}\right)$. Service time for each procedure was also collected, and was observed that large number of procedures took shorter than mean service time $\left(\frac{1}{\mu}\right)$ and only a few procedures took much longer time, that is; the service time followed a negative exponential distribution.

The following approximates the then prevailing queueing system at the hospital:

"Patients (in-patients, outpatients, and emergency patients) arrived at the radiology section in a random manner (mean rate of arrival = $\lambda$), i.e. followed a Poisson distribution."

Patients joined the queue with First-In-First-Out (FIFO) service discipline. There was no reneging or balking.

Time for radiological procedures (service time) followed a negative exponential distribution (mean rate of service = $\mu$). Patients could receive service at any of the S similar radiological stations (i.e. S servers in parallel), in addition to the constant service time at the registration counter.

Using Kendall's notation for specifying the characteristics of the queue, we had M/M/S system, that is a queueing process having Poisson arrival pattern, S servers, with S independent, identically distributed, exponential service times with FIFO queue discipline.

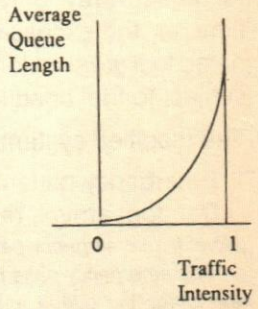
The adjoining figure shows the salient features of the prevailing queueing system.

We know that in the random arrival and service time case:

$$\text{Average queueing time} = \frac{\lambda}{\mu(\mu - \lambda)}, \text{ and}$$

$$\text{Average length of queue} = \frac{\lambda^2}{\mu(\mu - \lambda)}$$

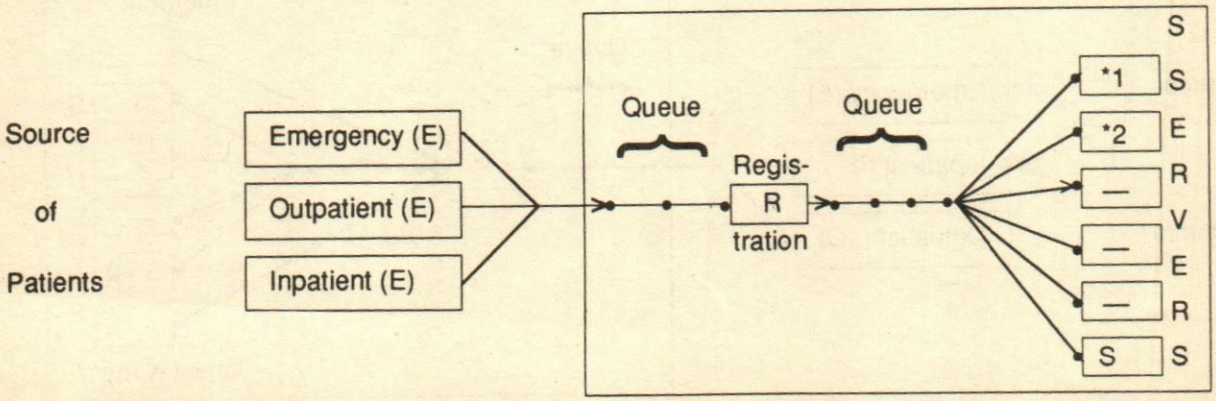
It is evident from equations that as $\lambda$ rises, with $\mu$ remaining unaltered, there is always a larger than proportionate increase in average length of queue. The graph of queue length against traffic intensity $\left(\rho = \frac{\lambda}{\mu}\right)$ gives a vivid impression. As $\rho \to 1$ queue length 'takes off'. Above, say, $\rho = 0.7$ the effect is most marked; small increases in $\varepsilon$ queue length. Therefore, the inordinate increase in $\lambda$ must be guarded against.




If the service time is given by the Erlang distribution (a generalisation of the negative exponential distribution) a limiting case of this is where service time is fixed. In the case of random (Poisson) arrivals and a fixed service time of $\frac{1}{\mu}$:

Average queueing time is halved to $\frac{\lambda}{2\mu(\mu - \lambda)}$ and similarly average length of queue is halved to $\frac{\lambda^2}{2\mu(\mu - \lambda)}$.

The doubling of queue time and length in the random service time case gives a good illustration of the price of variability: it is high.



Our task, then, becomes to minimize, to the extent possible, this variability in service time and also in the inter arrival time.

To avoid inordinate increase in traffic intensity during early hours, in-patients were now to come on a scheduled basis. The traffic intensity in early hours was thus lowered, effecting more than proportionate decrease in queueing time and queue length. In addition, one room was allocated for emergency patients only, thus the arrival pattern remained relatively stable for the remaining servers with the arrival of emergency patients.

In conjunction with the above, one room was allocated for chest X-ray only and thus the variability in service time of the excessively asked for procedure was eliminated to a great extent (small variation remained, though, subject to the condition of the patient).

The modified system took the following shape:

1. Emergency patients: M/M/1
   (random arrival, random service time, single server)
   *(Note: If an emergency patient is already waiting for service, the next arriving emergency patient gets a priority over other routine patients and jumps the queue and served as soon as any room becomes available).*
2. Routine Patients:
   (a) Chest X-ray : M/D/1
   (random arrival, deterministic service time, single server)
   (b) All other procedures: M/M/ (S-2)
   (random arrival, random service time, multiple servers in parallel)

The implementation of the modified queueing system resulted in the reduction of waiting time from as high, sometimes, as 8 hours to an average of 1/2 hour, contributing to better patient care, and also provided a relatively uniform workload for radiologists, alleviating some of their frustations. And in the process the additional expenditure, that would have otherwise been incurred due to asked radiological equipments and radiologists, was avoided.

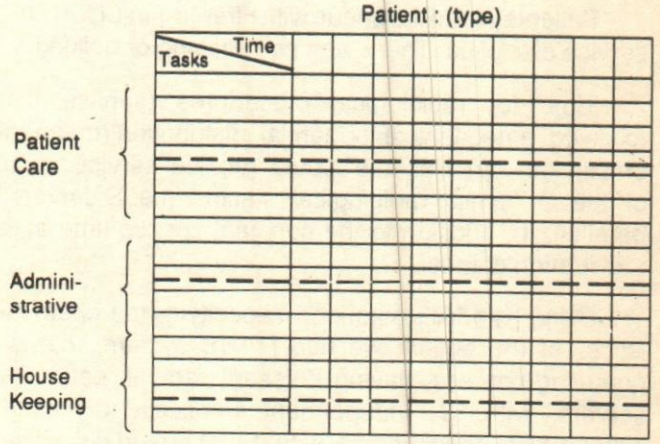
It must be emphasized that identical queueing time is psychologically far more significant for shorter service time than for longer ones. This aspect was taken into account while allocating one room specificallly for chest X-ray.

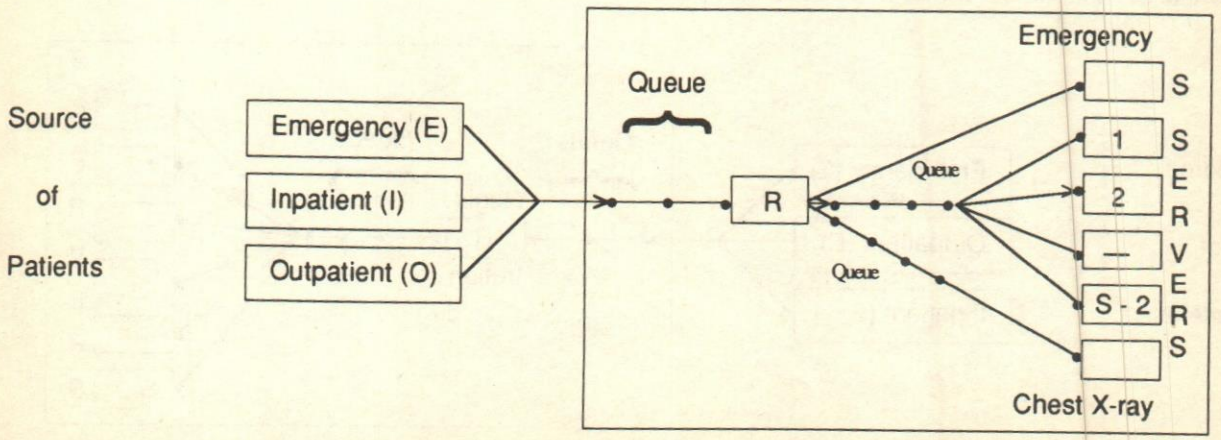
**Nurse Staffing**

*(Work Study, Resource Allocation)*

Work study has probably a higher saving : expenditure ratio than any other single management tool. Thus realizing its significance work study was initiated to assess the staffing needs-needs that were being voiced by the nursing personnee. Nursing personnel were contacted to acquaint them with the purpose of the study. Their participation in the study was solicited and emphasized.

**Work Study Methodology**



1. Exhaustive nursing tasks list prepared,
2. Tasks divided into three groups: patient care, administrative and housekeeping.
3. Tasks to be performed by each category of personnel (R.N., L.P.N., and Nursing Aids) established,
4. Tasks to be performed (patient-care) for each category of patient (Incontinent, Intensive care, Intermediate care, and minimal care) determined,
5. Tasks to be performed (administrative and housekeeping) for each ward based on bed complement determined,
6. Actual time for each task based on observations developed.
7. Frequency of each task recorded,
8. Bed complement, census, and staffing related to ward noted, and
9. Nurse mix by type of patient (patient-care) and by bed complement(administrative and housekeeping) established.

**Findings**

1. Static allocation of nurses' based on bed complement percentage,
2. Fluctuating demand on nurses time based on per cent occupancy and number of admissions and discharges,
3. Ample time of R.N. being spent on administrative tasks e.g. filling requisition forms for supplies from various departments, and
4. Some tasks being interchangeably performed by nursing personnel (e.g. R.N. doing LPN task).

**Modifications**

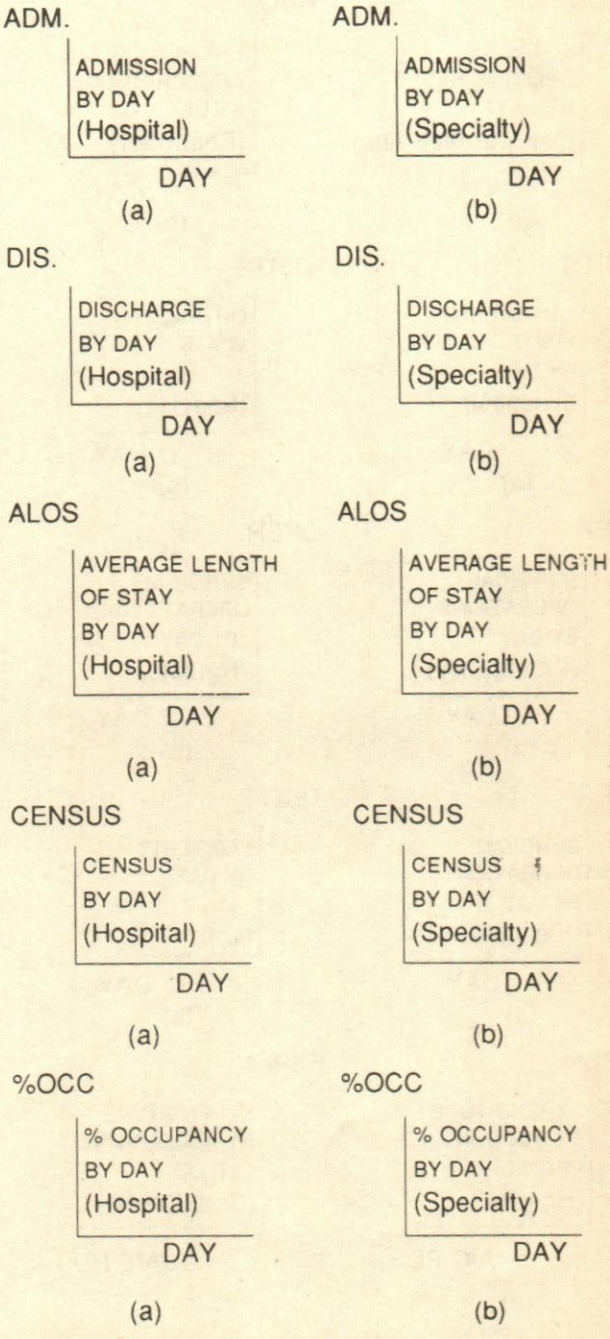
1. Creation of Nursing pool,
2. Dynamic allocation of nurse mix (R.N., L.P.N., and Nursing Aide) to wards (segregated by type of patients) based on bed complement, census, patient category, and expected admissions and discharges on a given day.
3. Standardisation of routine supply requirement based on census, and
4. Formalization of task assignments by nursing category.

The modifications offered a rational approach in staffing, and the consequent productivity improvement.

**Management Information Data Book**

*(Statistical Analysis and Forecasting)*

Routinely collected hospital census information and outpatient statistics, as well as performance figures from laboratory and other support service departments were segregated by day of the week and/or month for hospital and its specialities. Financial data on hospital expenditure was arranged by cost centres and by accounting periods. These data were then compiled in a single volume in tabular and graphical format to depict patterns, trends and variations. Peaks and troughs were easily detected.



PROC.

TOTAL PROCEDURES BY DAY (Radiology)

DAY

(a)

PROC.

FREQUENTLY PERFORMED PROCEDURES (Radiology)

DAY

(b)

PROC.

TOTAL PROCEDURES BY DAY (Nuclear Medicine)

DAY

(a)

PROC.

NUMBER OF PRESCRIPTIONS BY DAY (Pharmacy)

DAY

(b)

VISITS

OUTPATIENT VISITS BY DAY (Hospital)

DAY

(a)

VISITS

OUTPATIENT VISITS BY DAY (Specialty)

DAY

(b)

OPER.

SURGICAL OPERATIONS BY DAY (Emergency)

DAY

(a)

OPER.

SURGICAL OPERATIONS BY DAY (Routine)

DAY

(b)

OPER.

SURGICAL OPERATIONS BY DAY (Elective)

DAY

(a)

TESTS

LAB TESTS BY DAY (Lab)

DAY

(b)

EXPEN.

EXPENDITURE BY ACCOUNTING PERIOD (Hospital)

A/C PD

(a)

EXPEN.

EXPENDITURE BY ACCOUNTING PERIOD (Cost Center)

A/C PD

(b)

Trends based on cyclic and seasonal variations were easily detected from graphical displays. The Data Book aided decision-making in the areas of planning, organizing, and evaluation of delivery of health services by providing comprehensive picture of patient service levels and related expenditures facilitated. Figures of interest (admissions, for instance) were projected based on forecasts utilizing exponential smoothing results from the equation:

$$Fn = \alpha Y_{n-1} + (1 - \alpha) F_{n-1}$$

$$\text{or } F_n = F_{n-1} + \alpha (Y_{n-1} = F_{n-1})$$

where $F_n$ = Forecast for next period,

$F_{n-1}$ = Forecast for previous period,

$Y_{n-1}$ = Actual value for previous period, and

$= \alpha$ = smoothing constant $(0 \leq \alpha \leq 1)$

$F_{n-1}$ was arrived at by a simple average of past, twelve months' data, excluding those figures which were significantly outside the underlying pattern because of some assignable cause or chance (For instance, to project next Monday's admission, only past Monday's admissions were captured because of cyclic variations based on the day of the week. Similarly, seasonal variations were accomodated). It must be mentioned that judgement remains a necessary ingredient to any forecasting method.

The smoothing constant, $\alpha$, was tried between 0.1 and 0.3, and $\alpha = 0.2$ was found to yield closer forecasts.

**Few other applications ( *in other hospitals*)**

On similar lines enunciated in the preceeding pages following systems were designed.

*1. Out patient Appointment System:*

Consultation time by speciality was developed. Time slots were created. Appointment to referrals were given, considering the probability of no-shows and the random arrival of new patients. Queueing time was substantially reduced.

*2. Analysis of Supply System:*

Purchasing departments of two sister hospitals in the same general area was merged to obtain a preferred customer deal from suppliers in regard to quantity discount and delivery time. The regular trips of trucks between two hospitals was employed for delivery.

*3. Operating Room Analysis:*

Arrival time of nurses staggered to match the expected demand as indicated by past data.

*4. Accounts Receivable Analysis:*

Bills were expeditiously dispatched by improving information/paper flow from various centres where the patients received services to generate the patient bill. Delays in receipt of payment prompted friendly reminders after designated period. After elapse of pre-established time, if there was still no payment, a harsher reminder and then lastly, it was handed over to collection agency for a fee. Cash receipts were substantially improved and the cash flow problem considerably eased.

*5. Linen Distribution System:*

There was a chronic shortage of linen experienced on all wards, and the decision being made by the linen room supervisor as to how much linen to be allocated to different wards depending on what the wards asked for and how much linen was available. Based on the bed complements of the wards and the number of incontinent patients, linen standards for all wards in consultation with Nursing Directors and Unit Administration were developed. Four sets of linen were arranged to take care of the needs (fresh/soiled stocking on wards/laundry room, fresh/soiled in transit and soiled being processed/laundered). Procedures defining responsibilities for Linen Room Supervisor, Unit Administration, and Nursing Personnel for accountability and effective implementation of the system were also developed. Inventory was replenished to meet the requirement indicated by the linen standards.

*6. Relocation of a Health Care Facility*

CPM (Critical Path Method) was employed to complete the project expeditiously without unnecessary drag and with minimum cost.

**Some Computerized Applications**

*1. Unit Number System : (Medical Records)*

An unique unit number was assigned to the patient at his first encounter at the facility. Patient diagnostic history, results of tests and procedures performed was entered in the database. On his subsequent visit, data was retrieved from memory by simply entering the unit number provided by the patient. If the patient fails to provide the number, data was retrieved by entering last name and, if there is a tie, by first name, and in the event that does not break the tie, by date of birth. Substantial savings were attained by eliminating tests and procedures that otherwise might have been ordered, and the same by reduction in physician's consulting time because of the knowledge, at fingertip of previous diagnostic history.

*2. Diagnosis Related Group* (DRG):

Diagnosis Related Group, based on diagnosis, intensity of service and severity of illness (IS/SI) was created. Average Length of Stay (ALOS) for each DRG was computed for the region and the nation. Excessively high ALOS acted as pointers for investigation of causes, and subsequent removal of the underlying causes. A reduction in ALOS was realized in the region and the consequent reduction in burden on health care resources. Similarly excessive elective surgery was also flagged and the hospital contacted to consider second-opinion before operating. Substantial savings were realized.

*3. Computer Simulation:*

"When all else fails, simulate". In some complex situations, any effort in mathematical modelling becomes quite unreal, and computer simulation remains the only viable alternative.

**A word on Implementation**

*(Management by participation)*

Allen Mogenson (father of work simplification) had advocated that the industrial engineering department should train the supervisors and workers of the operating departments and the actual application of the methods is to be done by the workers and supervisors themselves. This theme ran across all our projects. Starting point of all our projects was a discussion with the supervisors at every level. Transmutation of ideas occurred through brainstorming sessions and meetings. Contacts were maintained throughout the design and implementation phase of projects. Obstacles encountered during the implementation phase were overcome through joint efforts and collective wisdom, and making everyone see that in pursuing the institutional objective his personal objective was also being satisfied and not being sacrificed.

Let us conclude by saying that the realisation of the commitment to provide health care to all will be possible only if we show a capacity for creativeness and self-renewal as a people.

**REFERENCES:**

**Batty, J.** : Industrial Administration and Management, Macdonald and Evans Limited, London, 1974.

**Murdoch, J.** : Queueing Theory, Macmillan, New York, 1978

□

# Management Learning : Experiences of Potential Managers in Process

**V. Anand Ram**

*While much has been written on the qualities of an effective manager, very little is known about the process by which managers acquire the knowledge, skills and attitudes which are relevant and useful to them at work. The present paper is an attempt to understand the process by which potential managers learn.*

*V. Anand Ram is an Associate Professor in Organizational Behaviour at the Indian Institute of Management, Bangalore 500076.*

A significant amount of research effort has been invested in the search for the qualities of managerial effectiveness. There are many frameworks which help us to look at the knowledge, skills and abilities needed by managers. Burgoyne and Stuart (1976), on the basis of their research, identified 11 attributes which were found in successful managers. These qualities fall into three groups which according to them represent three levels of learning Boyatiziss (1984) work on management competencies is another significant attempt to identify the qualities of an effective manager. He defines competency as an underlying characteristic of a person which results in effective or superior performance in a job. This may be a motive, trait, skill, aspect of one's self image or social role or a body of knowledge which a person uses. Kolb's (1986) work in this area of competencies falls in the following domains; at the highest level in this model is integrative competence; at the second tier are four learning competencies which are labelled as "behavioural", "affective", "perceptual" and "symbolic" and which correspond with the "active experimentation" "concrete experience", "reflective observation" and "abstract conceptualisation"; at lower tiers, various performance competencies are subordinate to the learning competencies.

Although the framework discussed earlier tells us about what successful managers are like, they tell us little about how managers acquire the needed skills or develop the required characteristics. Training and development professionals have been concerned about this issue,and they have focussed on their own technology of teaching. The unintended consequence of this has been that issues in learning have got tilted towards a concern for the teacher and the training methods that he uses to facilitate learning. What seems to be missing from most of the learning models is the learner and his or her actual experience of learning as he or she understands it. In the context of management education Ashton (1986) has identified three major features of teacher behaviour in a learning situation. These are:

1. Teachers tend to dominate through lectures, choice of cases and through teaching within their own area of expertise.
2. Students are reactive and are forced to act or react on the teachers terms with the content of the discussion, preferred learning styles and processes being dictated by the teachers.
3. There is a very limited value placed on the student's own experience - this may be a problem particularly with experienced managers.

In the context of management education, where the participants who go through our courses are adults and who have a fund of work related experiences, it is necessary to shift our perspective from being teacher centred to being learner centred.

**Management Learning - A Review**

Although research in the area of management learning and development is sparse, literature grounded in research is emerging. Orpen(1989) has spelt out in some detail the process by which managers discover and verify knowledge relevant to practice. According to him there are three distinctive features which characterize the process. First, it is particularistic in character because it arises from the need to understand the complexity of specific situations sufficiently well to act effectively in them. Every manager knows that although problems *per se* have a lot in common, each has its own distinctive feature that needs to be recognised as unique or idiosyncratic and responded to accordingly, if the manager has to be successful. The second feature is that each manager has distinctive knowledge derived from personal experiences that cannot readily be communicated to others, especially to others who have not shared these experiences. The third feature of learning is that managers use pragmatic ways to validate their knowledge. Managers need more than just predictions to be satisfied. They need to feel, and know why things happen.

Keller et al (1986) studied the contexts of managerial learning among 43 managers in a Canadian municipal bureaucracy. They found that learning tended to occur when there were opportunities for accountable decision making and where change was demanded and rewarded. Learning tended to happen when relationships with immediate supervisors involved receiving informal feedback and opportunities for upward communication and influence.

Similar findings have been reported by Mukhi (1984) on the basis of interviews conducted among 25 senior managers of public sector undertakings in Australia. The managers were asked "What have been the major influences in helping you to develop as a manager"? The five most important factors identified by the respondents were:

1. Having a need to achieve results.
2. Having an ability to influence and negotiate.
3. Ability to work with a wide variety of people.
4. Early overall responsibility.
5. Width of experience prior to 35 years age.

It is clear from above that assuming overall responsibility early in their careers and being exposed to a wide variety of experiences are critical factors contributing to the development of managers. These findings corroborate a similar study conducted by Margerison (1986) with a group of managers from the private sector in Australia. Burgoyne's (1976) work on the learning processes in the acquisition of managerial skills and qualities is another useful study. They identified seven learning processes which occurred fairly frequently in the acquisition of managerial skills. These are:

1. *Modelling* - copying or imitating a 'respected other' who is presumed to be right because of his position, status, previous success or personal charisma.
2. *Vicarious discovery* - Observing the actions and behaviour of others and modifying one's own actions by positive or negative imitation. This is the same as learning from other's experience.
3. *Unplanned discovery* - Learning from trial and error in the search for a solution to the problem.
4. *Planned discovery* - Learning from observing the consequences of one's actions in situations gone into with learning as a deliberate aim.
5. *Being taught* - Told or shown an approach, idea or relationship.
6. *Discussion* - Sharing information, ideas, interpretation, experience and feelings with others in task situations.
7. *Storing data* - Facts coming to one's attention in the normal course of events.

Davies and Smith (1984) studied the context in which 60 managers in five companies developed personally in their work. They found that development within an existing job tended to occur when circumstances were changing and when roles were not tightly defined, and that a job

move was most likely to afford personal development when it was self chosen and entailed confrontation with novelty necessitating major changes in perspective and decision making under conditions of risk and uncertainty.

Akin (1987) studied the actual learning experience that accounted for how good managers become competent. He interviewed 60 managers who were veterans in a variety of fields like insurance, manufacturing, social service, education, government and retailing. He was able to identify seven distinct organizations of those experiences - categories that he called learning themes. He found that there was a remarkable similarity in the way learning has been triggered and how important learning has been as experienced by the learner.

The striking feature of the studies reviewed above is that all of them have focussed themselves on experienced managers. The experiences of students going through a Post Graduate Programme in management has been missing. The present study was undertaken to explore the processes of learning in students attending a full time course of study in management.

**The Present Study**

The discipline of management education has emerged as one of the distinctive features in the Indian University System. The enrolment in the MBA programmes in Indian universities has risen phenomenally and an MBA has come to be regarded as an essential professional preparation for management positions both in private and public sectors in India. The experience of going through a two year post graduate programme in management exercises a powerful influence in shaping the beliefs, values and expectations of students. The transmission of these values is not through the content of the courses alone. The methods used, alongwith the teacher student relationship, are aspects which play an equally important role in shaping a management graduate.

The normal day to day experiences which adults confront at home or work provide many opportunities for learning. These are merely events and pass by without any impact if they are not examined. Experience is something we reflect upon and which causes us to modify in small ways our perceptions of situations and the way we behave in them. The ability to learn from day to day experiences is a skill in itself and the need for it grows daily. If management students have to be helped to take advantage of such situations they must be helped to become aware of their own processes of learning. It is with this purpose that the present exercise was undertaken with students.

The data for the present study came from a group of fifteen students in the second year of the Post Graduate Programme in Management. They were asked to reflect on significant learning experiences from which they had learnt something about being an effective manager. This paper attempts to analyse and interpret the learning experiences of students on the basis of a write up they prepared. The analysis attempts to provide answers to the following questions.

What did they learn?

Where did they learn?

How did they learn?

**What did They Learn?**

The first part of the write up was devoted to an identification of the knowledge, skills and attitudes which they believe were significant to function as effective managers. The different kinds of skills identified by them can be grouped into the following categories:

*Interpersonal Skills*

These skills cover the general ability to work well with others. The nature of the skills identified by the students varied from person to person. The ability to persuade people and deal with hostility in a group were aspects which were specifically mentioned.

*Communication Skills:*

The ability to elicit required information by conducting interviews and the ability to communicate ideas effectively, orally and in writing.

*Organizational Skills:*

These skills cover the ability to plan and organize one's own work, to work against deadlines and to delegate authority.

*Adaptive Skills:*

Adaptive skills refer to the ability of the individual to manage novel and unanticipated situations. These skills were identified as being helpful to the individual in coping with new people, organizational procedures or unexpected events.

*Personal Skills:*

The write-ups referred to experiences which enabled students to develop personal characteristics like learning to be self reliant, ability to work under pressure and development of self confidence.

*Subject Knowledge:*

Some of the students referred to knowledge acquired about marketing and ability to use computers in decision making as a significant skill acquired by them.

*Organizational Practices:*

A few students identified awareness of practices prevalent in companies as significant learning.

*Job Knowledge:*

Some students identified the appreciation that they developed about the nature of managerial work as being significant.

**Where Did They Learn?**

The answer to this question generally indicated that they had a clear explanation of the process by which they had acquired managerial capability. The interesting feature of the descriptions provided by the students were that the learning experiences identified by the students were not always related to the context of a classroom. Many of the abilities that they identified were related to experiences in other domains. Some of the events that resulted in learning experiences are.

i Working under pressure to complete a formal course requirement

ii Listening to a presentation by a company executive

iii Experience of receiving clear instructions in a simulated structured exercise from a friend.

iv Learning to assign responsibility, trust others and delegate work by being a member of a project team.

v The opportunity to make a presentation before company executives on work done during summer assignment.

vi Having to adjust to a new environment as a result of family delocation.

vii Going on a mountain trek, losing one's track and getting back to base.

viii Having to organize an activity as an office bearer of the Student's Association

The above events cover only a few which resulted in significant learning for the students. The interesting feature of these events is that they are not generally in the context of a classroom. For example, a large number of students attributed their interpersonal skills, self confidence and communication skills to their experience in their summer jobs and extra curricular activities they took part in. While classroom learning may have its own merits, events not specifically designed to promote learning figure prominently. This matches with the findings of Temporal (1978) who worked with managers and found that the contrived events contribute significantly to the growth and development of managers.

**How Did They Learn?**

The learning activities pursued by students indeed represent a very wide range. These activities have different meaning for different people. The lecture that a student attends or a role play or a structured exercise that he participates in is a unique experience for the student. However, one can discern that experiences are organised around some themes. These are:

*Learning by Accomplishment:* The description of a major learning experience by a student in his own words gives us a flavour of the personal nature of each experience.

"After a year's training, I joined the Project Engineering Division of a public sector company full of enthusiasm to do something. However, all I was asked to do were some odd jobs for different projects. My department was responsible for Electrical Systems Design. Though qualified, I did not know the practical aspects involved. I approached my boss and told him I'd handle a definite portion of the project and assume full responsibility for it. The project I was given was three months behind schedule. I worked hard learnt from others in the department and got out the specifications before the due date. The outcome of this experience was a realization that I was capable of working hard-that I liked doing things, that I could be quite organised with respect to people, time, etc. This resulted in a boost of self confidence".

In a similar vein another student described his learning in the following words. "My father was building a house. Not knowing Hindi he could'nt do much. I took over from my father decided on the contractor, met the architect, changed the plans, brought the materials, supervised the labour, gave the design and got the house built. I realised I could give orders and be listened to and that I was good at directing. This was my first taste of power to make decisions, do things my way with no interference".

It is clear from these descriptions that learning resulted from practical accomplishment. He learnt through the experience of seeking an opportunity, taking the initiative and meeting a challenge. This mode of learning is typical of people who involve themselves in new experiences and excel in situations where they must adapt themselves to specific and immediate circumstances.

*Learning by Introspection:* The description of learning events also cover activities when students ended up developing an insight and understanding about one's own self. For example a student afflicted with a serious illness described his experience in the following words:

"I was afflicted with a serious illness which kept me bedridden for six months. There was a possibility that I might have never recovered at all if the drugs had not suited me. However, they did so except that I was too weak to do anything. My parents couldn't stay back to keep me company as they work. So I spent a lot of time alone thinking, catching up on life. I learnt to cope with prolonged inactivity. I came to know who I was."

Another student discovered the importance of facing upto herself in the following words:

"I, had given up studies eleven years back and I used to find it very difficult to cope with studies here. I used to keep my problems to myself and keep moping inside my room. Towards the end of the first term, I shared these difficulties with a group of second year girls. Since that time they started supporting me, telling me how I should study, what books to read and also explaining concepts that were difficult. My problems really reduced and I could start learning all over again. It taught me that if one is new, one can always ask others for help. It is easy to learn once one has confessed that one doesn't know rather than pretending that one does."

These examples indicate a mode of learning by reflection on one's own experiences. Introspection can help an individual to develop insights about himself.

*Learning Through Formal Courses:* The experience of working under presssure and responding to the demands made by formal course requirements seems to be one of the modes of learning. Here is one such experience in a student's own words.

"In the Finance course our instructor really overloaded us with work, and there were surprise quizzes and a lengthy assignment to complete. All of us complained and yet we learned a lot from that course and it helped us to plan our days better. In the second term when there was no continuous pressure we found ourselves wasting a lot of time. It brought out for me the necessity to have enough activities to fill the day or else it leads to time wastage or lack of involvement."

A similar experience of having to respond to pressure was narrated by another student.

"In term-3 after the end semester exams we had to make a presentation before the Marketing Manager of a company for a marketing research project we had worked on. There were lot of things to be done and we were running behind schedule. After the end semester we had to do a lot of work to finish the job on time. I learnt a lot about crisis management from that experience."

A significant feature of learning through formal courses was the need for clear instructions and consistant feedback about one's performance. This was stated explicitly by a student who described her learning experience in the following words:

"In one of the Organizational Psychology workshop, I was participating in a target setting exercise for which the block building game was being used. I was blindfolded and as I was building the tower, feeling completely helpless and unsure of the task. However, one of the team members started giving precise instructions and helping me by placing the blocks in my hand. He sorted out large heavy blocks for the base of the tower and lighter ones for the top. He told me precisely how far right or left I should go and these instructions supported me and my confidence increased. It taught me the value of clear instructions and help which is clear cut and precise rather than vague".

These descriptions indicate that learning event where the student receives clear instructions, where she is frequently evaluated and receives continuous feedback enhances the value of learning.

*Learning By Interacting With Managers:* The experience of listening to company executives and interacting with them was identified by some students as a significant learning experience. One student wrote:

"There was a lecture series in Sales and Distribution Management in which business executives from different companies came and delivered lectures. I learnt quite a lot of practical fundamentals from the lecture series"

"The opportunity of meeting senior executives and other members from a management team drawn from Production, Sales, R and D, was a very gainful experience".

There were many other such experiences which were perceived by the students as having a very useful value.

**Conclusion**

This study was undertaken with the purpose of developing an understanding about the process of learning as seen from the perspective of the students. Since the data

pertains to only fifteen students no generalizations can be made. However, the following conclusion can be drawn from the data although tentatively:

1. The experiences from which students learn about being effective managers, vary. Most of the events identified as significant learning experiences by students occur in the course of everyday work or life experiences. This indicates that there is a need for understanding how management students and also experienced managers learn through natural daily life experiences. Academicians and professionals in the field of Training and Development have been concerned more with the identification of skills which make an effective manager. Very little attention has been devoted to understanding how skills are acquired by managers.
2. The data reported in the study also indicates that learning events have a very specific and personal significance for the student. It is, therefore, necessary for Management Teachers and Trainers to provide ample opportunities for students to examine their own experiences. Management courses for experienced managers and for those who have no work experience have been criticized for being dominated by the teacher's own specialization and perspective. The findings reported here emphasize the need for learner centred courses.
3. There is an increasing need for managers to be self reliant. If management education programmes are to help managers to become more self reliant, the design of such programmes must enhance a manager's capacity and willingness to take control and responsibility for events particularly for himself and his own learning. This can be achieved only if managers can develop insights into their own process of learning. Personal experiences and a reflections on these experiences should be an explicit agenda in management development programmes.

## REFERENCES


**Akin, Gib.** Varieties of Management Learning Organizational Dynamics 1987.

**Ashton, David.** Institutional Values and their effects in Management Education: Are learning Institutions learning Organizations 1986, Unpublished Paper.

**Boyatzis, Richard.** The Competent Manager. Wiley Eastern, 1984.

**Burgoyne, John.** 'The Nature, use and acquisition of managerial skills and other attributes' Personnel Review, 5(4), 1976.

**Burgoyne, John.** 'Learning Processes in the Acquisition of Managerial Skills and Qualities', Management Education and Development 7(3), 1976.

**Burgoyne, John Pedder, Mike Boydell, Tom** A. Manager's Guide to Self Development, McGraw Hill Book Co., 1986.

**Davis, Julia Mark and Easterby Smith.** 'Learning and Developing from Managerial Work experiences', Journal of Management studies, 21(2), 1984.

**Keller, D Finestone P. Lowy, A.** 'Managerial Learning: First Notes from an Unstudied Frontier', Group and Organization studies 11(3), 1986.

**Kolb, D.A. Lublin, Spoth J. Baker R.** 'Strategic Management Development Using experiential learning theory to assess and develop Managerial Competencies', Journal of Management Development, 5(3) 1986.

**Kolb, D.A.** 'Experiential Learning : Expreience as a Source of Learning and Development', Englewood Cliffs, New Jersey, Prentice Hall, 1984.

**Margerison, Charles.** 'Chief Executives Perceptions of Managerial success factors', Journal of Management Development 3(4), 1986.

**Mukhi, Suresh.** 'Educational Needs of Managers in Australia. The Future of Managerment Education', Gower Publishing Company, 1984.

**Orpen, Christopher.** 'Ethnomethodology as a Model for Management Research & Development', Management and Labour studies, 14(1), January 1989.

**Temporal, Paul.** 'Non Contrived Management Learning', Management Education and Development, 9(2), 1978.


□

**Here Comes the Training Wave**

"We are about to go into the training and retraining business on a tremendous scale . . . more than simple occupational skills. The new industries operate in, or create, a new culture as well—they bring new values: they reward new attitudes and lifestyles . . . It's a cultural jump as well as merely a change in job skills . . . Unless we help them enter the new cultures as well as the new economy, we are going to tear society apart."

*—Alvin Toffler, Futurist*

"Whereas in former years an organization could expect reasonable periods of technological stability between waves of change, today, in more and more industries, one change rapidly follows another. The purpose of training is to help people develop skills, not only for today's technology, but for tomorrow's and the day after's . . . . Learning has to be continuous because organizations face continual change of products, services, processes, markets, and competition, as well as technology. *Since everyone is caught up in change, everyone should be involved in learning.*"

*—The Work in America Institute report, "Training for New Technology"*

# Structural Transformation & Agricultural Stagnation in Kerala

**K.V. Joseph**

*Kerala's agricultural sector has been displaying signs of stagnation since mid-seventies. The pulls from opposite directions that stem from the structural transformation like the fall in the number of cultivators accompanied by an increase in the number of non-cultivating owners count much more than any other factor in bringing about stagnation in agriculture. Such a paradoxical situation originating from the crucial role of the cash crops of perennial nature in sustaining the structural changes paves the way for the domination of non-cultivating owners in agriculture who instead of raising productivity of land treat it only as a supplementary source of income.*

*K.V. Joseph is a Professor of Economics in the St. Xavier's college, Thumba, Trivandrum.*

The agricultural sector of Kerala which had been displaying fairly impressive rates of growth during the fifties and sixties started showing signs of stagnation since the mid-seventies. The state domestic product originating from agriculture has recorded a fall from Rs.628.63 crores in 1975-76 to Rs.587.2 crores in 1986-87 (GOK, 1988). A study on the pattern of agricultural development in India, Bhalla and Tyagi (1989) has calculated that the annual compound rate of growth was 0.64 percent for the period from 1970 to 1980. The stagnation has not been merely a fall in the growth rate alone. The gross cropped area in the state has fallen from 2.98 million hectares in 1975-76 to 2.87 million in 1986-87 (GOK, 1988). The number of cultivators in the state which was 1.16 million in 1971 has fallen to 1.06 million in 1981. (GOI,1971 and 1981). Agricultural productivity has also not recorded practically any increase since mid-seventies. (GOK, 1988). The stagnation in agriculture is indeed a multifaceted phenomenon affecting almost all aspects of the agricultural sector.

The stagnation of agriculture has become a topic of importance in the context of the serious efforts made in the successive five year plans for the development of agriculture. A few attempts have been made to identify the factors responsible for the same. According to Sivanandan (1985) "inefficient use of irrigation, insufficiency of inputs like fertilizer and credit, and the lack of long term investment in improving the productivity of the land" have to be postulated as the main causes responsible for the stagnation in agriculture. In another study on the agricultural stagnation of Kerala, Kannan & Pushpangadhan (1988) pinpoints on the environmental degradation in addition to ill-conceived development of critical factors like water and land management as the main causes responsible for the same. Though the role of these factors cannot be dismissed as insignificant, they are by themselves inadequate to explain the overall stagnation that has set in the agricultural sector in Kerala. The rationale for those aspects of agricultural stagnation like the fall in the area and the fall in number of cultivators have to be sought in factors other than the techno-ecological conditions projected in these studies.

Deeper forces would have been at work for a fairly long period in creating the conditions of stagnation in agriculture. This paper seeks to unravel and identify those forces which have culminated in the stagnation of agriculture in Kerala.

**Approach to the Study**

Agriculture has been the most important economic activity of man till the Industrial Revolution of 18th and 19th centuries. Since then, agriculture has declined in importance in so far as the aggregate value of output produced at least in some of the highly developed countries of the world. Industrial and tertiary activities have emerged as the most important activities as sources of income and also avenues of employment. Migration of people to the growing urban centres in search of new avenues of employment has become another feature of the declining importance of agriculture. Structural changes of the sources of income as well as avenues of employment have thus become integral parts of the development process of the modern period.

An era of change on similar lines appears to be emerging in Kerala also. The proportionate share of the income originating from agriculture as a percentage to total income has declined from 46.44 percent in 1970-71 to 32.62 percent in 1986-87 (GOK, 1988). Tertiary activities comprising trade, transport, banking, public administration and other services etc. have emerged as the most important sources of income in Kerala (GOK, 1988). Migration of people in search of non-agricultural occupations has also become a fairly widespread phenomenon in Kerala. Further, the quality of life as reflected in the low infantile mortality rate, longevity of average expectation of life, high literacy rate and improved health services would perhaps be as high in Kerala as in that in any other advanced country in the world.

However, the pattern of structural transformation discernable in Kerala appears to be circumscribed by a number of anomalous elements. Notwithstanding the potentials of tertiary activities like trade, transport, bankng etc. in acclerating the process of development, those activities by themselves are not in a position to sustain the growth of the economy, since such activities do not result in the production of any material good. They can operate and expand only on the base provided either by the primary agricultural activities or industrial activities. In Kerala, the tertiary activities have been expanding while agricultural sector has been stagnating and industrial sector has not been displaying any tendency for expansion. In no other part of India such a peculiar situation seems to exist. Maharashtra and Tamil Nadu may come close to Kerala in so far as the decline of the agricultural sector and the expansion of the tertiary sectors are concerned. However, in those two states industrial sector is sufficiently large to support a growing tertiary sector (CSO, 1986). A few questions would therefore arise for serious consideration. How can it be possible for the tertiary sector to expand when neither the primary sector nor industrial sector expands? Can there be other sources of income which sustain the tertiary sector?

In Kerala, as stated earlier, the number of cultivators has been declining since the seventies. However, the number of people owning land in the state appears to be on the increase. The number of holdings above 0.2 hectares in size was 43 lakhs in 1985. (GOK, 1988) They form nearly 89 percent of the total households in the state; against less than 30 percent of the households engaging in actual cultivation of land (GOI, 1981). Further, as already stated, there is an actual fall in the extent of the gross area under cultivation. When there is an actual fall in the number of cultivators accompanied by a fall in the gross cropped area, why should so many people own land?

Significantly the number of unemployed in the state is also swelling. The bulk of the unemployed seems to be educated persons. The state is reputed to be the most literate state in India. Why are they not coming forward to increase agricultural production by increasing the gross cropped area or by raising the productivity of the land? After all, human capital enriched through education accounts much more than any other input in raising agricultural productivity.

The pattern of structural transformation that has emerged in Kerala appears to be beset with pulls from opposite directions. The stagnation that has crept in the agricultural sector would appear to be the outcome of those pulls. The sections that follow contain an enquiry to find out how the pulls from opposite directions have originated and also the manner in which they contributed to the stagnation of agriculture. The study approaches the problem from a historical angle by relying mainly on secondary data.

**Emergence of Cash Crops as the Leading Sector**

It is well-known that Kerala has been a beneficiary of inward remittances, being part of the earnings of the Keralites working outside the state. Instances of the inflow of remittances were noticed even during the thirties though the amounts involved were not very big. The quantum of remittances assumed massive proportions with the exo-

dus of large number of Keralites to the oil-rich countries of the Persian Gulf region since the oil-boom of the seventies. It is estimated that the remittances range anywhere between Rs.500 to Rs.800 crores per year (GOK, 1987). Needless to say that the remittances would be one of the main source which sustains the tertiary sector in the state. A major portion of the remittances is being utilised for meeting the expenditure on items like the consumption needs of the migrant house-holds including conspicuous consumption, construction of residential buildings, consumer durables, transport etc. Such expenditure count to a large extent in boosting the tertiary sector.

The remittances became fairly large only after the oil-boom of the seventies. Tertiary sector in Kerala was fairly large and wide even earlier. The tertiary activities and services appeared to have assumed importance from the early decades of the 20th century when the economy as a whole began to show signs of progress and development. Till then, some sort of an economy with subsistence farming and customary services prevailed. The bulk of the people were leading a very simple mode of life by meeting only the bare needs of life as may be inferred from the following observation by a well informed authority: "rice conjee is the chief diet and for the rest esculent root with which the country abounds supply the deficient sustenance, his clothing is scanty, jewels are nearly unknown, housing condition is cheap" (Aiya, 1906). In respect of housing, transport, trade, banking and other services which fall within the domain of tertiary sector the conditions were really backward and primitive by any standard. There were, for example only 4045 houses with tiled roofs out of a total number of 5.37 lakhs houses in the whole of Travancore in 1891 (Govt of Travancore, 1891).

Expansion of the economy including that of the tertiary sector became conspicuous with the spurt in the prices of cash crops. Kerala which had a tradition in cultivating and exporting a variety of cash crops like pepper, ginger, turmeric, lemongrass, coconut, arecanut, cardamom and rubber began to display signs of progress and development when the international prices of these crops started to rise. Though prices began to increase from the latter half of 19th century, the rate of increase was very moderate in the beginning. The turning point came with the First World War. The index of export prices with 1870 as the base which was only 154 in 1913 went upto 284 in 1917-18 and continued to remain well-over 200 upto the world-wide Depression of the thirties (Govt. of British India, 1935). As a result, the export earnings of Travancore region of Kerala, which was only Rs.1.69 crores in 1899-1900 increased to Rs.11.84 crores in 1926-27 (Govt of Travancore, 1928). Earnings from the exports accounted for Rs.9.65 crores in 1931 while the total volume of income originating in the state itself was estimated at Rs.26 crores (Govt of Travancore: 1931). Naturally the export earnings would have accounted for more than one third of the state income. Among the items in the export trade, cash crops formed the most important item, constituting more than two-thirds of the total earnings. In fact, the share of the cash crops which was only 54 percent in 1899-1900, has increased to more than 68 percent by 1926-27.

Close on the heels of the increased inflow of export earnings, the era of development ushered in Travancore. New business ventures like joint-stock companies, banks and plantations were opened.

An all round improvement in the standard of living of the people leading to an expansion of internal trade and various other economic activities also took place in close succession. Expansion of vehicular transport also commenced. Simultaneously there was an extension of cultivation mainly for the purpose of raising cash crops. Quite interestingly the Travancore Banking Enquiry Committee of 1930 has reported of an instance of peasant migration from Kuravilangad in Meenachil taluk to Kavalangad in Muvattupuzha taluk in search of land suitable for ginger cultivation (Govt of Travancore, 1930).

The immobile peasantry of Travancore also ventured into a migratory movement to the Malabar region in search of wastelands suitable for extension of cash crops cultivation. Malabar region which was lagging behind could also make steady progress with the extension of cash crop cultivation initiated by the migrant farmers from Travancore. (Joseph, 1988 a) Simultaneously, the tertiary sector also began to expand as a concomitant variable.

**Cash Crops - Tertiary Sector Links**

Notwithstanding the overall dependence of the tertiary sector on cash crops the dependence of certain elements of the tertiary activities on cash crop cultivation is direct and intimate. Trade, transport, banking, finance and real estate form some of these activities which are directly dependent on cash crop cultivation. In Travancore, the number of banking companies for example, which was only 5 in 1918 increased to 258 in 1928 in the wake of increased flow of income from exports (Govt of Travancore, 1930). Interestingly, Travancore accounted for about 2 percent of the total number of banks in the whole of India in 1932-33 (Oommen, 1976). Further the banks which were operating in the villages were catering mainly to the needs of the ordinary peasants.

Expansion of cash crop cultivation in its turn is dependent on trade and transport. Needless to say, trade is

the only channel through which the cultivators can secure the benefits of any rise in the prices of their crops. Similarly, expansion of vehicular transport facilities ensure the movement of crops to the commercial centres. The other elements in the tertiary sector like public service, education, housing personal and cultural services could expand in Kerala only on the surplus rendered by the cash crop sector.

The dependence of the tertiary sector on cash crops continued to remain intact. Industrial enterprises capable of generating income at an accelerated rate are yet to emerge in Kerala. Those industries like the coir industry, and the cashew industry which have come into existence in Kerala depend on cash crops for their raw material requirements. In fact, the Gulf money could only supplement what the cash crop sector has been doing all these years in sustaining and nurturing the tertiary sector in Kerala.

Cash crop sector thus functions like the leading sector in the economy of Kerala. The domination of the cash crops would certainly have its impact on the cropping pattern. No wonder, cash crop cultivation is being extended in the state eventhough agricultural sector as a whole has been displaying signs of stagnation including that of a fall in the gross cropped area.

Table 1. Index of area under different crops in Kerala (Base = Triennium ending 1969-70)

| Name of the Crop | Index of area in 1980-81 | Index of area in 1984-85 | Index of area in 1986-87 |
|---|---|---|---|
| Paddy | 95.01 | 86.5 | 78.60 |
| | (29.17) | | (23.12) |
| Tapioca | 79.80 | 70.6 | 62.80 |
| | (8.49) | | (6.71) |
| Arecanut | 92.30 | 85.6 | 87.03 |
| | (2.1) | | (2.1) |
| Cashewnut | 141.80 | 137.5 | 134.21 |
| | (4.8) | | (4.75) |
| Coconut | 104.20 | 109.9 | 112.96 |
| | (22.6) | | (24.6) |
| Tea | 88.00 | 85.2 | 84.39 |
| | (1.3) | | (1.2) |
| Ginger | 108.0 | 124.7 | 142.15 |
| | (0.4) | | (0.57) |
| Cardamom | 100.00 | 108.6 | 116.18 |
| | (1.8) | | (2.21) |
| Coffee | 183.40 | 202.6 | 207.78 |
| | (2.00) | | (2.28) |
| Rubber | 139.90 | 183.5 | 204.64 |
| | (8.2) | | (12.11) |
| Pepper | 111.20 | 108.9 | 132.59 |
| | (3.8) | | (4.48) |
| Others | (15.34) | .. | (15.85) |
| All crops | 101.00 | 101.4 | 101.18 |

*Source* : GOK (1988)
1) Base year for ginger and cardamom 1975-76.
2) Figures in the brackets are the percentages of the crops to the total cropped area.

Among the crops indicated in the table rice and tapioca fall within the category of food crops, while all the others fall within the category of cash crops, though some of them like coffee or tea are consumed as beverages. Almost all the cash crops have recorded an increase in area under cultivation. The only exceptions are arecanut and tea. On the otherhand, the area under rice and tapioca, the two foodcrops which form the staple food of Kerala has recorded a serious fall. The total area under these two crops which was 38 percent in 1980-81 has fallen below 30 percent by 1986-87. (Table 1)

The extension of cash crop cultivation depends on two factors. First, the agro-climatic condition of Kerala is suitable for cash crop cultivation rather than for food crops. Though certain crops like tea or cardamom can thrive only on the regions of high altitude the important cash crops like rubber, coconut, cashewnut or even pepper can grow in almost all parts of the State with less moist content in the soil. On the other hand, rice, the staple food of Kerala grows only on wetlands. While cash crops can be conveniently extended to wetlands, rice cannot be extended to drylands. Secondly, as an economic venture, cultivation of cash crops have become more remunerative or profitable than food crops (Panicker et al, 1978). As already stated, extension of cash crop cultivation commenced only when they became profitable with the spurt in prices. The growing popularity of cash crops and the capacity of cash crops to support the tertiary sector stem from these two factors.

### Unhealthy Situation

However, some sort of an unhealthy situation has emerged in the agricultural sector apparently because of the attractive prices of the cash crops. Cash crop cultivation could be expanded in the beginning because plenty of cultivable wasteland was available. The area of wastelands has been more or less exhausted towards the beginning of the seventies. The index of cropped area itself has increased from 101.06 in 1980-81 to 101.18 only in 1986-87 indicating the non-availability of land for further extension of cultivation. *Ipsofacto* any further extension of cash crop cultivation could take place only at the expense of food crops. Extension of cash crops at the expense of food crops appeared to have commenced with the exhaustion of wastelands suitable for cash crops. Evidently the increase in the area under cash crops from 44.70 percent in 1975-76 to 54 percent of the total area in 1986-87 was due to the extension of cash crops at the expense of food crops.

Closely connected with the increase in cash crops another change has been also in the offing. The cash crops which are gaining in importance and displaying continuous expansion are perennial crops like rubber, coconut, coffee or cashewnut. Even coconut which is affected by root-wilt disease has been expanding in the state except in a few districts.

The extension of perennial cash crops at the expense of food crops need not necessarily be an undesirable development provided they are sufficiently productive and remunerative as to make good the loss, if any, sustained with the fall in food crop cultivation.

Though one or two crops have been displaying slight improvement in productivity, the overall situation is one of stagnation. Further, permanent crops do not provide any scope for intercropping and crop rotation, two important methods suitable for optimum output from each acre of land. Naturally, extension of perennial crops adversely affects not only food production but also the over all agricultural production in the state.

**Domination by Non-cultivating Owners of Land**

There are valid reasons to believe that the manner in which cash crop cultivation is extended and the purpose for which such extension is promoted operate as crucial factors for the fall in the area under food crops and to the eventual stagnation of the agricultural sector. As already stated some sort of structural transformation involving a shift of population from the agricultural to the non-agricultural sectors is taking place. However, the vast majority of the people who have left agriculture as an occupation in the wake of the structural transformation do not leave agricultural sector once for all. Many of them engage in non-agricultural occupations and at the same time retain agricultural holdings as non-cultivating owners. Otherwise there is no reason why 89 percent of the households should own land while the actual number of cultivators in the state is much less.

All of them would not be mere marginal farmers. A good many among them would be owning extensive areas of land. Unfortunately data relating to the number of such land holders and the extent of land owned by them are not available. According to the Land Reform Survey of 1966-67 there were nearly 2.9 lakhs non-cultivating holders who owned land in the range 1 to 2.5 acres in area. The land owned by them aggregated to 10 percent of the total holdings covered by the Survey (GOK, 1968). There is every reason to believe that the number of such owners have increased in the state since then.

It is well-known that a large number of government servants, teachers and bank-officials own land in Kerala. They belong to the class of people who have shifted from agriculture to the tertiary sector. Since majority of them belong to the first generation of non-cultivating classes, many of them would be inclined to retain landed property. Further, majority of them would be staying in the rural areas as urbanization has not made any headway in Kerala. Agricultural holdings with perennial crops would be a supplementary source of income to them.

The class of non-cultivating owners include a good number of traders and business men of the rural areas. It was noticed during the course of a recent survey that there were well-over 200 people doing business of some kind or other in Kodencheri, a village which is entirely occupied by peasant migrants from Travancore since 1940. All of them owned landed property in the village (Joseph, 1988 a). They have been conducting trade as the main occupation in addition to engaging in agricultural operations as a part-time enterprise.

Recently a good number of households whose earning members work in foreign countries like the Gulf region and regularly send money to Kerala have also been taking a keen interest in acquiring agricultural holdings in Kerala. Economic and non-economic gains count with them in acquiring land in Kerala. In Murukkumpuzha, a village where another survey was conducted nearly 10 percent of the total landholdings have been purchased by the emigrant households between 1970 and 1978. (Joseph, 1988 b)

A major reason which induces such non-cultivating owners to retain land would appear to be the possibility of raising different varieties of perennial cash crops like coconut or rubber or cashewnut without involving personal participation in the process of cultivation. Significantly the area under perennial cash crops has been recording a steady increase since seventies. The prices of such crops are stated to be stable with widespread marketing and storage facilities available to them. Further, productivity of each hectare of land in terms of value of output in Kerala is stated to be the highest. Against an average income of Rs.3129 generated from the cultivation of a hectare of land in India as a whole, the average income from Kerala was stated to be Rs.7822 in 1984-85 (GOK, 1987). When land is scarce and the return from each hectare of land is high, it is but natural for the non-cultivating owners also to aspire for retaining land under their ownership if any. Further, opportunities for employment in the non-agricultural sector has not grown in proportion to the growth of population.

Ownership of land would be a source of income to those who are anxious to leave the agricultural sector also.

When non-cultivating owners thus dominate the agricultural sector the over all agricultural productivity would be the casuality. Like the absentee landlords of the past, the new class of owners would not be inclined to adopt intensive methods of cultivation for the purpose of raising the yield from the land. Many of them retain the land precisely because perennial cash crops do not require their personal attention. They would naturally get their land cultivated by hiring the services of agricultural labourers and any income which such indifferent cultivation fetches to them would meet their limited purpose of cultivation.

Further, the imposition of land tax at very low rate - being at about Rs.5 per acre, provides scope for owning land at very low real retention cost. In this respect the observation of Boserup (1965) about the agricultural policy in India as one which allows land owners to evade their fair share of economic burden of population increase holds good in so far as Kerala is concerned.

## Exodus of People from Agricultural Sector

The rapid spread of education in the state appears to have promoted an attitude favourable for migration among the people and thereby to the acceleration of the structural transformation of the economy. Keralites who were apathetic to any type of spatial mobility began to move far and wide in search of better occupation with the spread of education in the state. The urge for migration became conspicuous among the educated who became infatuated with the cult of the shirt and began to abandon agriculture and other traditional occupations as far back as the early decades of 20th century. It had its repurcussions in the agricultural sector which came to the notice of the Unemployment Committee of Travancore (1928-29) which observed that "the fall in the actual workers engaged in agriculture can only be explained by the fact that the people are abandoning agriculture for more attractive occupations". The exodus of the educated from the agricultural sector continued to remain unabated. In consequence agriculture has become an occupation of the uneducated and the marginally educated. (Table 2)

It is well-known that Kerala is the most literate state in India. However, agriculture has become an occupation of the less educated. As Table 2 indicates, the overwhelming majority of cultivators possess educational qualifications below matriculation only. Every year, nearly 2 lakh persons come out successful in the S.S.L.C. examination in the State. However, the number of cultivators in the state

Table 2. Composition of Cultivators on the Basis of Educational Qualification (1981)

(Rural areas only)

| Level of Educattion | Number of Male cultivators. | Percentage | Number of Female cultivators | Percentage |
|---|---|---|---|---|
| Illiterate | 82203 | 10.54 | 27045 | 34.5 |
| Literate with no formal Education | 199271 | 25.75 | 17296 | 22.5 |
| a) Primary level | 244289 | 31.32 | 20056 | 25.5 |
| b) Middle school | 175273 | 22.47 | 10068 | 12.8 |
| c) Matriculation | 64047 | 8.21 | 3438 | 4.2 |
| d) Above matriculation | 14764 | 1.89 | 491 | 0.5 |
| Total | 779842 | 100.00 | 78394 | 100.0 |

*Souce: Census of India 1981 : Series 10, Kerala Part III*

with matriculation or above as eductional qualification totalled only 82740. It reflects the apathy of the educated to take up agriculture as an occupation. It is reported that the educated persons, even if they are unemployed are reluctant to take up cultivation as an occupation.

Not only the educated, but also the younger generation abandons agriculture as an occupation (See table 3).

Table 3. Age composition of cultivators in the state in 1981 (percentage)

| Age Group | Males | Females |
|---|---|---|
| 0-14 | 0.20 | 0.49 |
| 15-19 | 3.31 | 4.34 |
| 20-24 | 9.34 | 7.81 |
| 25-29 | 10.59 | 8.91 |
| 30-39 | 18.63 | 21.45 |
| 40-49 | 19.27 | 24.66 |
| 50-59 | 19.33 | 18.66 |
| 60 and above | 19.15 | 13.63 |
| Total | 100.00 | 100.00 |

*Source: Census of India 1981 : Series 10, Kerala Part III*

As the table indicates the overwhelming majority of the cultivators belongs to the age group 30 and above. Only 23.63 percent of the males and 21.75 percent of the females among the cultivators fall below 30 years in age. It is evident that the younger members of the cultivating households are also reluctant to pursue cultivation as an occupation. Instead, they are eager, to take up white collar jobs. If white collar jobs are not available they seek their fortunes elsewhere by migrating to foreign lands like the Gulf region. Hayami, a Japanese economist who visited Kerala, was appalled to find "potential labourers still stand idle in rural areas looking for non-agricultural employment" inspite of the fairly high rate of wages that prevail in the agricultural sector in Kerala. (Hayami, et al; 1986).

Notwithstanding the role of education in promoting structural transformation, it serves as an important channel through which increase in productivity takes place. As Schultz observes, "the transformation of agriculture in Denmark between 1870 and 1900 could not have been attained without a large investment in schooling of the farm people" (Schultz, 1970, p189). No such improvement in productivity has taken place in Kerala in spite of the remarkable progress in education. Nor the chances for an improvement in agricultural productivity appear to be bright as agricultural sector is dominated by the uneducated and the aged people.

## Conclusion

The foregoing analysis points to the fact that the conflicting pulls which have originated with the structural transformation exert as much influence as any other factor in creating conditions of stagnation in the agricultural sector of Kerala. So long as the extension of cash crop cultivation takes place at the expense of food crops and non-cultivating owners dominate the agricultural sector, stagnation of agriculture including a fall in the gross cropped area and number of cultivators would be the inevitable outcome. Despite its potentialities, education, which constitutes another determinant of the structural transformation has not been effective in improving agricultural productivity. Looking back to the performance of agriculture in Kerala one is constrained to conclude that many of the policies adopted by the government under the successive five year plans have been ineffective in raising agricultural productivity in the context of the peculiar conditions that prevail in Kerala.

## REFERENCES


**Aiya, Nagam. V.** (1906) Travancore State Manual Vol. III, Trivandrum.

**Bhalla, G.S. & Tyagi, D.S.** "Spatial Pattern of Agricultural Development in india" Economic and Political Weekly, June 24, 1989.

**Boserup, Ester** (1965) the Conditions of Economic Growth, George Allen & Ltd., London.

CSO (1986) Monthly Abstract of Statistics.

**GOI** (Government of India) (1935) Statistical Abstract of British India 1923-24 to 1932-33, Delhi.

**GOI** (Government of India) (1971) Census of India Series 9 Kerala Part II (b) II Economic Tables

**GOI** (Government of India) (1981) Census of India Series 10 Kerala part III

**GOK** (Government of Kerala) (1968) Land Reforms Survey 1966-67, Bureau of Economics and Statistics, Trivandrum.

**GOK** (Government of Kerala) (1987a) Economic Review 1987, State Planning Board, Trivandrum.

**GOK** (Government of Kerala) (1987b) Kerala Economy in Figures, Directorate of Economics and Statistics, Trivandrum.

**GOK** (Government of Kerala) (1988) Statistics for Planning 1988, Directorate of Economics and statistics, Trivandrum.

**GOT** (Government of Travancore) (1891) Report of the Census of Travancore 1891, Trivandrum.

**Government of Travancore** (1928) Report of the Unemployment Committee of Travancore 1928, Trivandrum.

**Government of Travancore** (1930) Travancore Banking Enquiry Committee 1930, Trivandru.

**Government of Travancore** (1931) Report of the Census of Travancore 1931 Appendix IV Economic Conditions of the People, Trivandrum.

**Hayami, Yujiro,** et al (1986) Asian Villages at the Cross Roads, Tokyo, University Press.

**Joseph, K.V.** (1988a) : Migration and Economic Development of Kerala, Mittal Publications.

**Joseph, K.V.** (1988b) : "Rising Agricultural Wage Rates-A Sign of Keralas Economic Prosperity ?" Indian Labour Journal Vol. 29, No: 4.

**Kannan, K.P., Pushpangadhan. K.,** (1988) : "Agricultural Stagnation in Kerala An Explonatory Analysis" Economic and political weekly, Sept. 24, 1988.

**Oommen, M.A.,** (1976) : "Rise and Growth of Banking in India. The Social Scientist, Vol. 5, No. 5.

**Panicker, P.G.K.,** et al, (1978) : Population Growth and Agricultural Development. A Case Study of Kerala F.A.O. Rome.

**Schultz, Theodore** (1970) : Studies in Comparative Economics, Lal Book Depot, Ludhiana.

**Sivanandan, P.K.** (1985) : Kerala's Agricultural Performance. Differential Trends and Determinants of Growth, M. Phil Thesis, J.N.U., New Delhi.


□

# Production of Soyflakes at Rural Level

**B.D. Shukla & R.T. Patil**

*Soybean is a viable crop which can fulfill the requirement of protein as well as fat if rural based technology is made available for its processing. This paper describes an assessment of protein need in the daily diet of rural people. In order to meet the protein need from soybean, a technology package for production of soyflakes at rural level has been developed and presented in this paper.*

*B.D. Shukla is Head, Post Harvest Engg. Division and R.T. Patil is a Sr. Scientist at the Central Institute of Agricultural Engineering, Nabi Bagh, Bhopal-462 018*

Soybean (Glycinemax M) is a rich source of protein (40%) and fat (20%) and can be substituted in Indian diets to make it rich and nutritive. It is a potential crop in India and has production in increasing order since 1973 (Kapoor, 1988). Madhya Pradesh is called soybean state of India where over 90% of cultivable lands are covered with soyabean. According to an estimate, the State has plan of producing over 1.5 million tonnes of soybean by the end of this century (Shukla and Saxena, 1987). Thus, this crop has a vast potential of production in near future and is able to meet the needs of protein and fat requirements in the daily meal of common man if feasible processing technology at rural level is made available.

Indigenous soyproducts, have been developed by several Institutions in India viz. Central Food Technological Research Institute (CFTRI), Mysore; Andhra Pradesh Agril. University (APAU), Hyderabad; JN Krishi Vishwa Vidyalaya (JNKVV), Jabalpur; University of Agril. Sciences (UAS), Bangalore etc. (Vaidehi and Vijayakumari, 1981), but so far attention has not been given to the development of equipment and machinery for the production of soybased food products at rural or small scale level in the country.

Cereal flakes, in various forms, are taken almost through out the country. Flakes are prepared traditionally from rice, maize, millets, gram, etc, in villages. Hence, if an appropriate technology for production of soyflakes is made available, soyflakes will find its place in the diets of rural people. It will make the diet rich and also generate employment in rural areas. Keeping in view the present national need, the problem was undertaken with the following objectives:

i) To find the status of nutrition in some selected villages and identify the food habits of people to evaluate the substitution of soyflakes in their diets.

ii) To develop technology package for production of soyflakes at rural level/small scale level.

**Materials and Methods**

The important components of this study were: (i) the

status of nutrients in the daily diet of rural people, (ii) development of equipment for production of soyflakes and, (iii) testing and evaluation of equipment.

### Nutrition Survey

Nutritional status in the daily diet of rural people was evaluated in five selected villages; Islamnagar, Karond, Lambakheda, Nabi Bagh and Palasi, situated near the Central Institute of Agricultural Engineering (CIAE), Bhopal. To simplify the work, farmers in the villages were divided in 5 categories based on their land holding capacity (Table-1). The dietary survey was conducted keeping in view the age of family members in a family. Each family was divided into the age group of 0-6, 7-12, 13-18 and above 18 years. A proforma containing the required informations to be collected was given to housewives of all the families living in the villages and was taken back once it was completed by them. The consumption of protein, fat and carbohydrates were estimated as per the procedure described by Shukla and Saxena (1987).

Table 1. Category of farmers in villages

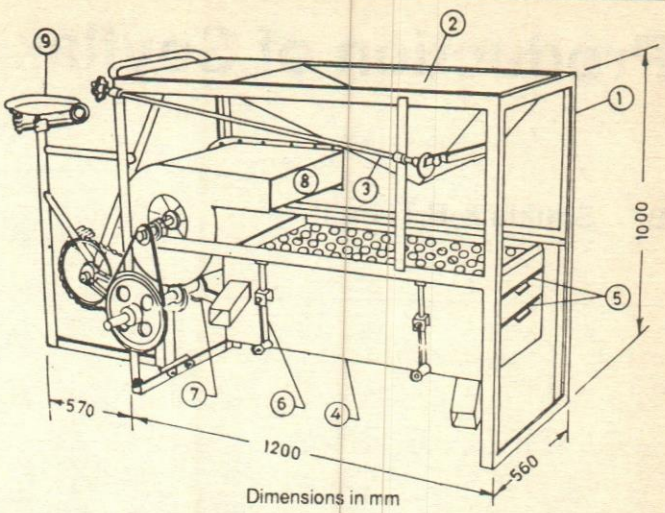
| Category of farmers | Land holding, ha |
|---|---|
| Big farmers | 5 & above |
| Medium farmers | 2 to 5 |
| Small farmers | 1 to 2 |
| Marginal farmers | 1 & less |
| Landless farmers | No land |

### Equipment

For various required unit operations, equipment either were developed or selected.

### Cleaning and Grading of Soybean

It is a primary and important operation. A cleaner-cum-grader developed at CIAE, Bhopal (Kachru et al 1986) was found suitable to serve the purpose. This is a pedal-cum-power operated cleaner where the separation takes place on the basis of size and shape of the grain (Fig. 1). A blower is attached in the front side to remove the lighter materials. The grains are passed through a hopper and fall on a vibrating sieve (8mm size). The larger materials (than the grains) are retained over the first sieve whereas the sound grains pass through the same. If required the cleaned grains can further be graded by changing the size of the sieves. The recommended sieves for soybean are 7 mm on the top and 3.2 mm at the bottom.




Dimensions in mm

(1) Main Frame (2) Hopper (3) Feeding Mechanism) (4) Sleve Box (5) Scalping and Grading Sleves (6) Shoe for Sleve Box (7) Eccentric Unit (8) Centrifugal Blower (9) Standard Bicycle Parts.

**FIG. 1 PEDAL OPERATED AIR SCREEN GRAIN CLEANER**

### Dehulling of Soybean

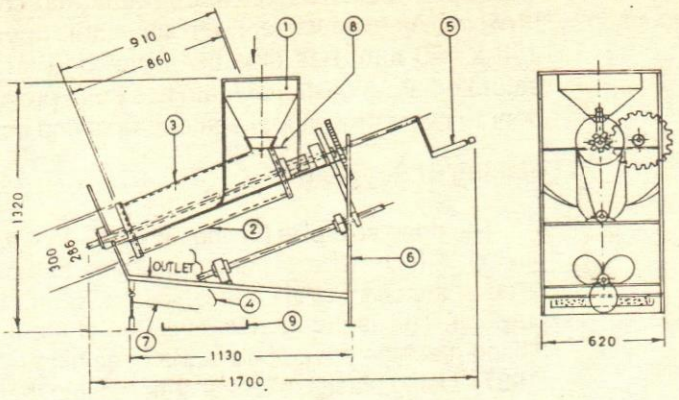
Soybean kernel contains about 10% hulls. The hulls contain cellulosic materials which are undesirable for human consumption. Otherwise also for making the flake, removal of hulls is essential (Smith & Circle, 1972).

A manually operated soybean dehuller (Fig.2) has been developed at the CIAE which meets the requirement (Singh & Shukla), 1989). It consists of two concentric cylinders, a driving mechanism and a blower/fan. A perforated deflector has also been provided in front of the fan which separates the brokens.

During the operation, the inner cylinder (286 mm diameter 860 mm length) rotates while outer one (300 mm diameter and 910 mm length) remains stationary. The flowability as well as dehulling capacity is regulated by increasing and decreasing the slope of the cylinders. Similarly, speed of rotation of the cylinders also controls the recovery. Clean soybean is fed through a hopper provided on the top. The clearance between the two cylinders is maintained at 75% of average grain size of the soybean. Due to shear and friction, soybean is splitted and hulls are loosened. The hulls and splitted soybeans are separated by passing the mixture through the perforated deflector provided near the outlet of the cylinders.

### Blanching of Soybean Splits

The clean splitted soybean is blanched in boiling water to reduce the trypsin inhibitor activity and urease activity to acceptable level (Nelson et al, 1980). For this purpose a

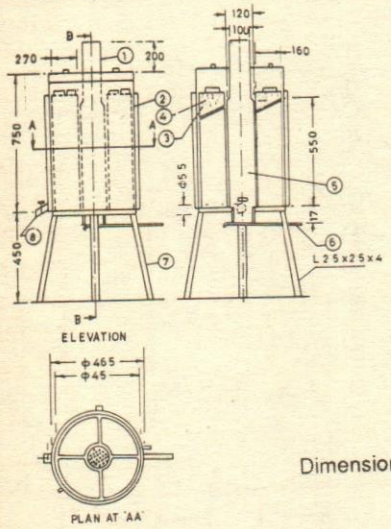



(1) Hopper
(2) Inner Cylinder
(3) Outer Cylinder
(4) Fan
(5) Handle
(6) Stand
(7) Deflector Screen
(8) Feed Adjuster
(9) Dhal Collector

Dimension in mm

**FIG. 2. SOYBEAN DEHULLER (MANUAL)**

blancher was developed (Patil, et al; 1987). The unit is made of 22 gauge GI sheet metal with two concentric cylinders (Fig. 3). The central cylinder, which serves as burning-cum-heat exchanging unit, differs in size in lower and upper portions, the diameters of which are 120 and 100 mm respectively, the diameter of outer cylinder is 450 mm. The splitted soybeans are kept in hot water held in the annular space between the outer and inner cylinders.




View at 'BB'

(1) Burning Cylinder
(2) Outer Cylinder
(3) Asbestos Rope Insulation
(4) Perforated Gauge
(5) Burning Zone
(6) Grate
(7) Stand
(8) Gate Valve

Dimension in mm

**FIG. 3 SOYBEAN BLANCHING UNIT USING AGRICULTURAL WASTE AS FUEL**

The outer cylinder is insulated with flattened asbestos rope of about 12 mm dia imbedded with plaster of paris. The central cylinder is extended 200 mm in length beyond the outer cylinder providing chimney effect which accelerates the combustion of fuel. At the bottom of the central cylinder, a removable grate is provided which holds the solid fuel and also serves as an inlet for air required for combustion. The cylindrical unit rests on a mild steel frame having 45 mm height. For convenience of loading and unloading and to facilitate reuse of hot water, soybean is kept in four cages made from perforated mild steel sheet metal with zinc or chromium coating. A gun-metal valve is provided to drain the water after processing the soybean. The reuse of hot water saves processing time and energy.

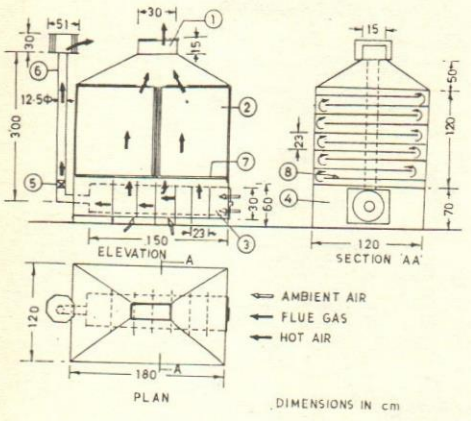
## Drying of Blanched Soybean

Drying of raw as well as blanched soybean is essential. At primary processing level, sundrying is practiced. Drawbacks in sundrying of cereal crops have been described by Shukla et al (1983) and Shukla, (1984). At secondary level processing of soybean, sundrying is not feasible though a study made by Patil and Shukla, (1989) suggests some improved methodology to achieve quality dried products. Several types of other dryers have also been developed in India (Pillaiyar et al1981 Shankar, 1988; Singh et al 1982 Shukla and Patil, 1989) for cereals but none of them have been adopted by the farmers due to one or other reasons. Therefore, there is the need for a dual purpose dryer which could be used at primary and secondary processing levels of the soybean. Such a dryer was developed, tested and found suitable at CIAE, Bhopal (Patil and Shukla, 1988).

In soyflake making technology, drying of blanched soysplits from 60% moisture content (mc)[1] to 25-30% mc is required in the first stage. In the second stage, the flake

[1] Unless otherwise specified, all the moisture contents (mc) in this paper have been expressed on a wet basis (wb)

is dried to a mc of 8-10%. Thus, for this dual purpose need, a natural convection type dryer was developed (Patil and Shukla, 1988). The dryer (Fig.4) consists of two main parts: Plenum Chamber and Drying Chamber.




Dimension in mm

(1) Saturated Air Vent (2) Drying Chamber to Accomodate 24 Trays of 90 cm x 120 cm (3) Heating Unit (4) Plenum Chamber (5) Butterfly Valve (6) Chimney with Exhauster (7) Wire Mesh (8) Wire Mesh Tray

**FIG. 4. DIMENSIONAL DRAWING OF NATURAL CONVECTION TRAY DRYER**

## Plenum Chamber

The size of the chamber is 1.8 x 1.2 x 0.7 m high having volume of 1.51 $m^3$. The frame is made of MS angle and flats which is covered with asbestos sheet (having fairly good insulating property and strength). The top of the chamber is covered with a wiremesh of 4x4 mm size. The burning (heat exchanging) unit is also housed in the centre of the plenum chamber at an inclination of 3°. The size of the unit is 0.3 m in diameter and 1.5 m in length having 6 fins of 0.6 x 0.45 m size. The volume of the burning chamber is 0.106 $m^3$ and the area of heat exchanging surface is 2.60 $m^2$. A chimney of 150 mm in diameter is provided as shown in Fig. 4. At the exit of the chimney a wind exhauster is provided to avoid the effect of wind direction in disrupting the combustion of fuel. Agricultural waste could be used as fuel in the tray provided in the burning chamber. To achieve an uniform burning with all kinds of agricultural wastes, a butterfly valve is provided in the chimney for manual control of the coming air for combustion.

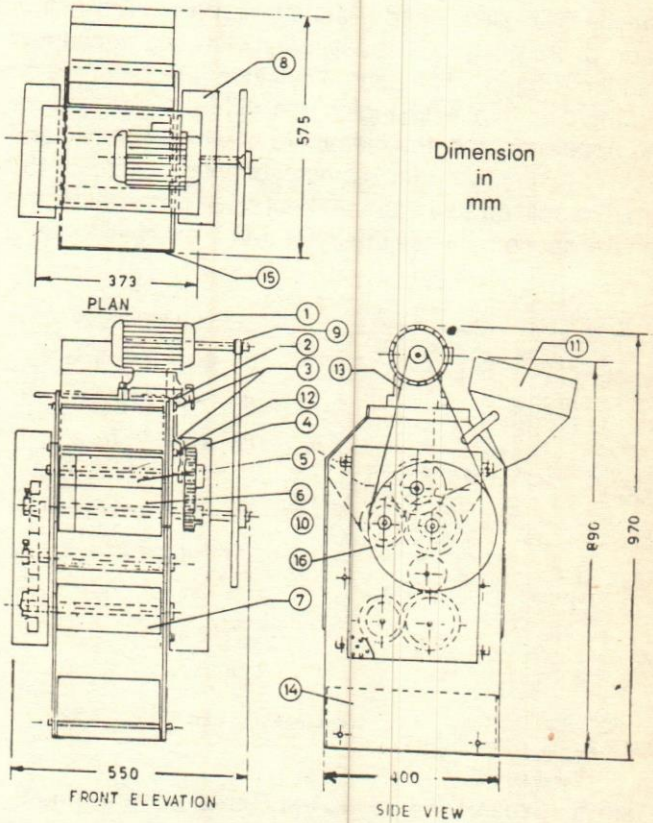
## Drying Chamber

The volume of the drying chamber is 2.60 $m^3$ which is 1.75 times the volume of plenum chamber and the volume of exhaust space is kept as 0.419 $m^3$. The 20 trays made of a wiremesh (1x1 mm) and of 1200 x 900 mm size are kept in drying chamber as shown in Fig. 4. a distance of 100 mm has been provided between the two trays. The chamber is made of soft wood frame and covered with plywood. An exhaust vent with adjustable opening (300 x 150 x 150 mm) has also been provided for escape of saturated air. A gasket of foam has been provided on the door to avoid any air leakage during drying operation.

## Flaking of Soybean

The dried soysplits having mc of 25-30% are used for flaking. A roller type of flaking machine has been developed at the CIAE (Patil and Shukla, 1988a) to serve the purpose. This is the modified version of the three rollers flaking machine developed in the beginning by Patil et al (1987). Using plastic rollers and increasing their numbers from three to five, the efficiency of the machine has been appreciated and quality of the product has also been improved (Patil and Shukla, 1988a).

As shown in Fig. 5 the machine consists of two support frames, a hopper, 4 rollers of 112 mm x 230 mm size and




(1) 2 hp 3 0 Elec. Motor (2) Support Frame (3) Spacers (4) Gear Transmission (5) First Set of Rollers (6) Second Set of Gears (7) Third Set of Gears (8) Gear Cover (9) Drive Pulley (10) Driven Pulley (11) Hopper (12) Hopper Vibrating Mechanism (13) V-Belt (14) Material Collecting Box (15) Cover (16) Spacer Cum Deflector

**FIG. 5. FIVE ROLLER FLAKING MACHINE**

one roller of 88 mm x 230 mm size with a gear train to obtain desired differential speed. The power was given by a 2 hp, 3 phase AC motor. The new nylon material i.e., metalon was considered a substitute to metallic roller to further reduce the noise level and to avoid their repetitive plating. The mechanical properties of the metalon are as given in Table 2.

Table 2 : Mechanical and thermal properties of Metalon rollers used in flaking machine

| Property | Value |
|---|---|
| Tensile strength, kg/cm² | 808-915 |
| Modulus of elasticity, kg/cm² | 21000-28000 |
| Hardness | D-80 to D-85 |
| Flexural strength, kg/cm² | 790-1265 |
| Coefficient of friction | 0.13-0.14 |
| Elongation at break at 23°C, | 40 |
| Thermal coefficient of linear expansion, mm/mm/°C | $9.0 \times 10^{-15}$ |

*Source* : M/s Kanoria Alkalis & Plastics Ltd., Shahidabad (UP)

## Testing Procedures

At laboratory scale study, soybean was taken from CIAE farm. At pilot plant level study, soybean was taken from farmer's field. Primary cleaning was done with CIAE cleaner. Cleaned soybean was passed through dehuller and hence splitted beans after removing the hulls were obtained.

At a time 5 kg of splitted soybean was loaded in each cage of the blancher. The annular space was filled with 60 litres of water and fuel loaded in the central cylinder was faired. The rise in temperature of water and mixture was recorded with the mercury thermometers. A sample of cooked soybean at 10 min. interval was drawn and urease activity was determined as a change in pH units, which was considered as an index for detoxification of soybean (IS: 7837-1975). The thermal efficiency of the blanching unit was computed using the following equation:

$$\eta_{th} = \frac{M_1 C_{p1} \Delta t_1 + m_2 C_{p2} \Delta t_2}{W C \lambda_c}$$

where,

$\eta_{th}$ = thermal efficiency of blancher

$C_{p1}$ = Specific heat of soybean = 0.65 K.cal/kg

$\Delta t_1$ = rise in temperature of soybean, °C

$M_1$ = weight of soybean, Kg

$M_2$ = weight of water, Kg

$C_{p2}$ = specific heat of water, K.cal/Kg

$\Delta t_2$ = rise in temperature of water, °C

W = weight of fuel required per batch, Kg

C = calorific value of fuel (assumed as 4500 Kcal/Kg)

$\lambda_c$ = efficiency of combustion of fuel (assumed as 75%)

Blanched splitted beans having about 60% mc was loaded into the tray dryer (Fig.4). An uniform loading capacity of 5 Kg in each tray was maintained. Thus, at a time 100 Kg of soysplits (60% mc) could be loaded into the dryer. The moisture content of soysplits was reduced to about 30% during the first stage of drying. The soysplits at this moisture content (30%) was passed through CIAE flaiking machine (Fig.5) and thus the flakes were prepared. The flakes were again loaded into the dryer for further drying. Before loading the product, the temperature distribution in the dryer at 12 identified points was recorded. At all the identified points after loading the product, change in temperature was recorded. The ambient temperature and relative humidity (Rh) were also noted during the experiments. The firewood was used as fuel for testing the performance of the dryer. Amount of fuel used for drying the product was weighted and recorded. The position of the trays was interchanged and product was stirred for mixing after an interval of one hour. The composite samples were taken at every one hour interval and their moisture content was determined by standard oven method. The overall thermal efficiency of the dryer was calculated by following equation:

$$\eta_{th} = E_e + E_s / E_f$$

Where

$\eta th$ = thermal efficiency of the drying system, percent

$E_e$ = energy required for evaporation of water, K.cal

$E_s$ = sensible heat required to heat the drying material to average drying temperatures, K.cal

$E_f$ = heat supplied by burning of fuel, K.cal

The values of unknown parameters were determined following the described procedures of Patil and Shukla (1988). Organoleptic method was used to evaluate the quality of soyflakes preparing various type of indegenous snacks.

## Status of Nutrition and Food Habit

In general balanced food is not taken in rural areas as has been observed in nutritional survey carried out in five selected villages. The main source of nutrition in the

villages was observed to be cereals. Meat and eggs are taken by rare families and that too occasionally (Shukla and Saxena, 1987). Rich farmers who can afford to have balanced food, are ignorant about its necessity. As shown in Table-3 the children (age group 0-6 years) of big farmers consume higher amount of carbohydrate and fat than their requirement, but they are lacking in protein. Generally, the status of big farmers is better as they keep dairy cattle. There is a general tendency of feeding more milk and ghee to children in villages. Adults in big farmer families take extra nutrients. Other age groups, even among the big farmers, receive inadequate diet.

Pulses are the major source of protein in cereal based diets. Its production has not been increased as compared to increasing rate of population in India. Hence shortage of protein in all categories of people was observed (Table 4). Among the nutritional disorders, children are affected more due to deficiency of protein and calorie. Protein deficiency in various age groups of people has been observed to be in order of 4-10 gm in their daily diets. During the survey, in general, ill health of children was observed in the villages. It may be due to protein calorie malnutrition which is largely responsible for ill health of children. Thus,

Table 4. Daily consumption of pulses and deficiency of protein in daily diet of villagers

| Type of farmers | Age group of family members, years | Standard requirement of protein from pulses for daily consumption, g | Available for daily consumption, g | Deficiency (-)/Excess (+), g (4-3) |
|---|---|---|---|---|
| Big farmers | 0-6 | 12.2 | 7.926 | -2.474 |
| | 7-12 | 15.5 | 9.162 | -6.338 |
| | 13-18 | 15.5 | 8.304 | -7.196 |
| | Above 18 | 16.6 | 11.926 | -4.674 |
| Medium farmers | 0-6 | 12.4 | 6.782 | -5.618 |
| | 7-12 | 15.5 | 5.600 | -9.900 |
| | 13-18 | 15.5 | 7.527 | -7.973 |
| | Above 18 | 16.6 | 9.184 | -7.416 |
| Small farmers | 0-6 | 12.4 | 5.850 | -6.550 |
| | 7-12 | 15.5 | 7.233 | -8.267 |
| | 13-18 | 15.5 | 8.195 | -7.305 |
| | Above 18 | 16.6 | 7.787 | -8.813 |
| Marginal farmers | 0-6 | 12.4 | 4.792 | -7.608 |
| | 7-12 | 15.5 | 7.235 | -8.266 |
| | 13-18 | 15.5 | 8.135 | -7.365 |
| | Above 18 | 16.6 | 9.976 | -6.624 |
| Landless labourers | 0-6 | 12.4 | 4.762 | -7.638 |
| | 7-12 | 15.5 | 5.494 | -10.006 |
| | 13-18 | 15.5 | 4.810 | -10.690 |
| | Above 18 | 16.6 | 7.504 | -9.096 |

Table 3. Daily consumption of cereals, pulses, jaggery, etc. and deficiency/excess of protein, carbohydrate and fat in daily diet of villagers

| Type of farmers | Age group of family members, years | Standard requirement for daily consumption, g | | | Available for daily consumption, g | | | Deficiency (-)/Excess (+), g | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Protein | Carbo-hydrate | Fat | Protein | Carbo-hydrate | Fat | Protein | Carbo-hydrate | Fat |
| Big farmers | 0-6 | 33.00 | 191.2 | 22.5 | 32.04 | 207.00 | 25.72 | - 0.96 | + 15.80 | + 3.22 |
| | 7-12 | 49.00 | 293.1 | 32.0 | 46.89 | 273.20 | 21.84 | - 2.11 | - 19.90 | - 10.16 |
| | 13-18 | 63.80 | 367.1 | 38.0 | 53.38 | 343.00 | 21.28 | - 10.42 | - 24.10 | - 16.72 |
| | Above 18 | 82.95 | 498.5 | 50.0 | 88.70 | 604.70 | 51.60 | + 5.75 | - 106.02 | + 1.60 |
| Medium farmers | 0-6 | 33.00 | 191.2 | 22.5 | 30.46 | 220.22 | 14.77 | - 2.5 | + 29.02 | - 7.73 |
| | 7-12 | 49.50 | 293.1 | 32.0 | 39.00 | 282.90 | 17.77 | - 10.00 | - 10.20 | - 14.23 |
| | 13-18 | 63.80 | 367.1 | 38.0 | 54.37 | 351.68 | 17.20 | - 9.40 | - 15.42 | - 20.80 |
| | Above 18 | 82.95 | 498.5 | 50.0 | 77.86 | 574.69 | 29.98 | - 5.09 | + 76.19 | - 20.00 |
| Small farmers | 0-6 | 33.00 | 191.2 | 22.5 | 22.4 | 139.84 | 10.58 | - 10.56 | - 51.36 | - 11.92 |
| | 7-12 | 49.00 | 293.1 | 32.0 | 37.11 | 258.27 | 16.99 | - 11.89 | - 34.83 | - 15.00 |
| | 13-18 | 63.80 | 367.1 | 38.0 | 58.60 | 386.15 | 26.91 | - 5.20 | + 19.05 | - 11.09 |
| | Above 18 | 82.95 | 498.5 | 50.0 | 67.55 | 426.55 | 27.59 | - 15.40 | - 35.95 | - 22.41 |
| Marginal farmers | 0-6 | 33.00 | 191.2 | 22.5 | 22.12 | 185.48 | 13.31 | - 10.88 | - 5.72 | - 9.19 |
| | 7-12 | 49.00 | 293.1 | 32.0 | 37.25 | 276.14 | 17.76 | - 11.75 | - 16.96 | - 14.24 |
| | 13-18 | 63.80 | 367.1 | 38.0 | 48.42 | 335.33 | 22.92 | - 15.50 | - 31.77 | - 15.08 |
| | Above 18 | 82.95 | 498.5 | 50.0 | 71.90 | 475.12 | 30.03 | - 11.00 | - 23.38 | - 9.97 |
| Landless labourers | 0-6 | 33.00 | 191.2 | 22.5 | 24.23 | 171.76 | 14.38 | - 8.70 | - 19.44 | - 8.12 |
| | 7-12 | 49.00 | 293.1 | 32.5 | 28.31 | 280.32 | 19.98 | - 20.69 | - 12.78 | - 12.20 |
| | 13-18 | 63.80 | 367.1 | 38.0 | 40.68 | 277.33 | 22.70 | - 23.12 | - 89.77 | - 15.30 |
| | Above 18 | 82.95 | 498.5 | 50.0 | 77.78 | 500.28 | 30.85 | - 5.17 | + 1.78 | - 19.15 |

protein available from soybean could meet its requirement to some extent in the diets of rural people if it is adopted by them.

Since cereals and pulses are the major source of food in villages, food-habit of people is also based on the same and products like chapati, soup, rice, sweet, etc., are very common. Soyflakes could be a substitute food taken at breakfast and evening tea time.

## Process of Soyflake Production

A process flow chart for producing soyflakes has been shown in Fig. 6. Clean soybean having 8-10% mc is passed through CIAE dehuller (Fig. 2), and finally splitted soybean is obtained. Soysplits are then blanched in a blancher (Fig. 3), which attains about 60% mc. Wet splitted beans are dried in a dryer (Fig.4) to a mc of 25-30% and then passed through the flaking machine (Fig. 5), which produces flakes. The wet flakes are further dried 8-10% mc in the same dryer (Fig. 4). After grading, the flakes are packed for consumption.

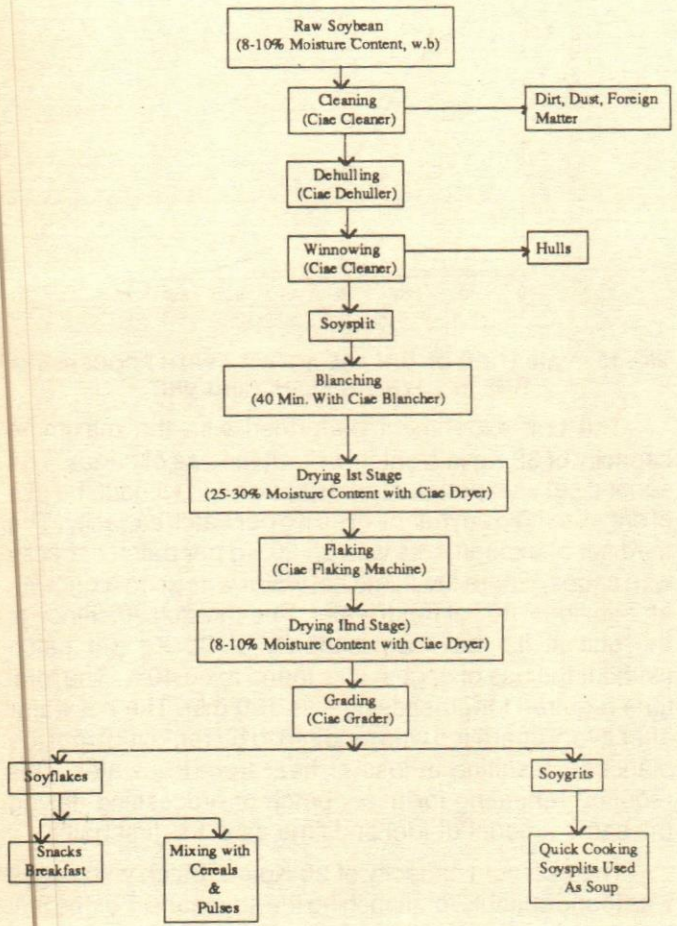



**FIG. 6 : PROCESS FLOW CHART FOR MAKING SOYFLAKES AT RURAL LEVEL**

## Performance of Cleaner

Basically the pedal operated CIAE cleaner (Fig. 1) was designed for rural people where electric power is not available. But, the same cleaner can be operated with an increased capacity by a 0.5 hp electric motor. As shown in Table-5, the capacity of the power operated cleaner was higher by 64% compared to pedal operated cleaner. However, there was no change in cleaning efficiency. For soybean, top and bottom sieve sizes are recommended as 8 mm and 3.2 x 20 mm respectively. Similarly for soysplits the top and bottom sieves are recommended as 3.2 x 20 mm and 3.5 mm respectively.

## Performance of Dehuller

As has been shown in Fig. 7, at increasing cylinder's slope, the recovery of split beans increases. The maximum recovery was obtained at 19° slope and beyond this a significant decline in recovery of split beans was obtained. It also appears from Fig. 7, that broker percentage

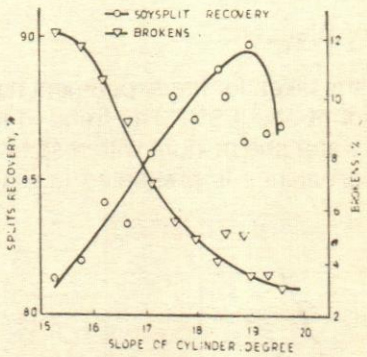



**FIG. 7 PERCENT OF SPLITS RECOVERY CORRESP TO DIFFERENT SLOPE OF THE CYLINDER**

has been declining with increasing the slope of the cylinder. After 19° slope, decrease in brokens percentage tends towards constant. Similarly effect of cylinder slope on hulling efficiency of dehuller is shown in Fig.8, (Singh

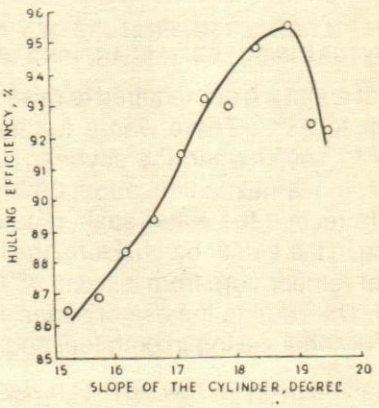



**FIG. 8 : EFFECT OF SLOPE ON THE HULLING EFFICIENCY**

Table 5. Specifications and test results for cleaners used for soybean (JS-7244)

| Equipment | Type | Overall dimensions, mm | Total weight, kg | Capacity, kg/h | Labourer requirement | Cleaning efficiency, | Cost, Rs |
|---|---|---|---|---|---|---|---|
| Hand operated double screen | Manual,cradel type batch cleaning | 900x600x100 | 14 | 225 | 1 | 99.0-99.8 | 600/- |
| Pedal operated air screen grain cleaner | Manual, pedal operated, continuous | 1600x500x1000 | 100 | 550 | 2 | 99.5-99.9 | 2700/- |
| Power operated air screen grain cleaner | Motor operated (0.5 hp), continuous | 1600x500x1000 | 110* | 900 | 2 | 99.5-99.9 | 3500/- |

* including electric motor

and Shukla, 1989). The orientation of grains inside the cylinders is governed by its slope and inner cylinder rpm. the preliminary trials indicates that at the rpm range of 100 to 150 and cylinder slope of 19°, hulling efficiency was maximum.

## Performance of Blancher

The soybeans taken for the experiment had an initial moisture content of about 9%. The trend in increase of temperature of water and mixture with respect to time for two consecutive batches is presented in Fig. 9. It was

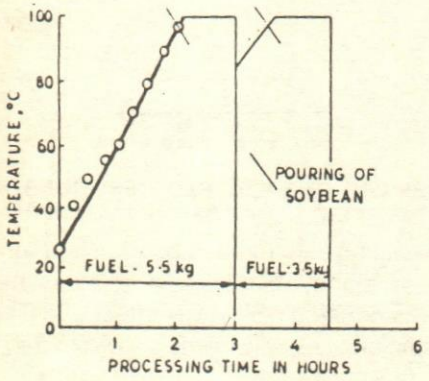



**FIG. 9 : VARIATION IN TEMPERATURE OF WATER AND MIXTURE IN SOYBEAN BLANCHING UNIT**

observed that about 2 h are required to raise the temperature of water to 95°C. There was a further increase in temperature to 100°C when the soybean was added to boiling water. In the next batch, about 30 l of fresh water was added to recoup the water soaked up by soybeans during boiling in the earlier batch. Here, the time required to raise water temperature from initial to 95°C, was about half an hour. Thus due to the use of cages, the hot water was reused giving a saving in both fuel and time.

The urease activity of raw soybean was found to be 2.1. The actual processing time was determined when urease activity reached 0.05 pH units. As shown in Fig. 10. The desired level (below 0.1 unit) is obtained after 50 min; urease activity is almost eliminated at the end of 60 min, which is therefore, recommended as the standard processing time of soybean in this blanching unit.

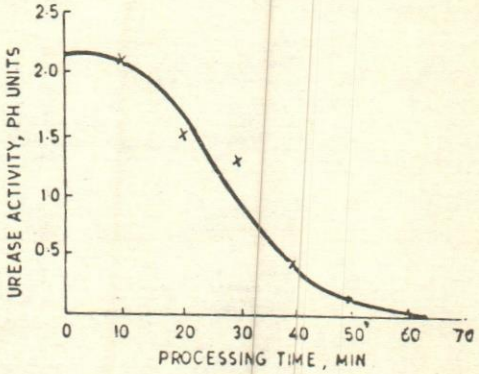



**FIG. 10 : VARIATION OF UREASE ACTIVITY WITH PROCESSING TIME IN SOYBEAN BLANCHING UNIT**

The first experiment performed with the maximum capacity of 30 Kg in a batch without the use of cages. The second set of experiments was performed without the use of cages to hold soybeans at 20 Kg per batch capacity. The third set of experiments was on 20 Kg per batch capacity with cages, where the same hot water was used alongwith an additional 30 l of fresh water. The thermal efficiency of the unit at its maximum capacity of 30 Kg per batch (without the use of cages) was found to be 40%. The total time required for processing was 180 min. The hot water after every operation was required to be removed from the blancher, resulting in loss of heat from the water. This required reheating for every batch of processing, taking the same amount of fuel and time as in the first batch.

The optimum capacity of 20 Kg per batch with cages was found suitable for blanching the soybeans. For the first batch, the same time as required for 30 Kg per batch capacity was required (i.e., 180 min), whereas for subse-

quent batches the time required was only 90 min. The total time includes that required for both operations, i.e., pre-heating and blanching. The thermal efficiency, with the use of cages in the first batch, was found to be 29.1%, and in subsequent batches 31.7% with a fuel saving of 36.36% (Table 6). The average thermal efficiency for whole day operation of five batches was 31.18%. In a day (9 h), 100 Kg. of soybean could be processed by this unit using about 20 Kg of low cost agricultural waste fuel or wood chips.

The space requirement for housing and handling this unit is about 2 $m^2$. The estimated cost of the unit was worked out as Rs.1,600/- and the cost of processing was Rs.0.26/Kg processed soybean. The same unit could be used to giving moist-heat treatment to a variety of food products at reasonably low cost (Patil et al, 1987).

## Performance of Dryer

The temperature variation in the dryer at no load, during drying of soyflakes and soydal (soysplits) is given in the Figs. 11 and 12. The temperature profile indicates that due to natural air circulation, there is a temperature

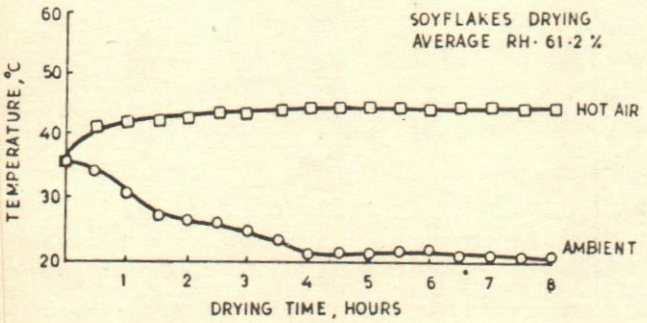



**FIG. 11 : TEMPERATURE VARIATION IN THE DRYER DURING SOYFLAKES DRYING**

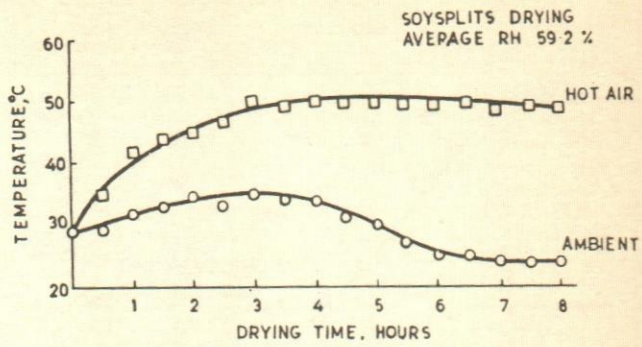



**FIG. 12 : TEMPERATURE VARIATION IN THE DRYER DURING DRYING OF SOYSPLITS**

gradient from bottom to top. Since the bottom portion is nearer to heat exchanger, the temperature of air at the bottom is higher than at the top portion of the dryer. The average airflow through the dryer at 5 Kg/tray loading density was found to be 3.13 $m^3$/min. The average temperature in the dryer at no load was 48.69°C with coefficient of variation of 7.3%. The rise in temperature in the dryer at temperatures during drying of soydal and soyflakes were 46.07°C and 42.65°C, respectively. These temperatures were higher by 16.63°C and 17.57°C over ambient for soydal and soyflakes respectively. The variation of moisture content with respect to time for soydal and soyflakes is presented in Fig. 13. For drying soydal and soyflakes, the time required were 15 and 16 hours respectively.

The drying behaviour of the product was dependent on the material characteristics which was also reflected by the rate of drying of each product. The rates of drying Kg of water/h/Kg of dry matter were, 0.1066 and 0.0531 respectively for soydal and soyflakes. The higher rate of drying in soydal may be due to higher initial moisture content as has been reported by Hall (1970).

Table 6. Thermal efficiency and energy requirement for soybean blanching unit

| Weight of soybean per batch, kg | Weight of water per batch kg | Time of blanching, min Pre-heating | actual blanching | Fuel required, kg | Temperature difference from ambient, °C | Heat utilized, Kcal | Heat supplied Kcal | Thermal efficiency | Heat utilized per kg of soy-beans to be processed, Kcal | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 30 | 90 | 120 | 60 | 6 | 75 | 8100 | 20250 | 40 | 270 | Without cages |
| 20 | 60 | 120 | 60 | 5.5 | 75 | 5400 | 18562.5 | 29.1 | 270 | With cages first batch |
| 20 | 30 (hot)+ 30 (cold) | 30 | 60 | 3.5 | 20 75 | 3750 | 11812.5 | 31.7 | 187.5 | With cages subsequent batches |

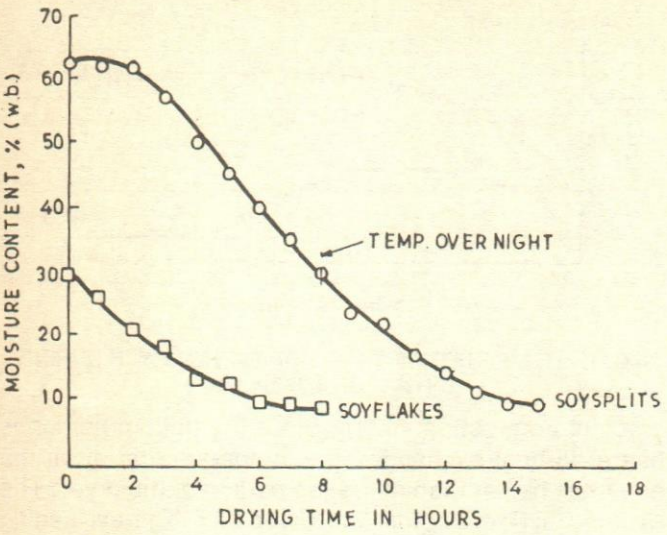



**FIG. 13 VARIATION OF MOISTURE CONTENT WITH TIME FOR SOYFLAKES ;AND SOYSPLITS IN TRAY DRYER**

It appears from the Table-7, that the thermal efficiency was higher (26.43%) in soydal followed by soyflakes (11.85%). Thus the thermal efficiency was also affected with the product characteristics and its initial moisture content. There was no deterioration in quality of the products after drying.

The economics of the dryer operation was also studied. The total cost of the dryer comes to about Rs.7,000/- The operating cost of the dryer per day was approximately Rs.25/-, Rs.46/- and Rs.46/- when operated for 1,2 and 3 shifts (8 h each), respectively. The operating cost with this dryer is considerably lower as only one unskilled person is required for its operation and availability of abundant amount of agricultural waste at a very cheap price. The cost compares very well with the sundrying. The drying time is reduced drastically and the material is saved from deterioration. Moreover, the operation of this dryer is independent of weather conditions.

## Performance of Flaking Machine

The optimum pretreatment required was 40 min blanching as has been finalised earlier by Patil *et al* (1987) and 1988). The variation of flake thickness and broken percentage with flaking moisture content was recorded. The data shown in Fig. 14 indicated that optimum moisture content was around 25-30%, for flaking. Flake thickness of as low as 0.35 mm could be obtained with brokens of only 24%. The soybean does not have any binding material as in case of cereals, hence, due to brittle structure of flakes, this much brokens are quite obvious. However, the broken flakes, can also be used as quick cooking split beans. The water absorption capacity and bulk density of flakes were 356.51% and 423.23 Kg/m$^3$ respectively. The power required was only 150 W. The substitution of metalon rollers has therefore, been found to improve the quality of flakes at the same time reducing the specific energy requirement of operation. The noise level was also considerably reduced due to metalon rollers.

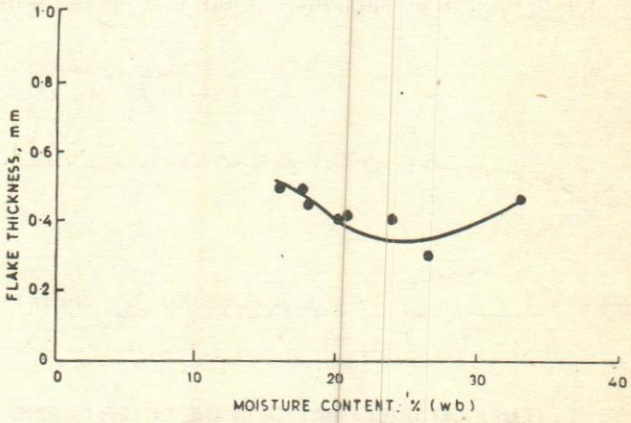



**FIG. 14 THICKNESS OF THE FLAKES OBTAINED AT DIFFERENT MOISTURE CONTENTS IN PLASTIC ROLLER FLAKING MACHINE**

Table 7. Calculation of thermal efficiency of the dryer for drying soydal and soyflakes in tray type natural convection dryer.

| Material | Wt. of sample, kg | Drying time, h | Fuel, kg | Moisture content, % | Final weight kg. | Moisture content, % | Water evaporated, kg | Average drying temp. °C | Average ambient temp. °C | Bone weight, kg | Rate of water evaporated/ hour/kg of din | Energy for evaporation E , Kcal | Sensible heat for heating the material E , Kcal | Head supplied by fuel E , Kcal | Thermal efficiency of the system 100 (E + E /E ), % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Soybal | 100 | 15 | 46.0 | 62.80 | 40.50 | 8.15 | 59.5 | 46.07 | 29.44 | 37.20 | 0.1066 | 35700 | 784.35 | 138000.00 | 26.43 |
| Soyflakes | 43 | 6 | 17.0 | 30.00 | 33.40 | 9.88 | 9.6 | 42.65 | 26.08 | 30.10 | 0.0531 | 3760 | 282.26 | 51000.00 | 11.85 |

## Rural level Application and Testing

A complete set of machines performing various unit operations were installed in a village threshhold. In the beginning, flakes were prepared under the supervision of experts and slowly few farmers were trained in flake making process as well as operation of the machines. Once they were found fit in doing the job, the whole activity were handed over to them. Only from outside the performance of the machines and income generated by the farmers were observed.

A plant of such type can process 200 Kg soybean in 16 h working time and provide employment to 4 persons per day. It provides about Rs.225/- per day profit to an enterpreneur. The cost of soyflakes was worked out to be about Rs.7.50 per Kg and the grits (broken) could be sold @ about Rs.6.00 per Kg. The total investment for setting such a type of plant is about Rs.28,000/-. The soyflakes was found acceptable in organoleptic assessment (Table-8). Several indegeneous snacks could be prepared with soyflakes for which the villagers are quite familiar with.

Table 8: Organoleptic evaluation of soyflakes for use as poha

| Character | Average score | Level of acceptance |
|---|---|---|
| Taste | 7.21 | Good |
| Flavour | 6.26 | Fair |
| Colour | 7.26 | Good |
| Feeling/texture | 6.21 | Good |
| Appearance | 5.95 | Below good and above fair |
| General acceptability | 7.63 | Very good |

## Conclusion

Nutritional status of daily food taken by the rural people in India could be improved introducing soybased foods. Soyflakes can play a major role as a feasible technology for its production has been developed and found suitable at small scale/village level adaptation.

## REFERENCES


**Hall, CW**. Drying farm crops, Layll Book Depot, Ludhiana, 1970.

Indian Standard, Specification of edible full fat soyflour, Bureau of Indian Standards, New Delhi, IS:7837-1675. 1975.

**Kachru, RP; Srivastava, PK; Bisht BS and Ojha** TP. 100 Bankable post harvest equipment developed in India, Central Institute of Agril.Engineering, Bhopal, 1986.

**Kapoor, RP**. India in 21st Century: 'Food grain demand and supply side issue'. In KV Raman, MM Anwar and RB Gaddagimath (Editors), Agricultural Research systems and Manangement in the 21st century, NAARM, Hyderabad, 1988.

**Nelson Al, Wei L.S. and Steinberg MP**. 'Foods from whole soybean', World soybean research conference I, Proceedings Ed FT Corbin, West View Press, Colorado, 1980.

**Patil, RT and Shukla BD.** 'Natural convection cabinet tray dryer using agricultural waste fuel'. Drying Tech. Int. Jr. 6(2), 1988.

**Patil, RT and Shukla, B.D.** 'Development of five roller flaking machine'. In Annual Report, SPU, CIAE, Bhopal, 1988 a.

**Patil, RT and Shukla BD**. 'Studies on open sundrying of blanched soybeans'. In XXV ISAE Convention Proceedings, held at Udaipur, India, during Jan. 5-7, 1989.

**Patil, RT, Shukla BD and Gandhi AP**. Development of low cost soybean blanching unit using wood chips as fuel. Energy in Agric., The Netherland, 1987.

**Patil, RT; Shukla BD and Gandhi AP**. 'Soyflaking - a low cost technology at rural level'. In N. Ali; AP Gandhi and TP Ojha (Editors), Soybean Processing and Utilization in India, CIAE, Bhopal, 1988.

**Pillaiyar, P; Yusuff, KM, Narayanswamy RV, Venketsan V and Ramachandran K.** 'Drying parboiled paddy with cup and cone dryer', Journal of Agril.Engg. 18: 1981.

**Shankar G.** 'The grain dryer', Indian Grain Storage Institute, Hapur, Per. Communication, 1988.

**Shukla, BD**. 'Drying of maize in a freely ventilated crib with solar air heater in Kenya'. Trop. Agri.61(1) 1984.

**Shukla, BD and Patil, RT.** 'Overview of grain drying and storage problem in India', GASGA Seminar proc. held at ACIAR, Canberra, Aug. 21 to Sept. 4, 1988.

**Shukla, BD and Saxena BB**. 'Popularization of soyproducts as food sources in selected villages'. In N.Ali, AP Gandhi, and TP Ojha (Editors), Soybean Processing and Utilization, CIAE, Bhopal, 1987.

**Shukla, BD, Stickney RE and Manalili I**. 'Preliminary tests of a low cost paddy dryer utilising rice hull and straw'. IRRI Saturday Seminar, IRRI, Manila, Feb. 12, 1983.

**Singh, BPN, Narain M, Saxena RP, and Sarkar BC**. A continuous grain dryer for small throughputs. Tech. Bull No. AE/5/82, Deptt. of Agril.Engg. GBPUAT, Patnagar, 1982.

**Singh, J. and Shukla, BD.** Post harvest technology of oilseeds, CIAE, Bhopal, 1989.

**Smith AK and Circle SJ** (Editors), Soybean Chemistry and Technology, Vol.I, proteins, AVI, West, View CT., 1972.

**Vaidell MP and Vijayakumari, J**. A hand book on recipes for the use of soybean, UAS, Bangalore, 1981.


□

# Soybean Products Utilization in USA - Possible Approach for Indian Bakery Industry

**S.D. Kulkarni**

Soybean produced in USA is processed mostly for oil extraction and meal is used in animal feed and human food systems. Soyproducts have become major ingredients in US food industry and bakery industry is the largest user because of their unique functional and nutritional properties. Variety of soyproducts such as flour, grits, soyfiber and soyoil are preferred in bakery products, viz. bread, cookies, cakes, doughnuts etc., to improve the product quality. The author feels that soyproducts can be used in bakery products, produced in India to get the advantage of high protein soyflour available.

*S.D. Kulkarni is a scientist SPU Project at the Central Institute of Agricultural Engineering, ICAR, Bhopal-462018.*

USA produces over 55 million tonnes of soybean on 25 million ha of land. Some portion of the produce is used for the production of full fat soyflour, salted whole beans. However, major portion is processed for soybean oil extraction and defatted meal for cattle feed and variety of flours, protein concentrates, protein isolates, grits, etc. These products are further utilized in the production of various food products viz. meat analogs, extruded products and bakery products. Bakery industry in USA is the largest commercial food user of soyflour (Hoover, 1979, Dubois, 1980).

## Approach

A survey of soybean processing plants and small scale bakeries was undertaken to get detailed information on soyproducts produced for use by bakery industry, and present state of soy use in bakery products. Two large scale soybean processing companies (ADM and Cargill) were visited for detailed information on variety of soyproducts produced from defatted soybean meal. Also few small scale bakeries (135-500 Kg/day)located at Ft. Collings, Colorado State, USA were visited for information on the trends in bakery production and inclinations for soy use in bakery products.

## Soybean Processing and Bakery Industry

Variety of soyproducts are available in USA with various product specifications for use in bakery products. The large scale soybean processing companies visited (ADM, 1988; Cargill, 1988) indicate a similar approach for processing of defatted meal for value addition and better utilization. The soyproducts produced for possible use in bakery items are treated sufficiently to destroy nearly all enzyme activity and to improve flavour, but not sufficient to impair baking quality. They are soyflour, soygrits, and soy

concentrates and isolates, soyfiber etc. Many companies produce these types of primarily processed soyproducts (Dubois, 1980). These are specified for bakery food applications on the basis of protein content, fat content, protein solubility etc. However, protein solubility is seen first as a measure of functionality of the material to judge its suitability as ingredient. Most flours for bread use have a PDI of 50-75. (Dubois, 1980).

*Soy Flour* : Variety of soyflours are produced for use in bakery products. FULL FAT soyflour is processed to retain all of the fat present in the soybean. The bean is subjected to a mild heat treatment to minimise enzyme activity. High fat soyflours (refatted) are defatted flours to which varying amounts (6-15%) of soybean oil are added. (ADM, 1988; Cargill, 1988). ADM produces with the trade name '15% Hi Fat Bakers Nutrisoy', a high fat soyflour with PDI of 75 specially for baked goods, pan cake mixes and cake mixes. These companies give nutritional information viz. protein, fat, fiber, trypsin inhibitor, minerals, essential amino acids, vitamins etc. for their product. LECITHINATED soyflours are considered useful in bakery applications such as doughnuts and sweet goods. ADM produces 6 and 15% lecithinated soyflour with the trade name 'Soylec $C_6$ and $C_{15}$' respectively for bakery food application, where as Cargill produces lecithinated flour in the range of 3-15% lecithin levels (Table 1). High fat, full fat, and lecithinated soyflours are often used, (3-5%) in heavier cakes because of the increased richness and emulsification functions, they provide. An increase in water absorption by about 1-1.5 Kg for each Kg of soyflour used is usually obtained. In addition, the high fat or lecithinated flour may permit reduction in eggs and shortening. Lecithin is an anti-oxident and enhances the machinabilty and shelf life of the product and stability of vitamins in the bakery foods. Normally 2-4% flour is used in bakery products viz. doughnut, pastry items, bread etc. DEFATTED soyflour is produced by grinding defatted flakes to different sizes after various degrees of heat treatment to get PDI of 90 to 20. Cargill produces soyflour with 100 mesh and 200 mesh particle sizes enabling 98% of the product pass through respective screen. The nutritional analysis of flours presented by different companies indicate (Table 2) the product quality. Defatted soyflour is an excellent replacement for NFDM (Non Fat Dry Milk) in these products due to economical, functional and nutritional attributes. Defatted soy flours are permitted in standardized bakery items' at a maximum level 3%, flour weight basis (Anon, 1979a). However, no maximum has been established for other bakery foods. The "U.S. Standards of Identity" for enriched white bread allows the use of upto 3% NFMS (Non fat Milk Solids) or soyflour as optional ingredients and there is no limitation for non-standardized breads (Hoover, 1980). In cakes where water absorption and film forming characteristics are desired, usage level is 3-6% on flour weight basis, which provides more uniform distribution of air cells, improved texture, softer and more tender crumb. In sweet goods, 2-4% defatted soyflour improves water holding capacity and finished product quality. For doughnuts, 2-4% defatted soyflour is used. Soyflour addition reduces the fat absorption during frying, and texture and eating properties are improved. The increased absorption and moisture retention increase yield and shelf life. In hard cookies, the use of 2-5% defatted soyflour gives a crisp product. Toasted defatted soyflour having a PDI of about 20, is added for colour to the crumb, and toasted flavour to whole grain, multi grain or natural grain bread. With these advantages, it is finding increased use in bakery application. ENZYME ACTIVE soyflour can either be a defatted soyflour processed to retain lipoxygenase enzyme activity, or a full fat enzyme active defatted soyflour with PDI of 85-90 (Cargill, 1988; ADM 1988). It is used primarily in

Table 1. Typical analysis (percent) of relecithinated soyflour

| | Lecithin Level | | |
|---|---|---|---|
| | 3% | 6% | 15% |
| Protein (Nx6.25) | 51.0 | 50.0 | 45.0 |
| Moisture | 5.0 | 5.0 | 4.2 |
| Fat (ether extract) | 3.0 | 6.0 | 15.0 |
| Ash | 5.8 | 5.6 | 4.9 |
| Fiber | 2.4 | 2.3 | 2.1 |
| Carbohydrates | 32.0 | 31.0 | 27.5 |
| Total bacteria count | | < 10,000/g | |
| Salmonella | Negative | Negative | Negative |

Source : Cargill, 1988

Table 2. Typical analysis of defatted soyflour

| | Cargill | A D M | |
|---|---|---|---|
| | | Bakers nutrisoy % | Bakers nutrisoy 60 % |
| Protein (Nx 6.25) | 52.5% | 52.0 | 52.0 |
| Moisture | 6.0% | 7.0 | 7.0 |
| Fat (ether extract) | 0.9% | 1.0 | 1.0 |
| Ash | 6.0% | 6.0 | 6.0 |
| Fiber | 2.5% | 3.0 | 3.0 |
| Carbohydrates | 31.0% | 31.0 | 31.0 |
| Total bacterial count | < 10,000/g | * | * |
| Salmonella | Negative | * | * |

* Note indicated
Source : Cargill, 1988
ADM, 1988

white bread and bun production for whiter crumb. The FDA Standards of identity (Anon, 1979b) permit a maximum of 0.5% enzyme active soyflour on flour weight basis, in standardized bakery foods.

*Soygrits*: These are produced by grinding the defatted soy flakes (Cargill, 1988; ADM, 1988). ADM produces soygrits with trade name "Toasted Nutrisoy grits" with 20 PDI and four granulation sizes i.e. 8-20 (90% through no. 8 US, Std. Screen and 10% through no. 20 US std. Screen), 20-40, 40-80 and 80-0 for use in cookies, crackers and speciality breads. Heavily toasted grits with a PDI of 20-30 are used in whole grain, multigrain and natural grain breads and cookies to add colour and toasted flavour.

*Protein Concentrates and Isolates*: Concentrates with 65-70% protein content and isolates with 90-95% protein content are produced by both the companies (M/s ADM, M/s Cargill) for various uses. ADM produces soyprotein concentrate (70% protein content) with trade name 'ARCON F' and 'ARCON G' for use in bakery products. Also two types of isolated soy protein (91.5% protein) are produced with trade names 'ARDEX-F' and 'ARDEX-F dispersible' for use in bakery and confectionary products (ADM, 1988). Soy protein concentrates and isolates can be used up to 5% on flour weight basis to increase the protein content without adversely affecting white bread quality (Onayemi and Lorenz, 1978).

*Soybran/Soyfiber* : It is produced (ADM, 1988) by toasting and grinding the seed coat portion of soybean. Its use is suggested in bread, crackers, cookies etc. for adding dietary fiber. It has about three to four times more iron content than that of soybeans besides low levels of phytic acid.

*Soy Oil* : The importance of soy oil has been recognised by the bakery industry, its use as shortening is common (Dubois, 1980, Steele's bakery, 1988, Jon's bakery, 1988 and Fuller's bakery, 1988).

### Small Scale Bakery Industry

Normally in USA, the complete automation is a common phenomenon in bakery industry. However, in small scale bakeries it is not feasible due to limited production and less number of machines. The individual units viz. mixer, fermentation and proofing cabinet, sheeter, moulder, baking oven, slicer etc. are used for performing different unit operations. Accordingly the manpower requirement is decided on the basis of work involved in handling of raw material, dough and the product. Manpower requirement, machinery setup and utilization depends on the production capacity, product quality and available market (Table 3). It was observed that all the bakeries (Jon's, Steele's and Fuller, 1988), sell the entire production of different items through the shop attached to bakery itself.

Variety of breads and other products are produced. Now-a-days there has been a trend of using minimum chemicals in the products. Therefore, the use of preservatives is being stopped by these bakers. To overcome the emergent situation of demand, bakery (Fuller, 1988) is equipped with the deep freezer maintained at 20 °F (-7 °C). Properly mixed dough is prepared in advance, stored in the deep freezer unit and used for supply of fresh bread in short time in case of unforeseen demand.

Table 3. Comparative details of different bakeries

| | Steele's bakery | Fuller's bakery | Jon's bakery |
|---|---|---|---|
| i. Average Production lb/day | | | |
| Cake | 200 | - | - |
| Bread | 12500 | upto 800 | 300 |
| ii. Shortening | Soy oil | Soy oil/Palm oil | Nil |
| iii. Soyflour | Nil | Nil | Nil* |
| iv. Baking temperature °C (bread and cake) | 395 | 360-370 | 350-400 |
| v. Baking time, min | | | |
| Bread | 15-20 | 20-25 | upto 1hr |
| Pies | 45 | - | - |
| Muffins | 10 | - | - |
| Cake (Turning - 7 baking - 20 | 27 | - | - |
| vi. Mixing | Vertical mixer Hobart | Vertical Mirr-or Hobart | Manual |
| vii. Sheeter and moulder | Straight belt type | Straight belt type | - |
| viii. Baking | Rotary oven | Rotary oven | Cabinet type oven (tray) |
| ix. Manpower | 12 | 2 | 2 |
| x. Slicing | Slicer | Slicer | Slicer |
| xi. Marketing | Local market | Local market | Local market |

* Planning to use soyflour in bread.

Some of the bakeries (Jon's) have started the bread production without addition of any chemical viz. preservatives, dough stabilizers and dough conditioners. Instead some non-traditional ingredients are used to make the product more natural. They (Jon's) use the specially produced organic wheat i.e. wheat produced without any application of chemicals, pesticides, fungicides etc. but organic manure during crop growth. Sugar is not used as ingredient, and items like raisin juice/molaces/honey are used as sugar replacers (Table 4). Sea salt is preferred

over other salts available in market (Jon's 1988). These products are accepted by the consumers on the plea that there is no possibility of any damage to health due to chemicals. Now-a-days people in USA are getting inclined for organic foods and they prefer the absence of chemicals in foods. On the same analogy, this unit is producing the variety of breads and getting good response. It is worth mentioning here that this type of bread (Natural bread) is much costlier (twice the price) than standard white bread and still people are going for it.

Among the bakeries visited, they had bread as main product followed by cakes/pies etc. Soybean oil is commonly used as shortening in bread making. They agreed to have a knowledge of usefulness of soyflour in bakery products and their use by large bakeries. However, one baker (Jon's 1988) indicated that he would like to use soyflour in natural bread.

Thus, soyproducts are used in variety of bakery products mentioned in preceding paragraphs. However, the general uses indicated are given in Table 5.

## Conclusions

Soybean processing industry produces variety of products from byproducts such as defatted meal and soyhulls for use in human foods. Majority of these products are put to various food uses and bakery industry (Table 5) is the major consumer in USA because of their unique functional and nutritional properties in improving the product quality. Though, majority of the bakeries use soyflour (2-5% flour substitution) it was observed that small scale bakeries use only soy oil. The soyflour is preferred in bakery industry for the following reasons.

Table 5. Bakery food applications of various soyproducts

| | White bread & rolls | Speciality bread and rolls | Cake | Cake dough nuts | Sweet goods | Cook-ies |
|---|---|---|---|---|---|---|
| Defatted soyflour | x | x | x | x | x | x |
| Enzyme active soyflour | x | | | | | |
| Low fat soyflour | | | x | x | x | |
| High fast soyflour | | | x | x | x | |
| Full fat soyflour | | | x | x | x | |
| Lecithinated soy-flour | | | x | x | | |
| Soy grits | | x | | | | |
| Soy concentrates | | | | | | |
| Soy isolates | | x | | | | |
| Soy fiber | | x | | | | |

Source : Dubois, 1980

i. There is a 6-7% increase in yield of bread from soyfortified flour that offsets the increased flour cost (Hoover, 1979).

ii) Soyflour provides functionality, better water absorption and at least as good a tenderlizing effect, body and resilience as will NFMS (Hoover, 1979).

iii) Improves protein content and nutritional quality of the product.

Production of edible grade, soy based byproducts with varied degree of heat treatment and product quality can be adopted by Indian soybean processing industry for use in bakery and other food industry. This can also find enough market for soyproducts and serve the requirements of bakery industry. In India, some solvent extraction plants have come forward and started the production of edible grade soy flour. The product can be put to variety of bakery

Table 4. Details of bread produced by Jon's bakery

| Type of bread | Ingredient | Net Weight, lb | Price U.S.$ |
|---|---|---|---|
| Cinnamon raising | Whole wheat flour, water, raisins, raisin juice, yeast, sea salt and | 1.75 | 2.10 |
| Rye | Whole rhy wheat flour, whole wheat flour, water molasses, sea salt and caraway | 10.50 | 1.47 |
| Sprouted wheat | Whole wheat flour, water, sprouted wheat, raisin juice, yeast and sea salt | 2.00 | 2.10 |
| Honey wheat | Whole wheat flour, water, honey, yeast and sea salt | 1.75 | 1.85 |
| Light wheat | Whole wheat flour (60&), white flour (40%) (unbleached, unbromated, enriched), water, honey, yeast and sea salt | 1.50 | 1.70 |
| Sour dough | Whole wheat flour, water, white flour (enriched, unbleached, unbromated) sea salt | 10.50 | 1.50 |
| Raisin wheat | Whole wheat flour, water, raisins, raisin juice, yeast and sea salt | 1.00 | 1.15 |
| Sun wheat | Whole wheat flour, water, sunflower seeds (roasted, dehusked), raisin juice, yeast and sea salt. | 1.75 | 2.00 |

Note : i. Rasin juice/honey/molasses is added as substitute to sugar
ii. No shortening is added.
iii. No chemicals, preservatives and dough stabilizers added.

uses. However, if the products with varied specifications are made, it may serve to a greater extent in nutritional improvement of the population.

The protein may be present in the given raw material, in sufficient quantity but the contribution to nutritional value may be limited by the particular essential amino acid in the protein. In wheat, the amino acid lysine limits the nutritional value of its protein, and the limiting amino acid in soybean is methionine. Therefore, the combination of these two is complimentary to each other. The PER (Protein Efficiency Ratio) for white bread is about 0.7, while for bread with 3% soyflour added is about 0.83 (Hoover, 1979). When soyflour is increased to the 6% level, the PER increases to 1.3. At 12% level the PER is 1.95 and protein content is increased by 50%. The nutritional improvement being of prime importance to country like ours, and looking at the nutritional and functional advantages of soybeans the higher usage levels up to 12% can be adopted by Indian bakery industry to get improved product quality and food value.

## REFERENCES


**ADM (Archer Daniels Midland) Company**, Box 1470, Decatur, IL 62525. (Visited in May, 1988), USA.

**Anon**, (1979a). Code of Federal Regulations. CFR 21,136,110(C) (11). USA.

**Anon**, (1979b). Code of Federal Regulation. CFR 21, 136.110 (c) (12). USA.

**Anon**, (1987). Soya Blue Book, 87, American Soybean Association, P.O. Box 27300, St. Louis, MO 63141, USA.

**Cargill Protein Products**, Box 2817, Cedar Rapids, Iowa 52406, USA, 1988. (Visited at Minneapolis).

**Dubois, D.K.** (1980). Soyproducts in bakery foods, AIB Technical Bulletin, 2(9)

**Fuller's Bakery** (1988). (Contact : Mr. & Mrs. Fuller, owner) Ft. Collins, Colorado, USA.

**Hoover, W.J.** (1979). Use of soyproteins in baked foods. J.A.O.C.S. 56 :

**Jon's bakery** (1988). (Contact : Ms. Kristi and Mr. John Long), Ft. Collins, Colorado, USA.

**Onayemi, O.** and Lorenz, K., (1978). 'Soy concentrates and isolates in bread making Bakers' Digest 52(1) : 18.

**Steels's Bakery** (1988). (Contact person Mrs. Thelona Fleener, Ft. Collins, Colorado, USA.


Technology refers not only to marvels that make life so comfortable for us today; it can also be directly related to the survival of life at its most elemental level.

*—Akio Morita*

The very process by which a firm becomes most productive in an industry tends to render it less flexible and inventive.

*—George Gilder*

The basic questions asked of new technologies earlier have been simple: do they contribute to the economic gains or military cout? New technologies now have to pass far stricter tests-ecological and social as well as economic and strategic.

*—Alvin Toffler*

Thinking is of no use without feeling, but feeling is no substitute for thinking. Instead of abondoning thinking, we need to put feeling back to it.

*—Edward de Bono*

# Changes in Investment Pattern in Punjab Farms

**G.S.Mander & S.S. Grewal**

*This paper is an attempt to evaluate the pattern of investment in Punjab farms in the perspective of economic development. The paper tries to trace the changes in the pattern of investment that transformed the traditional agriculture into a modern one.*

*G.S. Mander & S.S. Grewal are Assistant Professor and Professor-cum-Head respectively in the Department of Economics and Sociology, Punjab Agricultural University, Ludhiana.*

The impressive growth in total output and productivity in Punjab agriculture in the wake of green revolution has been widely reported. What has not been adequately reported is the concomitant change in the pattern of investment that has transformed the traditional agriculture into a modern one. In the present study, an attempt is made to see the pattern of investment in Punjab farms in the perspective of economic development.

The study is based upon information collected from 180 randomly selected farmers spread over six development blocks located in different agroclimatic regions of the Punjab State. In order to get a clear picture of the change in the pattern of investment in cultivating households, the data regarding expenditure on different items of investment over a period of 30 years i.e. from 1955-56 to 1985-86 were recorded. The basis for selecting such a long time period was that the study conducted by Diskalkar and Suryavanshi (1972) which reported that farmers could remember the major investments made even 25 years ago with a reasonable degree of accuracy. The data were taken on an yearly basis so that various phases of development could be properly identified. Average household investments thus obtained are given in Table 1.

In order to make valid comparisons and to draw meaningful conclusions, these data were deflated with the help of a suitable[1] price index. The pattern of investment at constant prices (Base: 1970-71=100) is presented in Table 2.

The development theory suggests that the pattern of investment in earlier stages of development will be subsistence type while after sometime, it would be income oriented and then the importance will be given to consumer durables. A seven-fold increase in the investment

[1] For this purpose, "Index Numbers (unweighted) of Wholesale prices of 50 (Agricultural and Industrial) Commodities in Punjab" were used. These were taken from various issues of Statistical Abstracts of Punjab.

Table 1. Per household investment at current prices

(Rupees)

| Year | Purchase of land | Farm machinery | | | Land improve-ments | Irr.Structures | | Livestocks | Non-farm invest-ments | Buildings | Consumer durables | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Tractor & allied imple-ments | Plant protec-tion eqpt. | Other machinery & imple-ments | | Pumpsets bores & tubewell rooms | Brick/ under-ground channels | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 1955-56 | - | - | - | 9.11 | - | 7.34 | - | 14.66 | - | 88.89 | 8.89 | 128.89 |
| 1956-57 | 44.45 | - | - | 7.78 | - | 6.89 | - | 20.89 | - | - | 20.00 | 100.01 |
| 1957-58 | - | - | - | 11.55 | - | - | - | 26.66 | - | 100.00 | 15.78 | 153.99 |
| 1958-59 | - | - | - | 8.22 | - | - | - | 51.11 | - | 177.78 | 8.40 | 245.51 |
| 1959-60 | 431.11 | - | - | 15.02 | - | 11.11 | - | 75.55 | - | 318.66 | 16.00 | 867.45 |
| 1960-61 | - | - | - | 16.89 | - | 12.45 | - | 31.11 | - | 297.78 | 24.45 | 382.68 |
| 1961-62 | 266.66 | - | - | 9.78 | - | 31.11 | - | 15.55 | - | 88.89 | 8.89 | 420.88 |
| 1962-63 | 186.66 | - | - | 17.33 | - | - | - | 54.22 | 28.89 | 214.22 | 42.22 | 543.54 |
| 1963-64 | 155.55 | - | - | 15.11 | - | 16.89 | - | 46.66 | - | 322.22 | 13.34 | 569.77 |
| 1964-65 | - | 48.89 | - | 23.55 | - | 74.66 | - | 35.55 | 44.45 | 357.78 | 37.78 | 622.66 |
| 1965-66 | - | - | - | 31.78 | - | 25.78 | - | 32.66 | 28.89 | 124.45 | 41.11 | 284.67 |
| 1966-67 | 360.00 | - | - | 26.45 | - | 9.34 | - | 100.22 | - | 355.55 | 57.78 | 909.34 |
| 1967-68 | - | 44.44 | - | 25.34 | - | - | - | 70.00 | 137.78 | 422.22 | 120.00 | 819.78 |
| 1968-69 | 57.78 | 51.11 | - | 36.66 | - | 46.34 | - | 43.34 | 35.55 | 352.00 | 86.66 | 709.44 |
| 1969-70 | 533.34 | 100.00 | - | 56.66 | - | 148.00 | - | 155.55 | 75.11 | 524.45 | 144.45 | 1697.56 |
| 1970-71 | 422.22 | 262.22 | - | 86.86 | - | 97.34 | - | 76.00 | - | 528.89 | 38.66 | 1311.97 |
| 1971-72 | 266.66 | 204.45 | - | 131.55 | - | 120.45 | - | 55.11 | 433.34 | 431.11 | 69.34 | 1712.81 |
| 1972-73 | 666.66 | 168.89 | - | 74.66 | - | 296.45 | - | | 30.22 | - | 791.11 | 43.52 |
| 2073.51 | | | | | | | | | | | | |
| 1973-74 | 200.00 | 186.66 | - | 98.89 | - | 165.34 | - | 111.11 | - | 551.11 | 39.55 | 1352.66 |
| 1974-75 | - | 514.45 | 5.78 | 86.89 | - | 386.65 | - | 97.78 | 426.66 | 1191.11 | 172.98 | 2882.31 |
| 1975-76 | 266.66 | 348.89 | 5.20 | 66.58 | - | 190.22 | | 86.66 | 133.34 | 1188.89 | 96.89 | 2383.33 |
| 1976-77 | 395.55 | 595.55 | 3.49 | 132.45 | - | 427.55 | - | 47.55 | - | 734.00 | 244.89 | 2581.03 |
| 1977-78 | 250.00 | 422.22 | 6.89 | 84.22 | - | 360.45 | - | 117.34 | 1111.11 | 882.22 | 174.22 | 3408.67 |
| 1978-79 | 266.66 | 1035.55 | 8.22 | 93.78 | - | 162.22 | - | 36.45 | - | 911.11 | 107.93 | 2621.92 |
| 1979-80 | 195.66 | 1854.66 | 10.89 | 115.60 | 3.34 | 557.34 | - | 92.45 | - | 515.55 | 419.34 | 3764.72 |
| 1980-81 | - | 1845.11 | 11.11 | 128.45 | 9.78 | 660.00 | - | 195.55 | 1124.45 | 1422.22 | 144.22 | 5540.89 |
| 1981-82 | 355.55 | 2944.45 | 9.22 | 176.45 | - | 389.06 | - | 97.34 | 84.45 | 891.11 | 234.11 | 5181.74 |
| 1982-83 | 177.78 | 1696.45 | 12.71 | 131.11 | 18.78 | 455.55 | - | 117.78 | 244.45 | 804.45 | 213.55 | 3872.61 |
| 1983-84 | 427.34 | 1324.00 | 11.55 | 110.45 | 22.45 | 392.00 | - | 117.78 | 377.78 | 1308.89 | 332.62 | 4424.86 |
| 1984-85 | 360.00 | 1558.00 | 13.34 | 141.34 | 15.55 | 480.00 | - | 285.34 | 966.66 | 2320.00 | 571.71 | 6711.94 |
| 1985-86 | 344.44 | 1905.56 | 27.50 | 196.39 | 21.39 | 844.44 | 16.67 | 285.56 | 485.85 | 2752.78 | 752.33 | 7633.91 |

during the study period itself speaks of the fact that capital progressively tended to enlarge its influence in Punjab Agriculture over time. In this long history of investment, three stages are distinguished.

### 1. Pre-Green Revolution Period

Punjab agriculture in the period 1955-56 to 1965-66 can be termed as traditional or subsistence type of agriculture. Two drought years viz., 1965-66 and 1966-67 were also included in this phase. In this period, the farmers were not in a position to adopt modern technology and undertake associated investments. Producers were wedded to old and obsolete methods of production and shunned innovation. The data in Table 2 supports the argument that before green revolution, agriculture was traditional and it started transforming only in the mid-sixties. During this period, the investments were made mainly in the purchase of land and live-stocks. On an average, the share of land purchase in the total investments during this period was 27.80 per cent. Very little funds were diverted to farm machinery, which is clear from the share of investments on tractors and allied implements being 0.81 per cent of total and that of irrigation structures being 3.51 per cent of total investments. The farmers used traditional type of machinery for performing various farm operations. Some of the cultivators did show a little interest in non-farm investments but the share of this item in the total investments in this period was again very small (1.77 per cent).

### 2. Green Revolution Period

There was an upward swing in Punjab agriculture after mid-sixties. This phenomenon usually called 'Green Revolution', gave rise to allround optimism and with this,

Table 2. Per household investment at constant prices (Base : 1970-71 = 100)

(Rupees)

| Year | Purchase of land | Farm machinery | | | Land improvements | Irr.Structures | | Livestocks | Non-farm investments | Buildings | Consumer durables | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Tractor & allied implements | Plant protection eqpt. | Other machinery & implements | | Pumpsets bores & tubewell rooms | Brick/ underground channels | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 1955-56 | - | - | - | 20.15 | - | 16.22 | - | 32.43 | - | 196.61 | 19.66 | 285.07 |
| 1956-57 | 92.04 | - | - | 16.10 | - | 14.26 | - | 43.26 | - | - | 41.42 | 207.08 |
| 1957-58 | - | - | - | 23.42 | - | - | - | 54.06 | - | 202.76 | 31.98 | 312.22 |
| 1958-59 | - | - | - | 16.17 | - | - | - | 100.50 | - | 349.54 | 16.51 | 482.72 |
| 1959-60 | 822.74 | - | - | 28.67 | - | 12.21 | - | 144.18 | - | 608.14 | 30.54 | 1655.48 |
| 1960-61 | - | - | - | 31.76 | - | 23.41 | - | 58.51 | - | 560.05 | 45.98 | 719.71 |
| 1961-62 | 484.93 | - | - | 17.76 | - | 56.58 | - | 28.28 | - | 161.64 | 16.16 | 765.37 |
| 1962-63 | 325.03 | - | - | 30.18 | - | - | - | 94.42 | 50.30 | 373.02 | 73.52 | 946.47 |
| 1963-64 | 243.70 | - | - | 23.67 | - | 26.46 | - | 73.10 | - | 504.82 | 20.90 | 892.65 |
| 1964-65 | - | 69.02 | - | 33.25 | - | 105.42 | - | 50.19 | 62.75 | 505.12 | 53.34 | 879.09 |
| 1965-66 | - | - | - | 41.04 | - | 33.30 | - | 42.18 | 37.31 | 160.74 | 53.10 | 367.67 |
| 1966-67 | 395.78 | - | - | 29.08 | - | 10.26 | - | 110.18 | - | 390.89 | 63.52 | 999.71 |
| Av. for | 197.02 | 5.75 | - | 25.94 | - | 24.84 | - | 69.27 | 12.53 | 334.44 | 38.89 | 709.44 |
| pd I. | (27.80) | (0.81) | | (3.66) | | (3.51) | | (9.77) | (1.77) | 47.19) | (5.49) | |
| 1967-68 | - | 45.41 | - | 25.89 | - | - | - | 71.53 | 138.39 | 431.36 | 122.62 | 835.30 |
| 1968-69 | 58.58 | 51.82 | - | 37.18 | - | 46.98 | - | 43.94 | 36.05 | 356.89 | 87.86 | 719.30 |
| 1969-70 | 527.17 | 98.84 | - | 55.35 | - | 146.29 | - | 114.22 | 74.24 | 518.38 | 142.78 | 1677.27 |
| 1970-71 | 422.22 | 262.22 | - | 86.66 | - | 97.34 | - | 76.00 | - | 528.89 | 38.66 | 1511.99 |
| 1971-72 | 250.37 | 191.95 | - | 123.51 | - | 113.09 | - | 51.74 | 406.85 | 404.76 | 65.1- | 1607.37 |
| 1972-73 | 546.40 | 138.42 | 1.64 | 61.19 | - | 242.97 | - | 24.77 | - | 648.40 | 35.67 | 1699.46 |
| 1973-74 | 131.35 | 122.59 | - | 64.94 | - | 108.58 | - | 72.98 | - | 361.95 | 25.98 | 888.37 |
| 1974-75 | - | 295.02 | 3.31 | 49.82 | - | 221.74 | - | 56.07 | 244.67 | 683.06 | 99.19 | 1652.88 |
| 1975-76 | 150.04 | 206.78 | 3.08 | 39.46 | - | 112.74 | - | 51.36 | 79.82 | 704.61 | 57.42 | 1412.51 |
| 1976-77 | 246.93 | 371.78 | 2.18 | 82.68 | - | 266.90 | - | 29.69 | - | 458.21 | 152.87 | 1611.24 |
| 1977-78 | 133.19 | 224.94 | 3.67 | 44.87 | - | 192.03 | - | 62.51 | 591.96 | 470.02 | 92.82 | 1816.01 |
| 1978-79 | 145.46 | 564.89 | 4.49 | 51.15 | - | 88.50 | - | 19.88 | - | 497.01 | 88.87 | 1430.25 |
| 1979-80 | 92.27 | 875.26 | 5.14 | 54.55 | 1.58 | 263.02 | - | 43.63 | - | 243.30 | 197.90 | 1776.65 |
| 1980-81 | - | 714.99 | 4.30 | 49.78 | 3.79 | 255.75 | - | 75.78 | 435.73 | 551.12 | 55.89 | 2147.13 |
| 1981-82 | 127.22 | 1053.62 | 3.30 | 63.14 | - | 139.22 | - | 34.83 | 30.22 | 318.87 | 83.78 | 1854.20 |
| Av. for | 189.28 | 347.90 | 2.07 | 59.34 | 0.36 | 153.01 | - | 55.26 | 135.81 | 478.46 | 87.83 | 1509.33 |
| pd. II. | (12.54) | (23.05) | (0.14) | (3.93) | (0.02) | (10.14) | | (3.66) | (9.00) | (31.70) | (5.82) | |
| 1982-83 | 60.55 | 577.83 | 4.33 | 44.66 | 6.39 | 155.17 | - | 40.11 | 83.26 | 274.00 | 72.74 | 1319.04 |
| 1983-84 | 138.54 | 429.26 | 3.74 | 35.81 | 7.28 | 127.09 | - | 38.18 | 122.48 | 424.36 | 107.84 | 1434.58 |
| 1984-85 | 105.82 | 457.95 | 3.92 | 41.54 | 4.57 | 141.09 | - | 83.87 | 284.14 | 681.93 | 168.05 | 172.88 |
| 1985-86 | 92.66 | 112.65 | 7.30 | 52.83 | 5.75 | 227.18 | 4.84 | 76.82 | 130.71 | 740.57 | 202.67 | 2054.08 |
| Av. for | 99.39 | 494.42 | 4.35 | 43.71 | 6.00 | 162.63 | 1.21 | 59.75 | 155.15 | 530.21 | 137.83 | 1695.15 |
| pd. III | (5.86) | (29.17) | (0.29) | (2.58) | (0.35) | (9.59) | (0.07) | (3.52) | (9.15) | (31.28) | (8.13) | |

Figurure in the parentheses denote percentages of total investments in the year.

the mechanisation of agriculture started. The period from 1967-68 to 1981-82 was taken to denote the transitional phase of Punjab agriculture. In the transitional phase, the level of investments is more influenced by production requirements or by the need for income/consumption in future. In this period, the Punjab cultivators started adopting technological innovations. The share of land purchases had come down to 12.54 per cent in this period and that of livestocks to 3.66 per cent of the total. On the other hand, the share of modern machinery in the total investments increased. The share of tractors and allied implements was 23.05 per cent and that of irrigation structure was 10.14 per cent in the total investments. On close scrutiny of data, this period of transition can be further sub-divided into two, though overlapping but distinct phases, on the basis of the type of technology adopted by the farmers. In the first phase the emphasis was on increase in output per unit area and in the second phase output per unit time received more attention.

*(a) Adoption of Technology to Increase*

Production Per unit of Area: A remarkable increase in investments on irrigation can be observed from 1968-69

onwards. This was associated largely with 'Wheat and Rice Revolution'.

High yielding varieties of wheat were introduced in 1966-67. Once the farmers found that the new wheat varieties were more responsive to fertilizers and water, the farmers started investing in these items. The introduction of high yielding varieties of rice from 1968-69 onwards further necessitated higher investments in irrigation arising out of heavy need of rice for water. The farmers response to these innovations was clear from the investments made by them in irrigation structures. The farmers started investing not only in electric motors but also in relatively costly diesel operated tubewells when electric connections were not readily available, as reported by Kahlon (1984). So with the increased water supply and complimentary inputs, the farmers tried to increase production per unit of area.

*(b) Adoption of Technology to Increase*

Production Per Unit of Time: The farmers invested a lot of funds in mechanisation of irrigation following the adoption of high yielding varieties of wheat and rice. Again, the short duration varieties of these crops made multiple cropping possible. But the stress on optimum periods of sowing for obtaining higher yields in crop rotation and the problems in performing certain operations (e.g. threshing in wheat and puddling in rice etc.) necessitated the introduction of tractors in which they made huge investments. Though the investments on tractors started in 1967-68 or even earlier but it increased fast from 1970-71 onwards, i.e. after the 'Rice Revolution'. In the latter years of the study, the importance of this item declined.

After heavy investments in irrigation and tractorisation, the sample farmers started investing in plant protection equipment (1972-73 onwards), with average share of 0.14 per cent, land improvements (1979-80 onwards) and special types of structures to minimize water losses (1985-86 only). Non-farm investments made throughout the period indicates the attitude of farmers to diversify their income pattern.

### 3. Period of Stabilization of Investments

The period 1981-82 onwards can be termed as the period of stabilization of investments. The investments in machinery (tractor and allied equipment) declined marginally from the year 1982-83 onwards. The share of irrigation structures in total investments declined from 10.14 per cent in period-II to 9.59 per cent in period-III. Similarly, the expenditure on tractor and allied equipment was highest in 1981-82 and it sharply declined there after. The expenditure of funds on consumer durables picked up in this period. The share of this item increased from about 5 per cent in period I and II to 8.13 per cent of total investments in period III. The farmers also started making investments in the non-farm enterprises in order to further raise their incomes apart from giving more importance to raise their standard of living. The share of funds diverted towards non-farm investments increased from 1.77 per cent in period I to about 9.0 per cent of total investments in period II and III.

### Farm Investment Pattern and Future Prospects

From the above discussion on farm investment pattern it can be inferred that before mid sixties Punjab agriculture was traditional. Following the adoption of high yielding varieties of wheat and rice, and instant mechanisation of Punjab agriculture occured to make it possible to increase production per unit of area and per unit of time. Since these varieties were more responsive to water, the farmers diverted huge funds to mechanise irrigation. Time constraint compelled the farmers to make investments in tractors and allied equipment. This changing pattern indicates that technological change in Punjab agriculture has been task oriented. It consisted of a task-by-task upgradation of technology leading to modernisation of a traditional agriculture of the state. Recently, the investments in agriculture has stabilized, although it has declined marginally from the year 1980-81 onwards. The importance of consumer durables and non-farm investments has increased whereas that of machinery declined.

If we stretch the scenario towards future, it can be visualised that the farm incomes are likely to increase further although the rate of increase may not be as fast as that realised in the earlier years. A question is often raised as to where will the farmers invest their savings. It is, therefore, of great importance to charter the farm investment policy for proper utilisation of farm surpluses.

The results of the present study indicate that investment in agriculture has stabilized for the last few years and agricultural sector, in general, may not be in a position to absorb more investments. Some earlier studies (Singh, 1977; Kahlon, & Singh, 1978; Singh, & Miglani, 1976) also pointed out the existence of over investments in certain items of fixed capital in agriculture for instance, tractors. Thus, there is limited scope for further increase in investments in agriculture.

In the absence of proper avenues of non-farm investment there is a danger of these surpluses being diverted

to wasteful expenditures, the evidence of which is already available. This will affect the economic development of the state. On the other hand, if there exists attractive non-farm investment opportunities, it will give a boost to the Punjab economy. Therefore, efforts should be made to motivate farmers, particularly the upper sections of farming population for using surpluses in non-farm enterprises. Saving mobilisation programmes in the rural areas should be given top priority so that these surpluses could be utilized in a better way in other sectors of the economy.

Certain studies have brought out that there is excess capacity of labour in Punjab farms. The reason behind this was lack of employment avenues in other sectors of the economy. Employment opportunities in non-farm sector can be created by channelising farm savings for creation of employment in sectors other than agriculture. This will increase productivity of labour and consequently will make more capital available for agriculture.

## REFERENCES


**Diskalkar, P.D. and S.D. Suryavanshi,"** A Study of the Investment Decisions in Ahmednagar District", **Ind. J. Agric**. Econ., 1972,

**Kahlon, A.S. and R. Singh,**."Tractor Use by Punjab Farmers", **Agric**. Sit. India, 1978,

**Kahlon, A.S.**, Modernisation of Punjab Agriculture, **Allied Publishers**, New Delhi, 1984.

**Singh, A.J. and Miglani S.S.** "An Economic Analysis of Energy Requirements in Punjab Agriculture", **Ind. J. Agric**. Econ., 1976.

**Singh, R.** "The Impact of Tractors on Land Development and Expansion of Irrigation", Economic Affairs 1977.


□

**It is unfortunate that "rationality" has come to have a very narrow definition in business analysis. It is confined to find the "right answer" but fails to see "the right problem".**

*—Peters and Waterman*

**As the horsepower in modern automobiles steadily rises, the congestion of traffic steadily lowers the possible speed of your car. This is known as progress.**

*—Sydney J. Harris*

**Anything that makes the world more humane and more rational is progress; that's the only measuring stick we can apply to it.**

*—W. Lippmann*

**Progress is assessed by looking forward to see how much of the task is yet to be done rather than by looking backwards and see what has already been achieved.**

*—Edward de' Bono*

# A Methodology for Evaluation of Agricultural Training Programmes

**S. Bhaskaran, L. Sundararajan & D. Somasundaram**

*Although several evaluation methodologies have been in vogue, there exists no objective measure to find out the effectiveness of the evaluations done. In this article the authors attempt to develop an objective scale for measuring the effectiveness of evaluation done for training programmes organised by four major agricultural development training institutions namely FTI, RIT, ETI and SPTI. A unique approach followed in developing the scale has been discussed.*

*S. Bhaskaran is an Associate Professor of Agricultural Extension, K.A.U., College of Agriculture, Vellayani. L. Sundararajan has been the former Professor and Head, T.N.A.U. Coimbatore & D. Somasundaram is the Professor & Head, K.V.K., T.N.A.U., Vridhachalam.*

Evaluation is an integral part of any project especially in a human resource development programme like training. This has been rightly stressed in the recommendations of National Seminar on Extension Education in Human Resource Development (1986) which suggested that, to achieve the intended goal and objective of any training course, systematic and objective evaluation must invariably be undertaken for every training course. Michalak and Yager (1979) stated that a common method of evaluating the training departments' effectiveness is to report the number of classes, trainers, hours and topics and reactions of the trainees on changes in the level of trainees knowledge. Brandenbury (1982) suggested that evaluation could be by means of asking about functions, roles, techniques and skills used in training evaluation. Even though a host of evaluation methodologies have been in vogue, there exists no objective measure to find out the effectiveness of such evaluation done. Thus, there is a need for a scale to measure the effectiveness of evaluation done in training programmes. To meet this aim, an objective scale has been developed for measuring the effectiveness of evaluation done for training programmes organised by four types of training institutions namely (a) Farmers Training Institutions (FTI), (b) Extension Workers Training Institutions, (ETI), (c) Research Workers Training Institutions (RTI) and (d) Service Personnel Training Institutions (SPTI) which are responsible for human resource development of various persons involved in agricultural development. The authors describe a unique approach followed in developing the scale.

## Materials and Methods

The scale constructed has three aspects in an hierarchical order of 1. Evaluation phases, 2. Areas and 3. Components with ideal methods of evaluation. Three training phases viz., pre, during and post training as suggested by Lynton and Pareek (1967) and Somasundaram (1987) were identified. Based on a review and discussions with experts, 32 evaluation areas (table 1) under aforesaid

Table 1. Potential evaluation weighted scores of training evaluation phases and areas for different training institutions

| Potential evaluaion | Training institutions of | | | | Remarks |
|---|---|---|---|---|---|
| | Farmers | Extension workers | Research workers | Service personnel | |
| **Pre-training Evaluation Phase ($P_1$)** | 30 | 30 | 30 | 30 | |
| *Training Evaluation Area* | | | | | |
| Need assessment (A1) | 2.31 | 2.45 | 2.45 | 2.45 | |
| Commitment (A2) | 1.84 | 1.99 | 1.99 | 1.99 | |
| Formulation of objective (A3) | 2.27 | 2.42 | 2.42 | 2.42 | |
| Selecting subject matter content (A4) | 2.50 | 2.65 | 2.65 | 2.65 | |
| Selection of learning experience (A5) | 2.31 | 2.45 | 2.45 | 2.45 | |
| Training programme planning (A6) | 2.12 | 2.27 | 2.27 | 2.27 | |
| Physical facilities selection (A7) | 1.85 | 2.00 | 2.00 | 2.00 | |
| Duration and season of training (A8) | 1.84 | 1.99 | 1.99 | 1.99 | |
| Selection of trainers (A9) | 2.42 | 2.57 | 2.57 | 2.57 | |
| Orientation of the trainer (A10) | 1.97 | 2.12 | 2.12 | 2.12 | |
| Selection of trainees (A11) | 1.91 | 2.06 | 2.06 | 2.06 | |
| Selection of training methods (A12) | 2.36 | 2.50 | 2.50 | 2.50 | |
| Selection of training aids (A13) | 2.38 | 2.53 | 2.53 | 2.53 | |
| Selecting venue for field training (A14) | 1.92 | - | - | - | Area not applicable to ETI. RTI and SPTI |
| **During Training Evaluation Phase ($P_2$)** | 42 | 42 | 42 | 42 | |
| *Training Evaluation Areas* | | | | | |
| Orientation to the trainees (A15) | 4.34 | 4.34 | 4.34 | 4.34 | |
| Setting up the training situation (A16) | 4.60 | 4.60 | 4.60 | 4.60 | |
| Teaching methods (A17) | 5.44 | 5.44 | 5.44 | 5.44 | |
| Involvement of trainees (A18) | 5.83 | 5.83 | 5.83 | 5.83 | |
| Participation of trainees (A19) | 5.93 | 5.93 | 5.93 | 5.93 | |
| Self-evaluation of trainer (A20) | 4.84 | 4.84 | 4.84 | 4.84 | |
| Subject matter covered (A21) | 5.97 | 5.97 | 5.97 | 5.97 | |
| Evaluation during the class (A22) | 5.05 | 5.05 | 5.05 | 5.05 | |
| **Post-training Evaluation Phase ($P_3$)** | 28 | 28 | 28 | 28 | |
| *Training Evaluation Areas* | | | | | |
| Trainees reaction (A23) | 3.55 | 3.34 | 3.34 | 3.34 | |
| Evaluating the physical facilities (A24) | 2.60 | 2.59 | 2.59 | 2.59 | |
| Adequacy of subject matter covered (A25) | 3.20 | 3.19 | 3.19 | 3.19 | |
| Impact of the training (A26) | 3.33 | 3.30 | 3.30 | 3.30 | |
| Cost benefit analysis (A27) | 2.84 | 2.82 | 2.82 | 2.82 | |
| Evaluating the trainer (A28) | 3.00 | 2.98 | 2.98 | 2.98 | |
| Utilization of trained person by organization (A29) | - | 3.34 | 3.34 | 3.34 | Area not applicable to FTI |
| Follow up (A30) | 3.40 | 3.38 | 3.38 | 3.38 | |
| Feed back (A31) | 3.20 | - | - | - | Area not applicable to |
| Effort on training institution (A32) | 3.08 | 3.06 | 3.06 | 3.06 | ETI, RTI and SPTI |

phases were included. Evaluation components based on training activities for each area were identified. Initially 200 such components were collected and reduced to 75 based on Judges Relevancy Rating. Five common evaluation methods to assess the evaluation components were identified. Ideal combination of methods for each component on Judge Preferences was fixed (table 2). Each phase, area, component and method was assigned weightage based on Judges' Opinion. The judges weightages were subject to consistency test. Mean score, Spearman Rank Order Correlation Coefficient and Kendall's Coefficient of Concordance were the statistical tools used in the construction of scale.

## Results

*a) Evaluation phases weightage*

The mean weightages assigned by the judges for the three phases are presented in Table 1. While assigning weightages, judges were asked to ascertain that total weightages given to all three phases should be 100.

*b) Evaluation areas weightage*

The mean weightages assigned to 32 training areas are presented in Table 1. While assigning weightages judges were asked to assign scores ranging from 0-100 to each area. It would be seen that out of 32 areas, 31 areas are applicable to FTI and 30 areas each to ETI, RTI and SPTI.

*c) Evaluation components and method weightage*

The weightage assigned to 75 components and 5 evaluation methods are presented in Table 2 along with the ideal combination of method for each component. While assigning weightages judges were asked to assign values from 0-10 to each component/method. It may be seen from the table that 67, 66, 62 and 62 components are applicable to FTI, ETI, RTI and SPTI respectively.

*d) Consistency test*

This was tested by subjecting the assigned weightages for phases, areas, components and ideal methods to Kendall's Coefficient of Con-cordance test by using the weightages and relative importance score to each item. For getting relative importance score, judges were separately asked to rate the phase, area and component independently in a seven point continuum of most important to least important carrying score value of 7 to 1. The results obtained in consistency tests are presented in Table 3. It shows clearly that judges weightages were just not at a random basis but based on the relative importance of each item as perceived by the judges.

## Administration of scale and scoring procedure

The constructed scale with its components and methods may be administered to the person who is directly incharge of the training programme of aforesaid training institutions who are to give response as Yes/No to each component and method.

Table 3. Consistency test values of phase, area, component and ideal method

| Particular | d.f | $X^2$ value |
|---|---|---|
| 1. Evaluation phase | 23 | 24.56 ** |
| 2. Evaluation area under pre-training phase | 13 | 34.26 ** |
| 3. Evaluation area under during training phase | 7 | 21.54 ** |
| 4. Evaluation under post training phase | 9 | 20.48 * |
| 5. Evaluation components under pre-training fix phase | 35 | 68.97 ** |
| 6. Evaluation components under during training phase | 18 | 46.21 ** |
| 7. Evaluation components under post training phase | 19 | 52.76 ** |
| 8. Ideal evaluation methods | 4 | 17.33 ** |

* Significant at 5% level
** Significant at 1% level

The scoring procedure recommended for the scale is as follows :

Making use of the information as ideal evaluation methods, components, areas and phases, a formula computed to measure the effective evaluation is based on actual/potential model.

*Computing actual/potential score for method of evaluation :*

Potential ideal method is calculated by using the formula.

$$\sum_{i=1}^{5} M_i = M_1/M_2/M_3/M_4/M_5$$

i.e. summation of weightages of various combinations of ideal methods identified for one evaluation component. In the case of any one method involved, weightage of that method is to be considered. Actual ideal method score can be calculated by summing up the scores of all these used by the respondent.

*Computing potential/actual for component :*

Potential evaluation component score can be arrived at by component weightage multiplied by ideal method score which is represented as :

Table 2. Ideal evaluation methods for components, component weightage, ideal evaluation method score and potential component score

| Evaluation components | Ideal evaluation methods for evaluating (M) | Evaluation component weightage (1i) | Ideal evaluation method score (ΣMi) | Potential evaluation component score (Ci) | Remarks |
|---|---|---|---|---|---|
| 1. | P.D + L.R | 6.96 | (7.96 + 5.93) | 96.67 | |
| 2. | P.E + P.D | 6.60 | (7.57 + 7.96) | 102.30 | |
| 3. | P.D + L.R | 6.37 | (7.96 + 5.93) | 91.26 | |
| 4. | P.D + E.S | 8.06 | (7.96 + 7.51) | 124.69 | |
| 5. | P.D + E.S | 7.72 | (7.96 + 7.51) | 119.43 | |
| 6. | P.D + E.S | 7.72 | (7.96 + 7.51) | 119.43 | |
| 7. | P.E + P.D | 6.42 | (7.57 + 7.96) | 99.70 | |
| 8. | P.E + P.D | 6.85 | (7.57 + 7.96) | 106.38 | |
| 9. | P.D + S.S | 8.18 | (7.96 + 6.36) | 117.14 | |
| 10. | P.E + P.D | 7.75 | (7.57 + 7.96) | 120.36 | |
| 11. | P.D + E.S | 8.12 | (7.96 + 7.51) | 125.62 | |
| 12. | P.D | 7.72 | (7.96) | 61.42 | Not applicable to RTI & SPTI |
| 13. | P.D | 7.33 | (7.96) | 58.35 | Not applicable to FTI & ETI |
| 14. | P.D | 6.90 | (7.96) | 54.92 | Not applicable to FTI & ETI |
| 15. | P.E | 6.72 | (7.57) | 50.53 | Not applicable to ETI, RTI & SPTI |
| 16. | P.E | 6.66 | (7.57) | 50.42 | Not applicable to RTI & SPTI |
| 17. | P.E+P.D+L.R | 8.12 | (7.57+7.96+5.93) | 174.25 | |
| 18. | P.E + E.S | 7.75 | (7.57 + 7.51) | 116.87 | |
| 19. | P.D | 7.24 | (7.96) | 57.63 | |
| 20. | P.E | 6.75 | (7.57) | 51.10 | |
| 21. | P.E | 6.27 | (7.57) | 47.46 | |
| 22. | P.E + P.D | 6.69 | (7.57 + 7.96) | 103.90 | Not applicable to RTI & SPTI |
| 23. | P.E + P.D | 6.75 | (7.57 + 7.96) | 104.83 | Not applicable to FTI |
| 24. | P.E + E.S | 7.88 | (7.57 + 7.51) | 118.83 | |
| 25. | P.E + P.D | 7.00 | (7.57 + 7.96) | 108.71 | |
| 26. | P.D | 6.96 | (7.96) | 53.25 | |
| 27. | P.D. | 7.00 | (7.96) | 55.72 | |
| 28. | P.D. | 6.66 | (7.96) | 53.01 | Not applicable to RTI |
| 29. | P.E.+E.S | 6.27 | (7.57+7.51) | 94.55 | Not applicable to FTI |
| 30. | P.E.+P.D | 6.33 | (7.57+7.96) | 98.30 | Not applicable o ETI, RTI & SPTI |
| 31. | P.E.+P.S | 7.66 | (7.57+7.51) | 115.51 | |
| 32. | P.E. | 7.18 | (7.57) | 54.35 | |
| 33. | P.E. | 7.81 | (7.57) | 59.12 | |
| 34. | P.E. | 6.27 | (7.57) | 47.46 | |
| 35. | P.E+P.D | 7.33 | (7.57+7.96) | 113.83 | Not applicable to ETI, RTI, SPTI |
| 36. | P.E+P.D | 7.30 | (7.57+7.96) | 113.37 | Not applicable to ETI, RTI & SPTI |
| 37. | P.E+P.D | 6.90 | (7.57+7.96) | 107.16 | |
| 38. | P.E+P.D | 7.06 | (7.57+7.96) | 109.64 | |

*(Contd.)*

**Table 2. (Contd.)**

| Evaluation components | Ideal evaluation methods for evaluating (M) | Evaluation component weightage (1i) | Ideal evaluation method score (ΣMi) | Potential evaluation component score (Ci) | Remarks |
|---|---|---|---|---|---|
| 39. | P.E | 7.27 | (7.57) | 55.03 | |
| 40. | P.E | 6.75 | (7.57) | 51.10 | |
| 41. | P.E+P.D+E.S | 5.78 | (7.57+7.96) | 133.17 | Not applicable to FTI & ETI |
| 42. | P.E | 7.48 | (7.57) | 56.62 | Not applicable to FTI, RTI & SPTI |
| 43. | P.E+P.D | 6.42 | (7.57+7.96) | 99.70 | Not applicable to RTI & SPTI |
| 44. | P.E+P.D | 7.06 | (7.57+7.96) | 109.64 | Not applicable to SPTI |
| 45. | P.E+P.D | 7.57 | (7.57+7.96) | 117.56 | Not applicable to RTI & SPTI |
| 46. | P.D | 7.69 | (7.96) | 61.21 | |
| 47. | P.D | 7.03 | (7.96) | 55.96 | |
| 48. | P.D | 7.06 | (7.96) | 56.20 | |
| 49. | P.D | 6.96 | (7.96) | 55.40 | |
| 50. | P.D | 6.85 | (7.96) | 54.53 | |
| 51. | P.E+P.D | 7.21 | (7.57+7.96) | 111.97 | |
| 52. | P.D+E.S | 7.57 | (7.96+7.51) | 117.11 | |
| 53. | P.D+E.S | 7.66 | (7.96+7.51) | 118.96 | |
| 54. | P.D+E.S | 7.69 | (7.96+7.51) | 118.50 | |
| 55. | P.D+E.S | 6.57 | (7.96+7.51) | 101.64 | |
| 56. | P.D+E.S | 7.87 | (7.96+7.51) | 121.75 | |
| 57. | P.D+E.S | 7.87 | (7.96+7.51) | 121.75 | |
| 58. | P.D+E.S | 6.03 | (7.96+7.51) | 93.28 | |
| 59. | P.E | 6.00 | (7.57) | 45.42 | |
| 60. | P.E+L.R | 7.66 | (7.57+5.93) | 103.41 | |
| 61. | L.R+E.S | 6.96 | (5.93+7.51) | 93.54 | |
| 62. | L.R | 8.30 | (5.93) | 49.22 | |
| 63. | L.R | 7.52 | (15.93) | 44.59 | |
| 64. | L.R+E.S | 7.45 | (5.93+7.51) | 100.13 | |
| 65. | P.D+E.S | 8.52 | (7.96+7.54) | 131.8O | |
| 66. | P.D+E.S | 7.33 | (7.96+7.51) | 113.40 | |
| 67. | E.S | 6.88 | (7.51) | 51.67 | |
| 68. | P.D+E.S | 6.12 | (7.96+7.51) | 97.93 | Not applicable to FTI |
| 69. | P.E+E.S | 7.27 | (7.96+7.51) | 112.47 | Not applicable to FTI |
| 70. | P.D+E.S | 6.33 | (7.96+7.51) | 97.93 | |
| 71. | P.D+E.S | 6.82 | (7.96+7,51) | 105.51 | |
| 72. | P.D+E.S | 7.06 | (7.96+7.51) | 109.22 | Not applicable to ETI,RTI & SPTI |
| 73. | P.D+E.S | 7.48 | (7.96+7.51) | 115.72 | Not applicable to ETI, RTI & SPTI |
| 74. | P.D+E.S | 7.45 | (7.96+7.51) | 115.25 | |
| 75. | P.D+E.S | 7.78 | (7.96+7.51) | 120.36 | |

**Abbreviation**

1. P.D = Personal Discussion
2. P.E = Past Experience
3. L.R = Literature & Records
4. E.S = Extension Studies
5. S.S = Systematic Studies

$$C_i = L_i \Sigma M_i$$

Where $C_i$ = Potential evaluation component score

$L_i$ = Weightage of potential evaluation component

$\Sigma M_i$ = Potential ideal method score

For computing actual evaluation component score, weightage of evaluation component is multiplied by concerned actual ideal method score which can be denoted as:

$$c_i = l_i \Sigma m_i$$

Where $c_i$ = Actual evaluation component score

$l_i$ = Weightage of actual evaluation component

$\Sigma m_i$ = Actual ideal method score

*Computing potential and actual score for area :*

Potential evaluation area score is arrived at by summing the potential component scores of all evaluation components under each area which is denoted as :

$$\sum_{i=1}^{n} C_i = C_1 + C_2 + \ldots\ldots\ldots\ldots C_n$$

Where $\Sigma C_i$ = the sum of all potential scores of an evaluation area. The actual evaluation area score is computed by summing up all component scores of an area denoted as :

$$\sum_{i=1}^{n} c_i = c_1 + c_2 + c_3 \ldots\ldots\ldots\ldots c_n$$

*Computing potential weighted and actual weighted evaluation score :*

Potential weighted area is the weightage given to the area by judges and is denoted as :

$$A_1 = W_{ia}$$

where $A_1$ = Potential weighted evaluation area

Wia = Weightage of an evaluation area

Actual weighted evaluation area score is computed by multiplying the actual component scores with concerned area weightage and divided by potential weighted evaluation area score.

$$a_1 = \frac{\Sigma c_i \times W_{ia}}{\Sigma c_i}$$

where $a_1$ = Actual weighted evaluaton score

$\Sigma c_i$ = Summation of all actual component scores in an area

$\Sigma C_i$ = Summation of all potential component score

$W_{ia}$ = Weightage of concerned evaluation area

*Computing the potential and actual phase score*

The potential score is arrived at by

$$\sum_{i=1}^{n} A_i = A_1 + A_2 + A_3 + \ldots\ldots\ldots A_n$$

Where $\Sigma A_i$ = The sum of potential weighted evaluation area score and actual is worked out by

$$\sum_{i=1}^{n} a_i = a_1 + a_2 + a_3 + \ldots\ldots\ldots a_n$$

Where $\Sigma a_i$ = Summation of actual weighted evaluation score. This has to be calculated separately for each phase. The actual evaluation phase score has to be converted to weighted actual evaluation score by

$$p_i = \frac{\Sigma a_i \times W_{ip}}{\Sigma A_i}$$

Where $\Sigma a_i$ = Summation of all actual score in an evaluation phase

$\Sigma A_i$ = Summation of all potential area scores

$W_{ip}$ = Weightage of concerned phase

This has to be calculated separately for each phase.

*Computing potential and actual training evaluation score:* The former is calculated by

$$\sum_{i=1}^{3} P_i = P_1 + P_2 + P_3$$

$P_1$, $P_2$, $P_3$ are potential weighted phase score or weightage assigned to phase and the latter is found by

$$\sum_{i=1}^{3} p_i = p_1 + p_2 + p_3$$

Where $\Sigma pi$ = Sum of all actual weighted evaluation phase score

*Computing effective evaluation score :*

This was arrived at by taking the proportion of potential and actual training evaluation score and multiplied by 100. This is denoted as

$$E = \frac{\Sigma p_i}{\Sigma P_i} \times 100$$

Where E = Effective evaluation score

$p_i$ = Actual training evaluation score

$P_i$ = Potential training evaluation score

## REFERENCES


**Brandenbury, D.C.** 'Training Evaluation : What's the current status'. *Training and Development Journal* 1982.

**Lynton, R.P., and U. Pareek.** Taining for Development, D.B. Taraporevala Sons & Co. Pvt. Ltd. Bombay 1967

**Michalak, D.F., and E.G. Yager**. Making Training process work, Harper and Row, N. York 1979.

**National Seminar on Extension Education in Human Resources Development.** Indian J. Extn. 1986.

**Somasundaram, D.** Modern approaches in water management training, Lecture notes for the USAID assisted water management training held at WTC, TNAU 1987.

# Quality Circles - Gateway to Workers' Participation in Management

Evergrowing competition in the market, increasing costs of input resources and the rising level of awareness about their entity among workers have compelled top managements of many companies to deviate from conventional styles of treatment to their workforce. Today, a company aspiring for growth can not afford to treat its workers as non-living input resources like raw material, money, machines, etc. Workers who are primarily responsible to use all input resources given to them are the key agencies to improve productivity and quality, to reduce wastages, to bring down manufacturing costs and thus to make their company not only to survive but also to grow in a competitive business milieu. Gone are the days when a company could prosper for years together with one standardized product demanding almost negligible change in manufacturing operations and using workers as machines for same repetitive jobs for years together.

With the race on for luring the customer with maximum number of new advantages available in the product over the competitors, companies have to go for faster changes in their product designs, technology, process operations, etc., than what had been in the past. No such changes can be fully implemented on the shop floor, until the worker who is the grass-root implementor of these changes, has successfully participated in arriving at these changes and is convinced that these changes are to benefit his company and himself or atleast is made to believe that changes would not be detrimental to his interests in the organisations. Thus, workers' participation in arriving at and in implementing their work-related decisions emerges to be an important prerequisite to cope up with increasing pressure of competition. Participation increases motivation and productivity, and greater the amount of participation, greater the beneficial effects (Likert, 1961).

In addition, the other environmental factor favouring worker's participation is a marked drift in the national and international scenarios towards democractic systems. Even developed and powerful communist countries like USSR have been taken over by the wave of multi-party systems. Industry, which is only a subset of the total socio-economic environment, can not remain unaffected by these environmental changes. Emery & Thorsud (1976) have aptly remarked that we cherish democracy in political elections, organisational life and socio-cultural politics, but why should it stop at the gate of the enterprises. Therefore, in order to make sure that a company does not lose its competitive edge as well as fits well within the changing business milieu, workers' participation in shop floor management becomes a necessity.

The subject of worker's participation in management at shop floor level has in it three basic terms i.e., workers, participation and management. The terms, in the present context, have been understood as : Worker is an employee at shop floor level (Whatever be his or her occupation) who does not have any authority of either policy making or regularly supervising other workers in his own work area (Virmani, 1978). Participation is mental and emotional involvement of persons in group situations that encourages them to contribute to group or goals and share the responsibility of achieving or not achieving them (Davis and Newstrom, 1985). Management at shop floor level is decision making process through which work-related objectives of shop floor are set and methods of achieving them are decided (Mannan, 1987). Keeping in view the meaning of each term, the workers' participation in management at shop floor level could be defined as the psychological involvement of workers in a group situation that encourages them to contribute and share the responsibility of decision making to set and achieve objectives of their work-related issues by releasing their own resources of initiative and creativity.

Quality Circles, which are rather a recent development in the direction of modifying human behaviour at work, provide the right answer to the question of workers' participation in management at shop floor level. A Quality Circle is basically a mechanism by which individuals (who are members of Quality Circle) are developed and are provided with opportunities to make use of their developed strengths while participating in the process of decision making by their circle as a whole. Precisely, Quality Circle

is a small group of employees or workers ranging from 4 to 10 in one group, who work for same supervisor or foreman, to identify, analyze and resolve their work related problems, leading to improvement in their total performance and quality of work life.

Quality Circles deal with minor quality problems (major being dealt by Quality Control Department), and other work-related problems but not with extraneous issues such as grievances or demands of various individuals. The membership is voluntary; the workers are free to join and leave Quality Circles of their area. The assumptions on which Quality Circles are based are: (i) voluntary use of man's mind by himself gives the best results, and (ii) a man who does a job knows best about the job. Thus Quality Circles offer workers to improve their own job and in turn contribute to betterment of the organisation as a whole. In the initial stages, issues pertaining to quality only were taken up in Quality Circle activities.

Application of Quality Circles was initiated for the first time in the world in Japan in May 1962. The spectacular performance of Quality Circles has played an important role in improving quality and productivity in Japan (Ingle, 1988). Outside Japan, it was in 1974 that first Quality Circle was started in USA. In India Quality Circles were first initiated in BHEL in 1980-81. Thereafter, this concept gained entry in over four hundred public as well as private sector organisations involving over one lakh shop floor level workmen. It covers organisations such as ordinance factories, railways, banks, steel plants, port trusts, BHEL, BEL, BASF, Hindustan Antibiotics, etc. in public sector as well as in private sector organisations such as Modi Rubber, J.K. Synthetics, Grasim Industries Limited, Crompton Greaves, Shriram Fibres, Century Pulp and Paper Mills, Mahindra &Mahindra, L&T, TELCO, Bajaj Auto, etc. during the last three years. There have also been series of conventions at regional, national and international levels involving nearly ten thousand shop floor level workmen from various organisations. The Quality Circle activity in India covers less than 0.3% of the shop floor level workmen. To make India internationally competitive 100 to 200 fold increase in Quality Circle activities is required.

In view of the literature available and the knowledge acquired so far pertaining to the role of Quality Circles in workers' participation in management, the present study was carried out to test the following hypothesis:

(1) Quality Circles create supporting environment for workers' participation.

(2) Quality Circles enable workers to view problems from other man's point of view, improving understanding of situations.

(3) Quality Circles develop analytical ability in workers for better decision making with regard to their work-related problems at their own level.

(4) Quality Circles develop analytical ability in workers for better decision making with regard to their work-related problems at next higher level i.e., supervisory level.

(5) Quality Circles develop analytical ability in workers for better decision making with regard to their work-related problems at their own level.

(6) Quality Circles develop communication abilities in workers for better interaction at their own level i.e., with their co-workers.

(7) Quality Circles develop communication abilities in workers for better interaction at next higher level i.e., with their supervisor.

(8) Quality Circles develop communication abilities in workers for better interaction at further higher levels i.e., with sectional incharge.

(9) Quality Circles directly increase workers' participation.

## METHODOLOGY

*Sample*: The elements of the universe are constituted of Quality Circle members of successful Quality Circles from BHEL, Kinetic Honda, Hindustan Motors and Bhilai Steel Plant. The final sample of 50 elements was selected at random from such members who attended Quality Circle Convention of Confederation of Engineering Industries held at Indore on January 6, 1990.

*Instrument*: The data were collected with the help of a questionnaire developed on the basis on conceptual framework of the problem under study. It was finalised in consultation with academicians who have been working in the area of workers' participation. The questionnaire was filled up by all the 50 elements.

### Results and Discussion

The data were statistically treated by using $X^2$-test (Table 1). The results were found to support all the nine hypotheses of the study. It has been confirmed through this study that Quality Circle create supporting environment for workers' participation, enable workers to view problems from another man's point of view for improving understanding of the situation. Quality Circles develop analytical ability in workers for better decision making with regard to their work-related problems at their own level, at next higher level and at further higher level. Further,

Table 1. Results based on the $X^2$-test

| | |
|---|---|
| Hypothesis1 | P<.01 |
| Hypothesis 2 | P<.01 |
| Hypothesis 3 | P<.01 |
| Hypothesis 4 | P<.01 |
| Hypothesis 5 | P<.01 |
| Hypothesis 6 | P<.01 |
| Hypothesis 7 | P<.01 |
| Hypothesis 8 | P<.01 |
| Hypothesis 9 | P<.01 |

Quality Circles have also been found to develop communication abilities in workers for better interaction at their own level, at next higher level, and at further higher level. Quality Circles directly increase workers' participation, breaking the barriers of hierarchy. Agarwal (1984) has contended that given the training, motivation and opportunity, a worker can best suggest ways to bring changes making his job easier, more productive and of higher quality. Judging from the current trend, Suri (1989) has rightly predicted that small group activities like Quality Circles which help promote a workers' involvement are likely to receive more attention and support. The findings of the present study are also in line with that of Singh and Chander (1989), who have concluded that Quality Circles create a consciousness for better quality environment through active participation of all concerned at the shop floor level. Participation opportunities given by Quality Circles have also been acknowledged by Holoviak and Holoviak (1989) as 'What is significant in Quality Circles movement is that the push for workers' participation did not come as a result of labour unrest, from top management or from government mandate. It came from the belief - the faith that this form of interaction would serve as a catalyst to achieve a competitive position in the world economy as a result of workers' initiatives'.

Similiar view on participative strength of Quality Circles has also been recently expressed by Singhania (1989) as 'Methodology and Culture for Quality Circles has foundation in participativeness for solving any problem. Thus total participation of group is involved'. Another similar view supporting dominance of participation in Quality Circles was earlier expressed by Deshpande (1985), according to whom 'the membership of Quality Circle means participative environment that provides identification of work. It replaces external control and the threat of punishment by self-direction and self control ..... participation encourages commitment and helps to remove the carrot-and stick management style'.

While above discussions put forth an extremely convincing case for Quality Circles as a mechanism to provide workers' participation in management at shop floor, however, it would not be fair to restrict utility of Quality Circles as a participative mechanism only. In fact, Quality Circles, when properly handled become a part of organisation's culture with a firm belief in people-building and continuous improvement in quality of work life. In this context, Ricker (1980) aptly remarked as 'Unlike other things which were tried before, Quality Circles are change agents. Right from the start workers feel; we are doing it because we want to, not because management tells us to. The small focus is problem solving, the big focus is improved communication.' According to him, he has seen circles really change the attitude and personalities of people, bringing them out of their shells and getting them to work as a peer group.

A similar view was expressed by Robson (1980) who remarked that 'Quality Circles can help to change the culture of an organisation to one where much wider sharing of corporate goals and real involvement of workforce are spread widely and where genuine two-way communication is a reality. 'In BHEL also, the introduction of Quality Circle movement was found to have broadened the base of participative work culture and brought about discernible attitudinal changes amongst the employees.

## Conclusion

Quality circles not only provide the necessary prerequisite for an effective participation of workers in management at shopfloor level but they can also be used as change agents for developing the desired productivity-oriented-team-culture through gradual process of people building.

*Deepak Kaul*
*Opinder Dhar*
*R.D. Pathak*
*Devi Ahilya University*
*Indore, Madhya Pradesh.*

## REFERENCES

**Agarwal, R.C.** (1984). Quality Circle Application in Jute Mills, The Economic Times, August 7.

**Davis K. and Newstrom, J.W.** (1985). Human Behaviour at Work: Organisational Behaviour. Singapore : McGraw-Hill.

**Deshpande, V.V.** (1985). 'Quality Circles - A Technique for increasing Productivity'. The Economic Times, July.

**Ingle S.** (1988). Quality Circles Master Guide, increasing Productivity with people power, Prentice Hall of India Pvt. Ltd., New Delhi.

**Likert, R.** (1961). New Patterns of Management, New York, MC Graw-Hill Company.

**Mannan, M.A.** (1987). Workers' Participation in Managerial Decisions making (a study in a developing country) Delhi : Daya Publishing House.

**Modi, H.K.** (1990) 'Workers Participation in Management', paper presented in Seminar on Labour Participation in Management organised by Bureau of Public Enterprises at New Delhi.

**Ricker** (1980) 'Quality Control Circles - The west adopts a Japanese concept', International Management, December

**Robson, M.** (1980), Quality Circles-A Practical Guide, U.K. Mike Robson and Associates.

**Singh, R. and Chander, S.** (1989). 'Japanese Management: Its relevence in India'. Proceedings of the All India conference on Emerging issues in Human Resource Management. Rohtak : March 30 & 31 Department of Commerce, M.D. University.

**Singhania, R.**(1989). Negative Attitudes and Quality Circles Quality Circle India, Special Issue on International Convention of Quality Circles, Vol. 3 No. 4.

**Sarazf, R.K.** (1990) 'Labour Participation in Management, BHEL Experience, Paper presented in Seminar on 'Labour Participation in Management at New Delhi.

**Suri, G.K.** (1989) 'Effectiveness of Consultative and Participatory Mechanism Some Observations'. Productivity, 30, 320-325.

## Knowledge Vs Skills

Failure to improve leadership skills often stems from confusion between education and training, understanding and habits, knowing and doing:

"Many management development programs attempt to alter behavior by imparting knowledge and understanding about particular theories of leadership, motivation, communication. . . . Managers may both understand and agree with the concepts of a program, yet lack the behavioural skills required to translate the concepts into action."

*—Jerry Porras and Brad Anderson. "Improving Managerial Effectiveness through Modeling-Based Training"*

"We are still using teaching methodology that has been demonstrated to not really change behaviour . . . lecture, film, case discussion, paper and pencil instruments and exercises. Nowhere is there evidence that these techniques really change behaviour."

*—Jack Zenger. "The Painful Turnabout in Training"*

"Programs designed to each supervisors how to manage the work and efforts of other people do not necessarily result in trained supervisors . . . . The issues often center about the need for a manager to be a good communicator, to be able to motivate his people, to give recognition, to make constructive criticism. Most managers seek to know *how* to motivate, *how* to communicate, and *how* to carry out the other aspects of leadership."

*—Arnold P. Goldstein and Melvin Sorcher, "Changing Supervisor Behavior"*

"Management schools which will begin the serious training of managers when skill training takes a serious place next to cognitive learning . . . [which] is detached and informational like reading a book or listening to a lecture . . . . Cognitive learning makes no more managers than it does swimmers. . . . They will drown the first time they jump in the water if their coach never . . . gets them wet and gives them feedback on their performance."

*—Henry Mintzberg. "The Manager's Job: Fact and Folklore"*

As it was assumed, the results show that the management students possess different values between the internal and external on the sphere of personal control and interpersonal control. The internals' emphasis is more on the theoretical values, than that of the externals on both the spheres of control (personal control, interpersonal control). Theoretical values indicate the character of problem solving and are related to investigation, research and scientific curiosity. The management students who had scored high on personal control (internals) and interpersonal control (internals) carry theoretical values. They are more achievement-oriented and have more control over their destiny and are likely to be better managers. The review of the research shows that the internal managers are likely to express a task-orientation and to outperform externals in a stress situation (Anderson, Hellriegel and Slocum, 1977). The leaders were more likely to be internals and exhibited behaviour characteristics of an instrumental, task-oriented style (Anderson and Craig-Fric, 1978).

On politico-economic value, the externals (personal control) pronounced better than their counterpart internals. The politico-economic values represent one's desire in accumulating money and securing executive power. The externals believe reinforcement are not under their personal control but rather are under the control of powerful others, luck or fate. Goodstadt and Hjelle (1973) suggested that externals are more likely to utilise a coercive powerbase, particularly through the use of threats. Mitchell, Smyser and Weed (1975) also had reached similar conclusions.

*Babu Thomas*
*Lecturer in Organizational Behaviour*
*Chhatrapati Shahu Central Institute of*
*Business Education & Research*
*Kolhapur, India*

## REFERENCES

**Anderson, C.R. and Craig-Eric Schneier.** (1978) "Locus of control, Leader Behaviour and Leader Performance among Management Students". Academy of Management Students, Vol. 21, No. 4.

**Anderson, C.R. Hellriegel D. and Slocum J.W.** (1977). "Managerial Response to Environmentally-induced Stress", Academy of Management Journal, Vol. 20,.

**Dixit Ramesh C and Singh Ram P.** (1975) "External vs. Internal control of Reinforcement as Related to Decision Time", Indian Journal of Psychology, Vol. 53, Part-2.

**Goodstadt, B.E. and L.A. Hjelle** (1973) : "Power to the Powerless : Locus of Control and the use of Power", Journal of Personality and Social Psychology, Vol. 27.

**Kahn, Robert L., Wolfe, Donald M., Quinn, Robert P., Snoak, J. Diedrick and Rosenthal, Robert A.** (1964) Organisational Stress: Studies in Role Conflict and Ambiguity", Wiley, New York.

**Mithchell, T.R. Smyser C.M. and Weed S.L.** "Laws of Control : Supervision and Work Satisfaction", Academy of Management Journal, Vol. 18.

**Organ, Dennis W. and Greene L. Charles N.** (1974) "Role Ambiguity, Locus of Control and Work Satisfaction", Journal of Applied Psychology.

**Paulhus, Delroy** (1983) "Sphere - Specific Measures of Perceived Control", Journal of Personality & Social Psychology, Vol. 44, No. 6.

**Rizzo, John R., House, Robert J. and Lirtzman, Sydney** (1970) "Role Conflict and Ambiguity in Complex organisations", Administrative Science Quarterly, Vol. 15.

**Rotter**, J.B. (1954). Social Learning and Clinical Psychology", Eaglewood Cliff, N.J., Prentice-Hall.

(1966) "Generalised Expectancies for Internal versus External Control of Reinforcement". Psychological Monographs, Vol. 80.

**Seeman, M.** (1963) "Alienation and Social Learning in a Reformatory", American Journal of Sociology, Vol. 69.

**Singh, Ashoka K.** (1983) "Socio-Cultural Deprivation and Locus of Control", Psychologcal Studies, Vol. 28, No. 2.

**Singh Satwar** (1987) "Motivation and Entrepreneurial Behaviour of the Farmers", Indian Journal of Industrial Relations, Vol. 22, No. 3.

**Valecha, Gopal K.** (1972) "Construct Validation of Internal-External Locus of Reinforcement Related to Work-related Variables", Proc. 80th Ann. Conv. of Amer. Psycho. Asson.

□

**- In a dynamic industrial economy, the ignorance about the basic fact that profit is but a provision for the cost of future has resisted all attempts at education.**

*—Peter F. Drucker*

**Profits are the reward for making a unique or at least a distinct contribution in a meaningful area; and what is meaningful is decided by market and customer.**

*—Peter F. Drucker*

# Paper and Paperboard Industry : Productivity, Structure & Related Issues

**Neelam Singh, Anjani K. Kochak & Neelam J. Malhotra**

*The present study analyses some of the major problems of the paper and paperboard industry (excluding newsprint). At the outset the growth of output and capacity and the degree of its utilization are examined. This is followed by a review of the demand projections made by several organizations. The study then discusses the main problems affecting the large integrated paper mills and further examines the partial factor productivity, energy and water consumption, profitability & R&D intensity ratios. To highlight the gaps in technology, international comparisons are made. Next, the main problems of small units are analysed. The working of the price/production controls in the industry and the implications of the decontrol since 1987 are examined. Further, the excise duty structure of the industry is critically evaluated.*

*Neelam Singh, Anjani K. Kochak and Neelam J. Malhotra are lecturers in the Lady Shri Ram College, University of Delhi, New Delhi - 110019.*
*This study is supported by the National Productivity Council under its Sectoral Studies Programme.*

Pulp and paper constitutes one of the most important segments of India's industrial economy and is treated as a basic sector. Its performance affects the availability of printing and writing papers to other sectors like education, communication, trade and commerce, banking and insurance etc., and that of packaging paper to industrial and agricultural sectors. Paper is therefore an essential item of consumption and its increased use reflects the improvements in living standards of the country. The per capita consumption of paper in India is very low, a mere 3 kgs. compared to over 200 kgs in USA and Sweden and close to 90 Kgs. in Taiwan. Recognizing the importance of paper and newsprint, the Government of India has listed it as one of the 17 "basic industries" of importance in the Industrial Policy Resolution (1948). Paper is also one of the items covered by the Essential Commodities Act (1955).

## Growth and Present Status

The paper industry (pulp, paper and paper board) is one of the oldest industries in India. The first paper mill was set up in 1832 in West Bengal. The upper India Couper Mills (Lucknow, 1882), Titagarh Mills (West Bengal, 1884), Deccan Paper Mills (Kerala, 1883), and Bengal Paper Mills (W. Bengal, 1891) were poineering units in this industry. The period 1894-1925 was a difficult one since the paper industry had to struggle for its survival from stiff competition of cheap, imported paper made from wood pulp. In 1925 the industry got its first fillip in the form of a tariff protection. From 1930 onwards bamboo was extensively used as a basic raw material. The production of paper which was more or less stagnant during 1900-1925 doubled by 1935 and from here began a steady development of the industry (Table 1).

The growth of the paper industry gathered momentum after independence and the number of paper mills increased from 17 in 1951 to 305 in 1989 while the installed capacity increased from 1.3 lakh tonnes to 30.14 lakh

1. Historical Technological Growth
2. Low Technological Growth
3. Medium Technological Growth
4. High Technological Growth.

For growth in demand the following three scenarios are evolved depending on varying growth rates of various explanatory variables.

1. Historical demand growth
2. High demand growth
3. Low demand growth.

Forecasts of demand for paper and paper board are arrived at for all the combinations of demand growth and technology scenarios. Looking at demand projections for the year 2000 we find little variation in demand as between technology growth options but high variations between demand growth options. For low demand the estimate for the year 2000 is around 33 lakh tonnes, for historical demand conditions around 46 lakh tonnes and for high demand around 81 lakh tonnes. Out of these estimates, demand of about 33 lakh tonnes looks more plausible, looking at the past trends. ICICI (1990) on the other hand has estimated demand equations for cultural and industrial paper using time series analysis after introducing a dummy variable to take into account production fluctuations in some years (1973 & 1983). Other explanatory variables like literate population, net domestic product from the tertiary sector etc. were not found to be statistically significant and therefore were not considered. By extrapolating their equations to the year 200 A.D., we arrive at a figure of about 33 lakh tonnes only which coincides with that fan NPC's low demand secnario. Thus we expect that the demand for paper and paper boards would be around 33 lakh tonnes by 2000 A.D. Assuming 80% capacity utilization, the capacity needed would be 41-42 lakh tonnes by the turn of the century.

**Large Paper Mills**

The large paper mills are basically forest based integrated units with chemical and heat recovery and have a fairly large base of production.

*Major Problems*

The two major problems of large firms are (i) uncertainty regarding availability of raw materials and (ii) technological obsolescence/upgradation.

Enormous growth in population has led to increased deforestation. Of the 720 lakh hectares of forest land available, well managed productive forests constitutes only 44%. This is only about 10% of total land mass of the country. Viewed against the fact that the country is committed to having 33% effective forest to the total mass, this seems very disturbing. Various studies have indicated that by the turn of the century demand for paper and paper board will be around 33 lakh tonnes and for newsprint about 9.5 lakh tonnes. Nearly 70% of cellulosic raw material needs of the industry are presently met by natural forest resources and balance 30% from unconventional raw materials. Assuming no change in the availability of wood and bamboo the short fall of forest based raw materials would be 57.4% according to IPMA and 60.6% according to DCPPI by 2000 A.D. According to NPC estimates the shortfall would be much higher, about 76% by 2000 A.D. Given the foreign exchange crunch, import of wood pulp to meet the shortfall is not possible. Therefore the only meaningful solution to the problem lies in a more rational development and utilization of forest resources by setting up pulpwood plantations. The problem that arises is in regard to the availability of land and the organization/management of the plantations.

The provisional figures for 1976-77 in respect of classification of land area show that 41.1 million hectare are cultivable wastes and fallow, and 21.9 million hectare are barren and non-cultivable. Besides about 40% of forest land consists of unproductive, fallow and scrub forests. These could be used for raising plantations. It has however been experienced that barren and degraded lands are usually fit only for growth of scrub species and are not capable of sustaining production forestry on an economic scale, as raising commercial species on such lands would be uneconomic, apart from physical difficulties. DCPPI estimated that requirement of land for captive plantations of paper industry would be only 1.6-2 million hectares which is about 2% of unproductive land mass.

Establishment and management of pulpwood plantations has largely been a government affair, the involvement of private sector has only started recently. At present the following types of ownership/management exists.

(i) Most of the existing plantations in India have been developed by Forest Departments of the State Governments. Massive programmes of afforestation were taken up on degraded lands, marginal lands etc., mainly to meet fuel wood requirements of local population.

(ii) In recent years paper mills and state governments have entered into a joint venture to raise pulpwood,

e.g. Titaghur Paper Mills and the Government of West Bengal have formed a joint venture company with the objective of raising pulpwood plantations on 24,000 hectares in 'non-reserved' forests and 'non-protected' forests.

(iii) Plantations have also been raised under farm forestry schemes. Sree Rayalaseema Paper Mills (SRPM) envisaged raising plantations over 6000 hectares of private land covering a period of twelve years. A tripartite agreement has been entered into among SRPM, farmers and the NABARD, the financing agency of the project.

(iv) Since there have been several representations by paper mills to give them land on long term lease to raise their own captive plantations, the State Government of Karnataka has decided to entrust degraded forest land to industries within the State for raising pulpwood.

Besides this, there is a need for intensive research work to provide the required technical base for ensuring reliable optimal yields from pulpwood plantations in India. It is necessary to exploit developments in genetic engineering which enables increase in the bio-mass produced from a given area of land e.g. in the Eucalyptus forest plantations developed by Aracruz Cellulose, the growth rate of conventional Brazillian Eucalyptus was doubled and at the same time there was increase in the fibre content of trees and quality of fibre[1]. It is believed that in India yield can be 3 to 5 times higher and extraction can be improved to the extent of 40% at least.[2]

Thus, we find that firstly, it is important to survey the availability of degraded forests and wastelands which could be utilized for establishment of plantations. Secondly, the optimal pattern of ownership/management of plantations and their financial implications require an in-depth study. Thirdly, a strong research base needs to be built up to ensure reliable and maximum yields from pulpwood plantations.

Most of the large integrated firms are more than 50 years old and are in dire need of modernization and rebuilding. It has been estimated that for setting up new capacity an investment of Rs. 22,000 per annual tonne is required at the present day prices, whereas to rebuild and modernize the existing installed capacity the cost is estimated at Rs. 7000 per annual tonne.[3] As such, modernization of existing large firms is the least cost alternative available to maintain productive capacity. Assuming that modernization can lead to increase in productive capacity amounting to 5% of installed capacity, an additional 1.5 lakh tonnes of effective capacity could be available on this account. Modernization however, should incorporate contemporary technology developments which are efficient in the use of scarce resources like raw materials, energy and water e.g. evolution of continuous digesters, cold blow systems, double disc refiners, falling film evaporator, displacement washing system, twinwire formers etc.[4] It is also important to develop indigenous technology to adapt foreign technology in areas of pulping, recovery, paper making, pollution control, energy conservation, instrumentation and development of equipment to suit local conditions e.g. the imported chippers which are used in some mills are unsuited to hardwoods; thus the average life of the knife of this chipper is 40 hours in India whereas it is 100 hours abroad.[5]

Thus, given the acute shortage of forest based raw materials it becomes important to encourage pulpwood plantations. Though degraded forests and wastelands seem to be available for growing plantations, the technical, financial and organization aspects need to be examined carefully. Modernization of existing old paper mills need to be undertaken on a priority basis and the possibility of granting them soft loans through Development Banks merits consideration.

**Productivity Analysis[6]**

During 1988-89 the total production by the sample units, was 5.52 lakh tonnes, accounting for 32% of the total production of the paper industry; their sales turnover aggregated to Rs. 1005.53 crores. As on 31.3.89, the installed capacity of sample units varied from 42 thousand to 92.5 thousand tonnes; all these units are over 25 years old except for one which is about 20 years old. For these 9 units the 1988-89 average installed capacity, output and sales turnover were 66.18 thousand tonnes, 61.35 thousand tonnes, and Rs. 111.73 crores respectively. Their capacity and output remained almost static during this period (Table.6). Their total output in fact decreased during 1986-87, though it increased during 1988-89. Compared to the 1985-86 level, the capacity utilisation deteriorated during 1986-87 and 1987-88, recovering, however, during 1988-89.

1 Y.A. Rao (1989)

2 DST (1988)

3 DST (1988).

4 For details see later sections

5 DST (1988)

6 The data for this analysis have been made available by the National Productivity Council.



labour productivity is greater for mills having a higher capital intensity, say, on account of employing more sophisticated or relatively new machinery; for balance sheet data the undervaluation of fixed assets is likely to be less for relatively new machinery.

ties of one of the firms.

12 None of these firms have a foreign financial or technical colla boration for operations in India. However, two of these units have joint ventures abroad and one unit has been providing technical services to a foreign firm in a developing economy (Source: Bombay Stock Exchange Directory).

Table 6. Capacity and Output of the Sample Units

| Year | Installed Capacity (thousand tonnes) | Output (thousand tonnes) | Capacity Utilisation (%) |
|---|---|---|---|
| 1985-86 | 580.00 | 538.14 | 92.78 |

be partly explained in terms of the absence of automation and mechanisation.[10]

Table 7. Raw Materials Consumption in Paper Industry

| Average for 1985-86 to 1988-89 | The Sample Average | Range |
|---|---|---|

The following points emerging from the analysis merit reiteration. First, as expected, labour productivity seems to be greater for firms having a higher capital intensity including those having more sophisticated or relatively new machinery. Second, the capacity utilisation and profitability appear to be higher for firms having higher sales realization per tonne of output, an indicator of product (structure or) quality and market power of the firm. Third, expenditure on R&D is very low in the sample units. Fourth, on an average 59% of the electricity consumed by the sample firms is internally generated. Finally, though the large firms depend primarily on wood and bamboo raw materials, two out of the nine sample firms have extensively used non-conventional raw materials.

**International Comparisons**

There has been tremendous progress in the process technology and design, development and manufacture of paper machinery abroad. This has enhanced yields, speed and efficiency in the use of energy, water and other raw materials. A comparison of some important ratios, namely steam, electricity, water, chemical and raw material consumption ratios for large integrated mills in India and abroad reveals the technology gap which exists between the two.[13]

(i) Steam consumption per tonne of paper is 11-14 tonnes in India compared to 6.5-8.5 tonnes abroad. Digester, evaporator and paper machine account for 82% of the steam consumed in a paper mill.

The factors responsible for less steam consumption indigesters abroad are (a) use of continuous digesters, (b) use of cold blow system, (c) installation of automatic cooking analyzers and (d) installation of computer based automatic cooking system.

Continuous digesters have lower steam, power and chemical consumption and give higher pulp yield compared to batch type digesters which are used in India. A net saving of approximately Rs. 75 lakhs per year can be achieved by using continuous digesters instead of batch digesters for a pulp production of 300 tonnes per day. Batch digesters are still in use in some mills abroad, however, they are equipped with cold blow systems to reduce steam consumption by about 0.5 tonne per tonne of pulp produced. Design, development and retrofitting an existing batch digester with cold blow system would cost about Rs. 1 crore for a 200 tpd plant.

The factors responsible for lower steam consumption in evaporators in mills abroad are:

(a) Falling film type evaporators

(b) Recompression evaporation system

(c) Less liquor for cooking

(d) Indirect heating system by installation of liquor heaters. The evaporator-recovery boiler combination becomes more energy efficient when highest possible concentration of strong black liquor is obtained from evaporators. The falling film type evaporators permit evaporation of liquor to higher solid concentration, reduce water or chemical boiling for scale removal and better control on exit black liquor. Mills abroad use vapour recompression evaporation system (VRE), where boiling liquor is forced through a compressor to increase pressure and temperature. Falling film type evaporators equipped with VRE system are able to achieve a reduction in steam consumption of 0.6 tonnes per tonne of paper.

The factors responsible for lower steam consumption in paper machine abroad are (a) use of twin-wire formers (b) use of on-line consistency meters in head boxes (c) use of trinip press (d) closed and well insulated dryer hoods with heat recovery system and (e) use of computer controlled instrumentation system.

Mills abroad use "twin wire formers" in the paper machines whereas mills in India use the conventional four drinier systems which have one wire. Because of this limitation, mills in India except a few modern ones are able to achieve a maximum speed of only 400 metres per minute in paper machine whereas mills abroad have achieved a speed of 1500 meters per minute. This aspect has greatly contributed to the attainment of higher scales of operation and reduction in all inputs per tonne of paper produced abroad.

Twinwire formers are effective in removing water from the pulp stock coming out of the Head Box. This has reduced load on the press and dryer in removing water. Mills abroad operate with higher consistency pulps 1.2% whereas mills in India operate with lower consistency pulps like 0.6%. This is responsible for lower steam consumption in paper machines abroad.

Trinip Press is more effective in removing water from the pulp sheet compared to the conventional suction press which is used in India. Similarly mills abroad are equipped with dryer hoods with heat recovery systems. This system is more effective in arresting the loss of heat as well as in recovering the heat from contaminated steam and hot water.

[13] The data quoted in this section are from DST (1988).

Table 11. Comparison of Conventional and Displacement Bleaching Process (per tonne of dry pulp)

| | Conventional | Displacement |
|---|---|---|
| 1. Water consumption (Kilolitres) | 99.0 | 17.0 |
| 2. Effluent Load (in $m^3$) | 98.0 | 17.0 |
| 3. Steam Consumption (Tonnes) | 0.4 | 0.2 |
| 4. Power Consumption (in Kwh) | 90.0 | 66-69 |

Source : DST (1988)

(i) Conventional bleaching system in India comprises a number of towers and columns and uses more steam compared to displacement bleaching system used abroad. In displacement bleaching all bleaching stages are carried out in a single tower, and this reduces water, steam and power consumption and effluent load.

(ii) Electrical energy consumption per tonne of paper is 1500-1700 kwh in Indian mills compared to 1150-1250 kwh abroad. Electrical energy is consumed in paper machine, stock preparation equipment, washing and screening sections, chippers, bleach plant and digesters. Paper machines abroad use 55-60 Kwh/tonne of paper less electrical energy compared to their Indian counterparts. This is because of the high consistency of pulp and use of thyristor controlled drive system abroad.

Stock preparation equipment uses less electricity to the extent 111-114 Kwh per tonne of paper abroad compared to India. This is because of the use of double disc refiners instead of the conventional conical refiners which are used in India.

Utilities use 88 Kwh per tonne of paper less energy abroad. Also mills abroad recycle a lot of water by having suitable modifications in the pipeline design inside the plant. This reduces pumping and effluent load. Recycle of water is not followed to a large extent in India. Mills abroad use less chemicals and this is also responsible for lowering their electricity consumption in the utilities section.

Soda recovery plants abroad use less electrical energy to the extent of 43 Kwh per tonne of paper in comparison to Indian mills. This is because mills abroad handle spent liquor with higher solid content since they use less liquor to chips for cooking.

Washing and screening uses 29-33 Kwh per tonne of paper less electrical energy abroad because of the use of continuous digesters with in-built diffusion washing system.

In chippers, electricity consumption is 20-30 Kwh per tonne of paper abroad because the scale of operation and capacity of chipper is higher. Capacity abroad varies from 40-50 tonnes per hour compared to 8-12 tonnes per hour in India.

Bleach plants abroad consume less electrical energy because bleaching is done in the displacement bleaching system with only one tower compared to the conventional bleaching towers and notary drum filters used in India.

The capital cost investment of displacement bleaching is higher by about Rs. 2.8 crores compared to the conventional bleaching plant. However, since the capital cost of water and effluent treatment is lower in the displacement bleaching plant, the net difference is about Rs. 1.9 crores. The operating cost of paper in the displacement bleaching plant is also lower by Rs. 93 per tonne.

Digesters abroad also use less electricity compared to those in India.

(iii) Water consumption per tonne of paper is much lower abroad (130-140 KL per tonne of paper) compared to India (270-350 KL per tonne of paper). One important reason for this difference is the use of displacement bleaching abroad. Also mills abroad use in-plant control measures, which reduces the water consumption by about 40%.

(iv) Chemical consumption per tonne of paper is lower abroad because of the use of continuous digesters and displacement bleaching.

(v) Chemical recovery (%) is higher abroad (95-98%) compared to India (80-88%). This is because of the use of continuous digesters which house the washing section as well the use of latest recovery boilers and multi-stage falling film type evaporators.

(vi) Raw material consumption per tonne of pulp is lower abroad (1.8-2 tonnes per tonne of pulp on dry basis for soft wood) compared to India (2-2.4 tonnes per tonne of pulp on dry basis for wood and bamboo, and 5.8 - 6.2 tonnes per tonne of pulp for bagasse with 50% moisture). The reason for higher yield abroad is the use of soft wood as raw material which has a larger quantum of fibrous material compared to hard wood. Also mechanical pulping which is used abroad to a large extent gives greater yield (95%) compared to chemical pulping (45-50%) which is prevalent in India.

**Small Paper Mills**

Small paper mills are largely based on non-conventional raw materials[14], they do not have chemical or heat

[14] Non-conventional raw materials include rice and wheat straw, bagasse, jute sticks, cotton linters, waste paper etc.

recovery or a bamboo/wood pulping unit and have a small base of production.

The small mills can be classified under three broad heads : (i) units based on waste paper recycling, (ii) units based on waste paper recyling supplemented by agro-based raw materials and (iii) mills based primarily on agro residues.

The first category consists of very small mills located near the metropolitan areas. DCPPI estimated that only 15-20% of the total paper produced in India is available for recycling since a large quantity is diverted for packing, handicrafts, toymaking fireworks etc. In contrast almost the entire paper production in some Asian countries like Taiwan, S. Korea and Thailand are based on recycled waste paper. Recycling has two basic advantages, viz very low energy consumption and negligible pollution load. Given these advantages, steps must be taken in India to increase recycling of domestic paper. The waste paper recovery system offers considerable scope for improvement by adoption of more rational and scientific methods of collection and grading. Use of printed material for packaging should be prohibited. This would also reduce the price of waste paper which currently is almost 40-50% of the cost of final product. Firms should also adopt deinking and de-gluing techniques. Import of waste paper should however not be encouraged since it would be a drain on our scarce foreign exchange reserves. The increase in excise duty on import of waste paper has adversely affected many of these firms. The viability of setting up a mother pulping plant in the public sector to help these as well as other small firms needs to be examined.

The third and a large part of the second category of firms come into the class of what is popularly known as 'agro paper mills'; although, there is no clear cut definition, the units which use agro residues pulp from domestic sources to meet 50% of their requirements are included under this category. The most important agricultural residues currently used are rice and wheat straw and bagasse.

The problem of agro residues is that their availability is seasonal, widely dispersed geographically and involves problems of transportation and storage.

Rice/wheat straw is used as fodder, fuel and roofing material in India. NPC made a detailed state - wise study about the availability of straw and found that in 1985-86, 42 million tonnes of rice and 16.4 million tonnes of wheat straws were surplus.

Bagasse is another promising raw material for the paper industry. Unlike cereal straw, bagasse possesses the advantage of being available in substantial quantities at a single point or within a reasonable distance from a cluster of sugar mills. Bagasse is used as a fuel in the sugar industry and currently the surplus bagasse is about 6-8%. However this can be increased to 12-14% if boiler efficiency of sugar factories is improved by providing economisers and pre-heaters. Drying of bagasse increases its calorific value and would thus increase surplus bagasse.

Though at an aggregative level there does not seem to be any shortage of straw yet firms do face problems especially when they are clustered within a short radius (e.g. in Gujarat). A policy of disperal of units with a minimum distance of 150 Kms is necessary. Besides there is need to develop methods for protection of agro residues from deterioration due to microbial action and storage.

There is no chemical recovery in small paper mills. Agro based mills employ mainly alkali pulping and the loss of this chemical is substantial e.g. a mill with 25 t.p.d. pulp plant based on straw consumes on an average 2000 tonnes of caustic soda which is not recovered. The energy used for producing 2000 tonnes of caustic p.a., where power itself is the basic raw material for its manufacture, would be sufficient to run a paper mill of 30 t.p.d. if the entire chemicals were recovered and reused.[15]

Chemical recovery in agro-mill is beset with three problems (1) high viscosity of black liquor at high (40%) solid concentration, (2) the high silica content in black liquor and (3) Low solid concentration in weak black liquor. The first two lead to choking of the evaporator tubes, there by making it difficult to increase the concentration in the evaporators. Although promising techniques are emerging like the DARS, SAICA, wet air oxidation, anaerobic digestion etc. for recovery of chemicls from black liquor of small firms, their commercial viability is yet to be proven especially for mills with capacity less than 25 tpd.

The absence of chemical recovery system in small units leads to large amount of alkali and dissolved organic matter being drained adding to COD and BOD. In addition, the normal pollution load of the paper industry from various sections like digestor, bleaching, paper machine etc. is also present, aggravating the already high water pollution.

The pollution from a waste paper based mill compared to an agricultural residue based mill in terms of SS, COD and BOD are found to be less by 18%, 80. 4% and 71% respectively.[16] This is primarily due to the high organic pollution load from the chemical digestion/poucher wash in agricultural residue based mills.

[15] Report of the Sub-Committee on Problems of Small Paper Mills with special reference to Recovery (1983).

[16] Kuttiapan (1988).

The total effluent load of a 30 tpd straw based mill is equivalent to that of a 150 tpd integrated paper mill based on forest resources with a full fledged recovery system.[17]

Data with respect to waste water generated by 18 agro firms shows the following characteristics.[18]

| | |
|---|---|
| 1. Waste water per tonne of paper produced ($M^3/T$) | 100-250 |
| 2. PH | 6.5-9.2 |
| 3. TSS (mg/l) | 280-1500 |
| 4. BOD (mg/l) | 350-2300 |
| 5. COD (mg/l) | 500-3300 |

This depicts the enormity of the pollution load given that the Minimum National Standards (MINAS) formulated by the Central Board for Prevention and Control of Water Pollution envisages the following specification.

| | |
|---|---|
| 1. PH | 6-9 |
| 2. SS | 100 mg/l |
| 3. BOD | 50 mg/l |

Therefore the highest priority should be accorded to development of economically and technically viable chemical recovery - effluent treatment technology for small firms. Ideally it should be possible to implement close mill concept where the total amount of back water is recycled. Recently Pudumjee Paper Mills in collaboration with a Swiss firm has developed an OPUR-P, a single stage anaerobic digestion process which they claim would solve the dual problem of energy generation and effluent treatment for small and medium firms.

Most of the agro mills were started with imported second-hand machinery. These were not suited to short fibre from agro residues and this resulted in frequent breakdowns of critical components of paper machine, particularly felts and wires.[19]. Presently the cutting machines do not remove the non-fibrous material from the straw. This does not add to output but only increases consumption of chemicals and COD, BOD load. For the same reason it is important to evolve methods of cleaning straw before it enters the digester. In the paper machine the wire section is designed for wood pulp and not straw pulp. Since straw pulp drains slowly, alternatives have to be devised. Desilication techniques need to be developed since silica presents problems in chemical recovery. Improved design of washers and black liquor filtration equipment for agricultural residues should also be developed to obtain high solid concentration of black liquor and ensure smooth evaporation. Since use of agro residues poses a different set of problems compared to forest resources, it is important to evolve/adapt technology suited to them.

**Productivity Analysis: Agro - Paper Mills**

NPC(1988) worked out productivity ratios for 18 agro based small paper mills for the years 1985-87.

(i) Labour productivity was measured as a ratio of total mandays to total finished output (tonnes) at the company level and was in the range 25-35. Our analysis of 9 large integrated firms indicated labour productivity to be in the range 8-21.5. Agro based firms are more labour intensive and a large part of the manpower is deployed in raw material handling at the yard and feeding in most of the mills.

(ii) Electrical energy used per tonne of output for agro based mills was in the range 800-1800 Kwh/tonne. The corresponding figure for large mills was 1130-2050 Kwh/tonne. Part of the difference is because agro firms do not possess a chemical recovery system.

(iii) Water consumption per tonne of output for agro mills was 93-205 Kl/t for unbleached paper and 180-320 Kl/t for bleached paper compared to an average of 238-439 Kl/t for large integrated firms.

Thus we find that agro mills use less electricity and water per tonne of output compared to large integrated firms. They also generate more employment. Besides, they utilize scattered agricultural residues which might otherwise be wasted and relieve pressure on forest resources. They also help disperse industrial development outside large manufacturing centres. They need less skilled manpower, investment and infrastructural facilities which are scarce in developing countries and thus serve important social and economic goals. Thus they should be encouraged by evolving suitable technology. However there is an urgent need to find a solution to the serious problem of pollution posed by these firms.

**Price Control**

Paper, being an item of mass consumption, attracted price regulation as early as 1942 in India.

Between 1972-73 and 1978-79 the Wholesale Price Index of Paper and Paper boards increased by 60.3% and 62.5% respectively. These prices went up by 19.7% and

[17] Report of the Sub-Committee of the Development Council for Small Paper Mills (1986).

[18] NPC (1988).

[19] NPC (1988).

27.5% respectively during 1979-80, with significant increases in the next two years. As per the new price index series (base year 1981-82), between 1981-82 and 1987-88 prices of paper and pulp, and of paperboard increased by 57.2% and 35.1%, during 1988-89 by 6.8% and 6.4% and between June 1988 and June 1989 by as much as 17.9% and 9.2% respectively.

After the 1968 formal deregulation of prices, the informal control for cultural varieties of paper was somewhat effective till mid-1973. But it broke down subsequently with frequent price increases and charging of "on-money" - an unaccounted premium over the list price - generating significant amounts of black money, as found by the Dagli Committee (see Y.A Rao, 1989). The year 1974-75 can be characterized as a peak year for the paper industry in terms of price rise and profitability (Ferguson, 1984). Yet, new entry on a large scale was absent primarily due to uncertainties regarding the supply of energy and raw materials (NPC, 1988, Report I, p. 12). The government sought to meet this situation of shortage as well as high prices of common varieties of writing and printing papers through price/production control. The industry was prevailed upon to revert to the production pattern of 1968-69 in favour of cultural paper, especially white printing paper, and to make available 2 lakh tonnes per annum of white printing paper for the educational sector at a concessional price of Rs. 2750 per tonne. The production percentage quotas for the specified varieties of paper are stated in Table 12. As an indirect partial relief, the excise duty rate on the concessional supply of paper has been only 5% *ad valorem*. However, small firms, new firms or those using non-conventional raw materials were exempted from the production control, as mentioned in Table 12 (Part B), with the following main considerations : (1) likely higher cost of production of small firms and their inability to comply with the required standards; (2) high capital and interest costs of new firms in the initial years; and (3) encouraging the utilisation of non-conventional raw materials. Further a firm facing an acute financial situation could seek the exemption for an year (Y.A Rao, 1989, p. 157). Excise duty reliefs or concessions have also been made on somewhat similar bases.

Limiting the production control to large firms was needed on administrative grounds. The equipment being somewhat product specific, firms with low capacity to manufacture writing and printing papers in relation to total production found it harsh to produce the stipulated production amounts, with adverse effects on capacity utilisation, cost of production etc. (Fergueson, 1984, p.127). Subsequent to representations from paper mills, from 1983 a slight relaxation was made for firms having this 'capacity' below 50%. New firms commenced after 1.1.76 were since 1979 given complete exemption from the production control, though from 1983 they were gradually brought under this control from the first year of production itself. However, excise relief to new firms (commenced after 1.4.79) on

Table 12. Paper (Regulation of Production) Order

A. Minimum Required Percentage of Firm's Total Production of Paper and Paperboard

| Type of paper | 1974 | 1975 | 1976 | 1978 | 1980 (Nov.20) | 1983 |
|---|---|---|---|---|---|---|
| I. White Printing | 30 | 30 | 30 | 30 | 30 | 25 (or 20) of the capacity to produce writing paper and paper board capacity |
| II. Cream laid or wove | 16 | 15 | | 20 | | |
| III. Colour printing : duplicating : offset : litho : and typing | 11* | | | 13 | | |
| Total | 57 | 45 | 30 | 63 | 30 | 25 (or 20) |

B. Exemption Granted to :

1. Small firms with Annual capacity in tonnes upto :

| Year | Tonnes |
|---|---|
| 1974 | 6600 |
| 1978 | 8250 |
| 1979 | 10000 |
| 1983 | 16500 |
| 1984 | 24400 |

2. New Firms: Commissioned on or after 1-1-76

1979 : Exemption for a period of 5 years from the date of commencement of production.

1983 : Minimum percentage of white printing paper production must be 5, 10, 15 and 20% in the first to fourth year respectively.

3. Firms using Non-Conventional Raw Materials to the extent of 75% or above by weight, for writing and printing paper production : exemption granted since 1979.

Source : Fergueson (1984), p.224-A: Y.A Rao (1989), pp. 154-59.

* In 1974 separate percentages were specified for these 4 categories. viz. 1. 5, 2.5, 6.5 and 0.5 respectively.

writing and printing papers was aimed at improving the total availability of such paper.

While the industry alleged inadequate and delayed revision of the controlled prices to cost increases, the compliance of the industry with regard to the concessional supply requirements, was only partial and it probably worsened gradually. The levy price per tonne of white printing paper remaining pegged for 5 years, was increased, as recommended by the BICP, to Rs. 3000 in June 1979, Rs. 3500 in Nov. 1980, Rs. 4200 in Dec. 1981, Rs. 5400 in April 1983, Rs. 6400 in May 1984 and to Rs. 7200 in Jan. 1986. This may be contrasted with Rs. 9000 as the estimated unit cost of production in 1986 of one of the relatively efficient firms (Subramanian, 1987), and with obviously a higher price of the equivalent market variety. Levy price of Rs. 3785 per tonne of creamwove or laid paper in 1979 was below the ex-factory market price of Rs. 5300; however, control on this price was revoked in 1980. The paper industry actually supplied only slightly over 1 lakh tonnes of concessional white printing paper, compared to the promised 2 lakh tonnes while the requirement of the educational sector increased over time. Firms initially even offset supplies of other varieties of paper to DGS&D against the stipulated production of white printing paper, a provision which was discontinued later. While initially the controlled prices were fairly close to the then prevailing average selling prices of the industry (Fergueson, 1984, p.10),an adverse impact of the control was felt in subsequent years with inadequate and protracted price revisions. The consequent uneconomic levy price led to (i) the producers shifting the product mix somewhat in favour of high value varieties of paper which were free from control, (ii) leakage of levy paper to the open market (Y.A Rao, 1989, pp. 152 and 162), and (iii) firms defaulting in the supply and obtaining stay orders or sometimes even interim relief from court (Fergueson, 1984, p.120), resulting in enormous administrative costs. An examination of the financial performance of a sample of large paper firms by Fergueson (1984) over the period 1973-74 to 1982-83 shows a sharp decline in the profitability and in the interest cover ratio (ratio of profits before interest to interest payments), while a considerable increase in the debt-equity ratio (pp. 102, 112, 137 and 138).

In consideration of the various administrative difficulties and extensive non-compliance by firms, the government has revoked the price and production control orders in Jan. 1987. Instead the Hindustan Paper Corporation, HPC, a public sector unit, would be provided a direct budgetary support (subsidy) of Rs. 3000 per tonne for an initial annual supply of only 80,000 tonnes of white printing paper for the educational sector at a price of Rs. 7560 per tonne. Subsidy fixed in nominal terms and a given production/supply quota, if unrevised, may become inadequate over time. However, any losses to the HPC would be an indirect subsidy by the government.

There has been a steep rise in prices of common varieties of paper since 1987, a situation similar to the pre-1974 price control. Economic Times (11-10-89) reports a 40% increase in price of white printing paper over the past year. There has been a much higher increase in the price of creamwove paper, another common variety (Financial Express, 5.2.90). ICICI (1990, pp. 26-28) corroborates similar price increases in 1988-89, which, it says, have been preceded by a few years of almost static prices while the input prices were rising. It further argues that if the present favourable profitability situation continues, firms may think of modernisation. However, the prices of textbooks, copybooks and other varieties of books used by children have increased considerably: the previously accorded favoured treatment to this section has been quietly given up (Facts for You, Aug. 1987 issue).

A lasting viable solution to the problem of high prices of paper in India requires (i) making the public sector more efficient and enhancing its share in production to curb the market power of large paper firms - though over time the degree of competition in the industry has increased with an improvement in the market share of small firms - and (ii) more important, joint coordinated efforts to reduce the cost of production of private sector units through modernization: also the supply of raw materials and utilities to the industry needs to be improved.

**Excise Duty Structure**

Before examining the excise duty pattern and the related developments of the previous decade, it may be briefly mentioned that the period 1970-71 to 1980-81 was characterized by an increasing burden of excise duty on paper. It increased from Rs. 316 to Rs. 1563 per tonne of output, and from 1.4% to 2.7% of the total central excise duty (Fergueson, 1984, p.96). The wholesale price index of paper and paperboard (1970-71 base year) was 262.2 in 1980-81. Thus, the excise duty per tonne increased much faster than the price of paper.

Like the price/production controls till 1986, the current excise duty structure of the paper industry favours smaller firms, newly-established firms and those using non-conventional raw materials.[20] A small (or medium sized) mill is

[20] These concessions are not applicable to the production of specified high value speciality products.

defined as one having an annual installed capacity upto 24000 tonnes - upto 33000 tonnes as per 6.6.1990 announcement - not having a bamboo or wood pulp producing plant, and using non-conventional raw materials; other firms are called large firms. Here the size classification pertains to the previous year's total production (clearances) of paper and paperboard[21]; successively higher 'average' rate of excise duty is levied on larger size categories (compare parts B and C of Table 13). Obviously this makes the marginal rate of excise duty jump rather sharply with a shift to the next size slab, and thereby has adverse implications on the incentive for capacity utilisation and expansion at least in the borderline cases (see NPC, 1988, p. 109; Subramanian, 1987). Slabs of increasing marginal excise duty, i.e. an incremental slab system, would be more meaningful instead.

Excise duty concession to smaller firms implies a subsidy from the national exchequer to them. Based on the actual rates of capacity utilisation of different size categories, Alka Subramanian (1987, Table 17) has found the difference in excise duty rate for the largest size category using non-conventional raw materials and for the smallest size category to be above 10% in 1983-84, 1984-85 and 1985-86, a sizeable difference indeed.

She suggested a proportional excise duty instead, i.e. a common excise duty rate, to remove the disincentive effect of the present tax structure, besides the former being administratively simpler. Such a drastic change in the excise structure does not seem feasible at present, considering the other objectives that small firms supposedly serve and also in view of the rather low capacity utilisation among smaller firms. However, it is recommended that the maximum excise duty rate difference should be restrained to a reasonable limit, say 5% ad valorem.

There are two, not mutually exclusive, schemes of excise duty differentials based on the pattern of raw materials usage. First, considering the critical situation regarding the availability of forest-based raw materials, a commendable policy introduced since 1983-84 has been the imposition of a lower rate of excise duty for large firms using non-conventional compared to conventional raw materials (cf Parts A and B, Table 13). This concession requires using at least 50% pulp, by weight, from non-conventional raw materials, i.e. other than bamboo, woods, reeds and rags (see Y.A Rao, 1989, p.146). [22] However, with a view to encourage the utilisation of domestic raw materials and to save foreign exchange, the use of waste paper and bagasse pulp from imported sources should not qualify for concession under this scheme (see NPC, 1988, P.115).

Second, there is complete exemption from excise duty on production of writing and printing paper and unbleached varieties of paper (Kraft paper) based on (i) bagasse - a potential major raw material - since 9.12.80, or (ii) even based on raw jute/mesta since April 1989, to the extent of 75% or more pulp, by weight, in each case.[23] The Indian Paper Manufacturers Association, IPMA, has requested for graded incentives ranging from 25% to 75% furnish, instead of a minimum of 50% to enable firms to install pulping requirements to use non-conventional raw materials in phases (IPMA, 1989, p.13). This would grant the much needed flexibility to firms; probably a similar graded scheme can be worked out for the bagasse use to enable firms to (partially) avail the excise duty exemption. This, however, would entail greater administrative complexity, namely ascertaining the percentage use of different raw materials. A better medium-term alternative would be to ensure that the price of different primary raw materials are in accordance with their actual cost to the society, instead of manouvering the private sector decisions through excise duty differentials.

In view of the paper shortage in the mid-seventies the government has encouraged new capacity creation for writing and printing papers by granting excise relief of 50% for 5 years - upto 30% of plant and machinery investment - on paper production (from pulp produced in the factory) by new units commissioned after 1.4.79; factories with second hand machinery are non-eligible (Y. A Rao, 1989, p. 147). Gradually this scheme has been extended upto 31.3.90 for the first clearance (1988-89 budget), and since April, 1984 to all specified varieties of paper and paperboard. It appears that in practice this scheme has benefitted mainly the small/medium scale sector because for various reasons few large paper firms have been set up in the private sector in the previous decade or so (see Fergueson, 1984). Any way, in the present situation of excess capacity and high prices, specially of common

[21] This excludes those clearance of paper and paperboard which are chargeable to nil rate of duty of which are completely exempted from excise duty, namely at least 75% bagasse based production and several other items mentioned later in this Section. So the rest of the clearances of a firm - determining the 'size' slab for levy of excise duty - may be far below its total production of paper and paperboard. This clause amounts to an indirect concession, given the lower rate of excise duty for smaller 'size' slabs.

[22] The excise duty concession availabe to small firms is also subject to this condition.

[23] The IPMA has been requesting for an extension of this scheme to a minimum 75% of pulp from cereal straw and/or combination of straw, bagasse and jute.

Table 13. Excise Duty Structure of Paper and Paperboard Industry

(Rs. per tonne)

| Year | A. Large Mills Using Conventional Raw Materials | | | B. Large Mills Using Non-conventional Raw Materials (Rates for Specified varieties of) | | | C. Small Mills Using Non-Conventional Raw Materials with Clearances (thousand tonnes) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Upto 3 | 3 to 7.5 | 7.5 to 12 | 12 to 16.5 | 16.5 to 24 |
| | Writing & Printing Paper | Kraft | Paper Board | Writing & Printing Paper | Kraft | Paper Board | All varieties of Paper and Paperboard (Excise Duty on Writing & Printing paper (WPP), and Kraft, if different from Duty on Paperboard) | | | | |
| | 10% *Ad Valorem* plus | | | 7% *Ad Valorem* plus | | | | | | | |
| 1983-84 | 1430 | 1810 | 1810 | 1180 | 1180 | 925 | 560 | 900 | 1120 | 1120 | |
| 1984-85 | 1005 | 1385 | 1810 | 645 | 900 | 925 | 560 (450) | 900 (730) | 1120 (900) | 1120 (900) | |
| 1985-86 | 1205 | 1585 | 1810 | 645 | 900 | 925 | 560 (275) | 900 (550) | 1120 (730) | 1120 (730) | 7% AV +925 (950 on WPP; 1200 on Kraft) |
| | On All Varieties 10% *Ad Valorem* Plus | | | | | | | | | | |
| 1986-87 | 1300 | 1700 | 2000 | 850 | | | 300 | 650 | 1000 | 1200 | 1500 |
| 1987-88 | 1400 | 1800 | 2150 | 800 | | | 400 | 750 | 1200 | 1300 | 1600 |
| 1988-89 | 1400 | 1800 | 2150 | 500 | | | 300 | 650 | 1000 | 1200 | 1500 |
| 1989-90 | 1470 | 1900 | 2260 | 525 | | | 315 | 685 | 1050 | 1260 | 1575 |
| 1990-91 | 1470 | 1900 | 2260 | 550 | | | 325 | 700 | 1100 | 1300 | 1600 |

Source : Central Excise Tariff, 1989-90 and 1990-91;Financial Express, 1.3.89 and 20.3.90; NPC (1988), pp. 107-08; Y.A Rao (1989), Subramanian (1987).

Notes :
1. This table pertains to broad categories; there are exceptions for sub-categories.
2. There is a special excise duty of 5% of the basic effective duty.
3. Cess on paper and pulp (including paper products) is 1/8% *Ad Valorem*; exemption for mills having fixed assets (plant and machinery) not exceeding Rs. 20 lakhs.
4. As per June 6, 1990 announcement, capacity of small paper mills availing concessional rate of duty under the scheme of non-coventional raw materials use has been enhanced from 24000 to 33000 tonnes per annum.

varieties of paper, the immediate need is to encourage fuller utilisation of existing capacity as compared to the new capacity creation.

Some additional important excise duty exemptions pertain to: paper and paperboard for packaging of horticulture produce and milk, handmade paper and paperboard by KVIC units, paper intended for printing of newspapers (since 1988), samples, paper for textbooks etc. All these concessions mentioned above seem to add upto a sizeable extent, (see also note 21). Excise duty on concessional paper has been 5% on levy price. In the context of a high incidence of sickness in the paper industry, it may be mentioned that the scheme of excise relief for weak industrial units operational from 17.10.1989, provides for interest free loans through designated development banks etc., upto 50% of excise duty paid for three years subsequent to approval of the rehabilitation package.

The above discussion points to two important policy-oriented suggestions, namely that (i) the excise duty differentials favouring relatively small firms, directly and indirectly, should be narrowed down to a reasonable limit, and (ii) in lieu of the present adhoc system of excise duty concessions for the use of certain raw materials, an attempt should be made towards ensuring that the relative prices of different primary raw materials, as faced by producers, match their relative cost to the society.

## Concluding Remarks and Recommendations

(1) There is an urgent need to develop indigenous technology or adapt foreign technology to suit local raw materials, both forest and non-conventional.

(2) Modernization of large old firms and revival of closed mills should be undertaken. It is the least cost alternative to maintain productive capacity.

(3) Priority areas of R&D are -

(a) evolving a technically and financially viable chemical recovery/effluent treatment plant for small firms.
(b) improvements in yield and other properties (strength, pulp yield etc.) of currently used species through genetic engineering and also through improved forest management practices,
(c) energy conservation measures for sugar industry,
(d) improved methods for storing and handling agro residues.

(4) There should be closer linkages for better diffusion of current advancements in technology between the research organizations and the actual users.

(5) There should be a greater geographical dispersal of firms based on straw.

(6) Import of waste paper and pulp should be discouraged and the viability of a mother pulping plant should be examined.

(7) Excise duty structure needs to be rationalized after an in-depth study of the "true" cost of production based on different raw materials to encourage the efficient sector in the long run. The true cost of production must include the social cost of pollution as well as the opportunity cost of wood/bamboo.[24]

(8) The present system of progressive average rate of excise duty for different size slabs should be replaced by progressive marginal rate of excise duty for different size slabs so that the disincentive for additional production is reduced.

(9) There should be graded incentives (in terms of excise duty concessions) for use of bagasse and other non conventional raw materials rather than the present minimum percentage use criteria.

(10) For control of prices in the short run, there is a need for increased competition among small private, large private and public sector units, modernization/upgradation of technology and assured supply of utilities (water, electricity etc.). In the long run installed capacity should increase *pari passu* with demand. Compared to the existing level, approximately an additional 11-12 lakh tonnes of installed capacity is required by the turn of the century.


## Acknowledgements

We are extremely indebted to Mr. N.K. Nair, Director (Research) NPC for his thought-provoking and valuable comments. We are also grateful to Dr. Manju Kalra Asst. Director (Research) NPC and Mr. P.G. Mukundan for providing us with useful reference materials and suggestions. However, the views expressed here and the responsibility for surviving errors, if any, are ours.


[24] Currently the price paid by a number of large mills for bamboo or wood under the lease agreement with forest departments is far below the market price of excise duty for different size slabs so that the disincentive for additional production is reduced.

## REFERENCES


**All India Small Paper Mills Association** (1986), Report of the Sub-Committee of the Development Council for Small Paper Mills.

**Bureau of Industrial Costs and Prices** (1987), Report on Energy Audit of Paper Industry, July, Ministry of Industry, Delhi.

**Commerce Research Bureau** (1987), Paper Industry: Burden of Sick Units, Commerce, Dec. 12-18.

**Committee on Paper Industry (1986)**, Paper Perspective - Year 2000.

**DST** (1988), Technology Evaluation and Norms Study in Paper and Pulp Machinery, Draft, April, Department of Science and Technology, Government of India.

**Economic Times** (1989), Paper Industry Still in the Red, October 11.

**Fergueson, A.F. & Co. (1984)**, A study Relating to Financial Health of Paper Industry in India with reference to Large Integrated Paper Units, Dec., Bombay.

**Gupta, T and Shah, N.** (1988), Paper and Paperboards in India : Demand Forecasts and Policy Implications, Oxford IBH Publishing Co.

**IAPMA** (1989), Prespective Plan till 2000 of paper Industry based on Agro Residues, Indian Agro Paper Mills Association, Delhi.

**IPMA** (1989), Paper Industry Needs a Policy Package for Survival, Indian Paper Makers Associations, Chairman's Address at Annual General Meeting, Delhi.

**Industrial Development Bank of India** (1987), A Study on the Paper Industry.

**ICICI** (1985), A Study on the Paper Industry, Bombay.

**ICICI** (1990), A Review of the Paper Industry, Bombay.

**Kuttiappan, N.K.** (1988), Problems of black Liquor Treatment in Indian Small Paper Mills: Possible Alternative Solutions, Paper Presented at the Workship on "Small Scale Pulp & Paper Mills using Non-wood Fibres in Developing Countries", sponsored by CPCB and NPC, New Delhi, April 25-28.

**Ministry of Industry**, Department of Industrial Development (1984), Report of the Working Group on Paper and Paperboard and Newsprint Industry for the VIIth Plan (1985-90).

**NPC** (1986), Study on Technology Forecasting/Assessment based on Long Range Quantitative Modelling for Indian Paper Industry, Reports I-III, National Productivity Council, Delhi.

NPC (1988), Productivity in Agro Paper Sector, Report I; A Techno-Economic Study of Agro paper Mills in India, Report II.

**Rao, Y.A.** (1989), The Paper Industry in India - Status and Prospectus, Oxford and IBH Publishing Co.

**Report of the Sub Committee on Problems of Small Paper Mills** with special reference to Recovery (1983), for submission to the Development Council for Pulp and Paper.

**Subba Rao, V.V.** (1988), Technological Status of Pulp and Paper Industry in India : An Overview, IPPTA, June 1988, Vol. 1, No.2.

**Subramanian, A** (1987), 'Small is not Beautiful : Study of the Paper Industry', Economic and Political Weekly, Aug. 29.

**Subramanian, A.** (1988), 'The Paper Industry : Consumption Trends and Projections upto 2000 A.D'., Economic and Political Weekly, May 28.

**Sachitanand, N.N.** (1988), 'Distorted Policy Mix Stalls Growth of Paper Indusry', Hindu, June 30.

# Productivity in Electronic Industry

NPC Research Section

*There are about 2500 units manufacturing electronic equipments and components in India. The total direct employment in the industry is in the region of about 3 lakhs; yet another 3 lakhs being sustained as dealers, service personnel and suppliers of allied equipments, tools etc. The Indian electronic industry, has yet to produce results which inspire confidence in its ability to weather any storm. Being a sunrise industry, it has yet to go a long way, but without adequate attention to achieve productivity, it may not reach its potential; argues this report.*

*Prepared by a team consisting of N.K. Nair, Director (Research), A.K. Burman Dy. Director (Research), Manju Kalra, Asst. Director (Research) of the Natonal Productivity Council and K.D. Kohli, Management Consultant.*

India's electronics industry, despite its spectacular growth in recent years, has still miles to go, considering the breathtaking advances made in the field by the more advanced countries of Europe, USA and Japan. Being a sunrise industry, it possesses great potential for investment, technology innovation and development, employment and income generation. Because of its all pervasive impact on other industries like steel, coal, paper, textiles etc. and also on the society at large, the electronic industry truely holds the key to the economic prosperity of the country. In fact, many believe that no aspect of the society will remain untouched by the fast developing electronics technology by the turn of the century.

In India, the electronics industry began to take shape around 1950. It can be said to have become a reckonable industrial group only from 1970 onwards when a separate Department of Electronics (Govt. of India) was also set up. Amongst other new industries which are considered potential contributors to the country's economic development (e.g. petrochemicals, automobiles etc.), electronic industry is one of the fastest growing (table 1), having

Table 1. Production Trends in Electronic Industry 1970-1989

| Year | Value of Production (Rs. Crores)* | Growth % | |
|---|---|---|---|
| 1970 | 152.8 | - | |
| 1971 | 173.0 | 13.0 | * at current prices |
| 1972 | 200.0 | 16.0 | |
| 1973 | 228.0 | 14.0 | |
| 1974 | 301.0 | 32.0 | |
| 1975 | 364.5 | 21.0 | |
| 1976 | 410.0 | 12.5 | |
| 1977 | 508.5 | 24.0 | |
| 1978 | 590.5 | 16.0 | |
| 1979 | 646.5 | 9.5 | |
| 1980 | 806.5 | 25.0 | |
| 1981 | 856.0 | 6.2 | |
| 1982 | 1205.0 | 41.0 | |
| 1983 | 1360.0 | 13.0 | |
| 1984 | 1890.0 | 39.0 | |
| 1985 | 2660.0 | 41.0 | |
| 1986 | 3460.0 | 30.1 | |
| 1987 | 4720.0 | 37.5 | |
| 1988 | 6300.0 | 33.5 | |
| 1989 | 8300.0 | 31.7 | |

Source : Department of Electronics, Annual Reports for various years.

maintained a double digit growth rate over the past one decade or so.

There are about 2500 electronic units manufacturing electronic equipments and components of which 69 are in the public sector, both Central & State. About 350 are the organized private sector units and approximately 2000 are in the small scale sector (DOE, 1989; TDA, 1990). Total direct employment in the industry is in the region of about 3 lakhs with another 3 lakhs being sustained as dealers, service personnel and suppliers of allied equipment, tools, materials etc. By 1994 the total employment in the sector is expected to rise to about 14 lakhs. Given the current government policy framework, and the continuous thrust on its development, the electronic industry is bound to grow over the years into a strategic segment of India's industrial sector with a much greater potential for better employment and income generation.

## Capacity Utilization

Electronic industry covers several product groups. Broadly these can be classified under three sub heads- 'Consumer Electronics', 'Professional Electronics' and 'Electronic Products/Components'. From each of these product groups we have selected a few important items to work out the rates of capacity utilization in the industry as a whole. These products are shown below :

| Product | Group Classification |
|---|---|
| Transistors-Diodes | Electronic Components |
| TV Picture Tubes | - do - |
| Integrated Circuits | - do - |
| Television Receivers | Consumer Electronics |
| Electronic Calculators | - do - |
| Radio Receivers | - do - |
| Tape Recorders | - do - |
| Electronic Computers | Professional Electronics |
| Teleprinters | - do - |

Table 2 shows that prior to 1980 the capacity utilization, in most cases, has been generally poor and in some cases continued to remain low even thereafter. While the output of electronic products, particularly in the component and computer groups has since picked up a great deal, the overall capacity utilization has imporved only marginally. (tables 3 & 4). Of the six units whose capacity utilization (table 3) has been studied in detail, ITI (Bangalore Unit) seems to have achieved fairly good results, particularly in respect of Telephone Instruments in which

Table 2: Capacity Utilization for Some Selected Electronic Products

| Product | | 1970 | 1975 | 1980 | 1982 | 1983 | 1984 | 1985 | 1986 | Unit | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Transistor/ | Cap. | 2.7 | 8.9 | 12.3 | 12.5* | 12.5* | 12.5* | - | - | Crore | *Repeated |
| Diodes, | Prodn. | 2.8 | 5.9 | 10.9 | 11.0 | 11.6 | 12.9 | - | - | Nos | |
| | CU % | 104.0 | 66.0 | 89.0 | 88.0 | 93.0 | 103.0 | - | - | | |
| TV Picture | Cap. | 12.0 | 136.0 | 242.0 | 310.0* | 310.0* | - | - | - | | |
| Tubes | Prodn | 2.3 | 69.8 | 259.0 | 334.0 | 481.0 | 800.0 | 1450.0 | - | '000 | |
| | CU % | 19.0 | 51.0 | 107.0 | 108.0 | 155.0 | 258.0 | - | - | nos | |
| Integrated | Cap. | 4.0@ | 4.0 | 17.0 | 19.0* | 19.0* | 19.0* | - | - | | @ Data pertains |
| Circuits | Prodn. | 1.4@ | 1.8 | 10.3 | 5.8 | 10.0 | 17.0 | 51.2 | - | Lakh | to 1974. |
| | CU % | 35.0 | 45.0 | 61.0 | 31.0 | 53.0 | 89.0 | - | - | nos | |
| TV | Cap. | 10.0 | 89.5 | 195.0 | 225.0 | 225.0* | 225.0* | 225.0* | 225.0* | | ** Production figure |
| Receivers | Prodn. | 5.1 | 39.4 | 86.8 | 125.0 | 155.0 | 1280.0 | 2480.0 | 3000.0 | '000 | from all Units |
| | CU % | 51.0 | 44.0 | 45.0 | 56.0 | 69.0 | - | - | - | nos | |
| Radio | Cap. | 23.1 | 29.6 | 31.1 | 29.9 | 31.1 | 28.3 | 28.3* | 28.3* | Lokh | |
| Receivers | Prodn. | 17.7 | 15.4 | 16.8 | 15.6 | 11.8 | 13.5 | 11.7 | 10.8 | nos | |
| | CU % | 77.0 | 52.0 | 54.0 | 52.0 | 38.0 | 48.0 | 41.0 | 38.0 | | |
| Tape | Cap. | 5.0@ | 40.0 | 40.0* | 40.0* | 40.0* | 40.0* | - | - | | |
| Recorders | Prodn. | 1.1@ | 5.3 | 39.7 | 104.0 | 98.6 | 180.0 | 1999.0** | 2200.0** | '000 | |
| | CU % | 22.0 | 13.0 | 99.0 | - | - | - | - | - | nos | |
| Electronic | Cap. | 12.5 | 23.0 | 90.0 | 99.4 | 99.4 | 99.4* | - | | | |
| Calculators | Prodn. | 8.5 | 10.3 | 9.9 | 8.6 | 5.7 | 100.0* | 121.9 | | '000 | |
| | CU % | 68.0 | 45.0 | 11.0 | 9.0 | 6.0 | - | - | | | |
| Electronic | Cap. | 24.0 | 84.0 | 80.0 | 1323.0 | 2316.0 | - | - | | | |
| Computers | Prodn. | 6.0 | - | - | - | - | | | | Nos | |
| | CU % | 25.0 | - | - | - | - | | | | | |
| Teleprinters | Cap. | 8.5 | 8.5 | 8.5 | 8.5* | 8.5* | 8.5* | 8.5* | | | |
| | Prodn. | 5.1 | 5.2 | 7.7 | 8.5 | 7.9 | 8.0 | 8.0 | | '000 | |
| | CU % | 60.0 | 61.0 | 91.0 | 100.0 | 93.0 | 94.0 | 94.0 | | nos | |

Source : CMIE (1987)

Table 3: Capacity Utilization in Some Selected Electronic Manufacturing Units

| Mfg. Unit | Item | Year | Capacity | Prodn. | Cap. Utilization % | Item | Capacity | Prodn. | Capacity Utilization % | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| PIECO | Electronic components ('000s) | 1984-85 | 524072 | 365696 | 70 | PA system & profess ional grade microphones (Nos) | 10500 | 6526 | 62 | A multi-product company |
| | | 1985-86 | 524322 | 445112 | 85 | | 10500 | 5020 | 48 | |
| | | 1986-87 | 525322 | 416353 | 79 | | 10500 | 5926 | 56 | |
| | | 1987-88 | 563232 | 537533 | 95 | | 10500 | 8056 | 77 | |
| | | 1988-89 | 853632 | 731080 | 86 | | 10500 | 5240 | 50 | |
| | Radio sets, tape recorders etc. ('000s) | 1984-85 | 63 | 122 | 194 | Electronic Measuring Instruments (Nos) | 21955 | 12196 | 55 | |
| | | 1985-86 | 1388 | 994 | 77 | | 26935 | 10372 | 38 | |
| | | 1986-87 | 1388 | 1187 | 85 | | 29970 | 14538 | 49 | |
| | | 1987-88 | 1388 | 1186 | 85 | | 29970 | 11961 | 40 | |
| | | 1988-89 | 2080 | 1670 | 80 | | 29970 | 5793 | 19 | |
| O/E/N Limited | Switches ('000s) | 1984 | 600 | 639 | 106 | Potentiometers ('000s) | 200 | 28 | 14 | * Additional capacity through a new Unit. |
| | | 1985 | 600 | 659 | 109 | | 200 | 26 | 13 | |
| | | 1986 | 1600 * | 598 | 37 | | 200 | 27 | 14 | |
| | | 1987 | 1600 * | 405 | 25 | | 400 | 45 | 11 | |
| | | 1988-89 | 1600 * | 531 | 33 | | 400 | 94 | 24 | |
| | Relays ('000s) | 1984 | 500 | 425 | 85 | Tools, jigs Moulds fixtures (Rs lacs) | 35 | 1.4 | 4 | |
| | | 1985 | 500 | 526 | 105 | | 35 | 2.4 | 7 | |
| | | 1986 | 1000 * | 550 | 55 | | 35 | 8.9 | 25 | |
| | | 1987 | 1000 * | 772 | 77 | | 35 | 10.9 | 31 | |
| | | 1988-89 | 1000 * | 1045 | 104 | | 35 | 17.1 | 49 | |
| WIPRO | Mini Computer Micro processor Rs lacs+ (Nos) | 1984-85 | 750 + | 3.38 + | 0.45 | Serial Printers (Rs lacs) | - | - | - | + capacity and prodn. data are in comparable units |
| | | 1985-86 | 6250 | 17.08 + | - | | - | - | - | |
| | | 1986-87 | 6250 | 42.79 + | - | | 1125 | 25.1 | 2.2 | |
| | | 1987-88 | 6250 | 57.99 + | - | | 1125 | 52.5 | 5.0 | |
| | | 1988-89 | 6250 | 56.54 + | - | | 1125 | 81.2 | 7.2 | |
| Hindustan Teleprinters Ltd. | Electro Mechanical Teleprinter (Nos) | 1984-85 | 8,500 | 7680 | 90 | Electronic Teleprinters (Nos) | - | - | - | @Provisional |
| | | 1985-86 | 8,500 | 8622 | 101 | | - | - | - | |
| | | 1986-87 | 8,500 | 8654 | 99 | | - | - | - | |
| | | 1987-88 | 8,500 | 6514 | 77 | | - | - | - | |
| | | 1988-89 | 8,500 | 5077 | 60 | | 8000 | 4266 | 53 | |
| | | 1989-90 | 8,500 | 2112 @ | 25 | | 8000 | 5807x | 73 | |
| BPL Systems & Projects Ltd. | Power Line carrier Communication Equipemnt (No) | 1984-85 | 400 | 275 | 69 | Powerline Protective Relay Equipment Nos | 100 | 22 | 22 | A multi-product company |
| | | 1985-86 | 400 | 197 | 49 | | 100 | 100 | 100 | |
| | | 1986-87 | 400 | 185 | 46 | | 100 | 25 | 25 | |
| | | 1987-88 | 400 | 281 | 70 | | 100 | 68 | 68 | |
| | | 1988-89 | 400 | 208 | 52 | | 100 | 33 | 33 | |
| | | 1989-90 | 400 | 162 | 41 | | 100 | 176 | 176 | |
| | Cassette Tape Recoder System ('000s) | 1984-85 | 50 | 14.3 | 29 | Electronic Telephone Instruments ('000s) | - | - | - | |
| | | 1985-86 | 50 | 22.8 | 46 | | - | - | - | |
| | | 1986-87 | 50 | 32.5 | 65 | | 500 | 6.9 | 1.4 | |
| | | 1987-88 | 50 | 36.5 | 73 | | 500 | 11.4 | 2.3 | |
| | | 1988-89 | 50 | 54.1 | 108 | | 500 | 19.1 | 4.0 | |
| | | 1989-90 | 50 | 44.4 | 89 | | 500 | 17.0 | 3.4 | |
| Indian Telephone Industries Ltd.** | Microwave Radio Equipment (Nos) | 1984-85 | 2000 | 440 | 22 | Stowager Exchange Equipment ('000 Lines) | 150 | 98 | 65 | ** Bangalore Unit Eng. |
| | | 1985-86 | 2000 | 1200 | 60 | | 150 | 108 | 72 | |
| | | 1986-87 | 2000 | 440 | 22 | | 150 | 116 | 77 | |
| | | 1987-88 | 2000 | 2000 | 100 | | 150 | 96 | 64 | |
| | | 1988-89 | 9000 | 3640 | 40 | | 150 | 132 | 88 | |
| | VFT Channals (Nos) | 1984-85 | 3000 | 3940 | 131 | Telephone Instruments ('000) | 275 | 337 | 122 | |
| | | 1985-86 | 3000 | 2912 | 97 | | 275 | 350 | 127 | |
| | | 1986-87 | 3000 | 3772 | 125 | | 275 | 361 | 131 | |
| | | 1987-88 | 3000 | 5660 | 189 | | 275 | 360 | 131 | |
| | | 1988-89 | 3000 | 6228 | 208 | | 275 | 456 | 166 | |

Source : (i) Annual reports of companies
(ii) Data supplied by the companies concerned

Table 4. Capacity Utilization of Some Selected Electronic Units latest year

| Mfg. Unit | Item | Year | Capacity | Prodn. | Capacity % Utilization | Item | Capacity | Prodn. | Capacity % Utilization | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| HMV | Record Player & Reproducers (Nos) | 1987 | 66,000 | 1,323 | 2.0 | Pickup cartridges & stereos ('000 nos) | 350 | 100 | 29 | |
| ICIM | Mini/Micro Computers (Rs. lacs/Nos*) | 1989 | 3000 (Rs lacs) | 120 | - | Digital Computer Systems (Nos) | 125 | 7 | 5.6 | *Incompatible units |
| | Line Printers (Nos) | 1989 | 500 | 161 | 32 | - | - | - | - | |
| NELCO | Radio/TV Receivers ('000) | 1988 | 200 | 25.98 | 13.0 | Solid State Voltage Stabilizers (Nos) | 15000 | 14,887 | 99.0 | |
| PSI | Mini/Micro Computers ('000 s) | 1987 | - | 676 | - | - | - | - | - | |
| Samtel | TV Picture Tubes ('000) | 1989 | 3000 | 2094 | 70 | - | - | - | - | |
| Usha Rectifier | Silicon Diodes & Thyristors ('000 Nos) | 1988 | 2140 | 890 | 42 | Rectifier Equipment (MW) | 1000 | 505 | 50.5 | |
| Weston Electronics | Televisions ('000 nos) | 1987 | 170 | 170 | 100 | - | - | | - | - |
| Tata Unisys | Mini/Micro processor based systems (Rs Crore/Nos) | 1989 | 20 crores Rs. | 287 hos. | - | Serial printer & Handlers (Nos) | 6000 | 500 | 8.3 | |
| Essen Computers | Personal Computers (Rs Crores/Nos) | 1989 | 40 crores Rs. | 3,943 | - | Computer Systems (Rs. crores/Nos) | + | 9 | - | + Included in Rs. 40 crores |
| BEL | Professional grade elect. equipment (Rs Lakhs) | 1988 | 37,155 | 37,542 | 101 | Components ('000 Nos) | - | 3567 | - | |
| HCL | Mini Computer Micro processor based systems (Rs. Lakhs) | 1988 | 4000 | 2573 * | 64 | Plain Paper Copier (Nos) | 3000 | 1,152 | 29 | * Includes Perifheral Nos. 7607. |
| | Electronic Test & Measuring instruments (Nos) | 1988 | 7875 | 7331 | 93 | - | - | - | - | |
| Hind Rectifier | Rectifier Stacks & apparatus ('000 Kilowatts) | 1988 | 240 | 2.5 | 1.2 | Silicon Diodes & Thyristors ('000 Nos) | 210 | 83 | 40 | |
| | Silicon Rectifier apparatus ('000 Kilowatts) | 1988 | 120 | 51 | 42.5 | - | - | - | - | |
| IDM | DP Systems (Nos) | 1988 | - | 902 | - | Punch Cards ('000' nos) Ribbons (Nos.) | 9,80,000 75,000 | 1,57,300 4656 | 16 6.2 | |

*Contd.*

| Mfg. Unit | Item | Year | Capacity | Prodn. | Capacity % Utilization | Item | Capacity | Prodn. Utilization % | Capacity | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| SCL | Micro Computers (Nos) | 1988 | 10,000 | 2890 | 28.9 | Clock CB (Nos) | 2000 | 1153 | 58 | |
| | LSI Devices (Nos) | 1988 | 4500 | 2517 | 56 | LSI DIES (Nos) | 8000 | 3741 | 47 | |
| ECL | CTV Receiver (Nos) | 1988 | 60,000 | 37,483 | 62 | TV Sets (Nos) | 25000 | 69,060 | 276 | |
| | SPC Telex Exchange Sets (Nos) | 1988 | 12000 | 7,643 | 64 | Digital Computer System (Nos) | 250 | 85 | 34 | |

Source : CMIE (Nov. 1989 & May 1990)

case capacity utilization has generally remained above 100 per cent throughout the five year period. In most other cases, the capacity utilization has been widely fluctuating from year to year suggesting continuous adjustments in relation to changing market demand for various items. Some cases of excellent results achieved apart, (NELCO, BEL, HCL & ECIL, for example) most of the fifteen companies have turned in disappointing performance. This is perhaps attributable to three main factors: (i) low volume production, (ii) uneconomic capacity levels and (iii) outdated technologies. In recent years capacity in the electronic industry has been expanding at a very fast pace. Average capacity utilization in the Electrical Machinery group (including Electronics) between 1970 & 1986 has been around 68% (CMIE, 1987) which in comparison with other manufacturing industries is quite low. This is not to suggest that the idle capacity is contributed entirely by the electronic units but the figures shown in tables 3 & 4 do seem to indicate that there is a great deal of scope for improvement in capacity utilization in the electronic industry also. Despite the limitations of data it can be concluded that the loss of output resulting from under-utilization of installed/available capacity will run into several crores of rupees which a developing country like India in its present nascent state of economic development can only ill afford.

No doubt, there exists a tendency within the industry to invest only in the manufacture of those products which yield quick returns and higher profits. This overanxiety for quick recovery of the investments often leads to the shifting of production efforts to more lucrative items, overlooking and sidetracking the long term interests in the process. This tendency needs to be curbed by means of clear cut policy directives from the Govt. and by the exercise of selfcontrol by the industry itself. The alternative of remaining a second rate electronic nation is too dreadful even to contemplate under the current difficult economic situation.

## Productivity Status

To study the state of productivity in the industry we have examined the available data from 22 individual companies. These 22 companies represent all sectors of electronic industry, namely computers, consumer electronics, professional electronics, and electronic components. Groupwise breakup of the 22 companies is as under:

| | | |
|---|---|---|
| Computers group | — | 6 |
| Consumer Electronics | — | 6 |
| Professional Electronics | — | 5 |
| Electronic Components | — | 5 |

Out of the 22 companies six belong to the public sector, the rest being from the private sector. No company from the small scale sector has been included because reliable data/information is not readily available from any source.

## Productivity Parameters

We have, relied on eight main parameters to assess the state of productivity in the electronic industry. These parameters listed below measure different aspects of productivity of each company :

1. Ratio of Earnings to Conversion Cost
2. (i) Ratio of Profit to Conversion Cost
   (ii) Percentage of Profit to Sales
3. Wages/Salaries to Sales
4. (i) Sales per Employee
   (ii) Profit per Employee
   (iii) Value Added per Employee
5. Purchased Services to Earnings

A summary of the results obtained is presented in table 5, while the details are given in Appendces 1–8.

Table 5: Productivity Ratios of Electronic Units at a glance (1984-89 Average)

| Ratio/Unit | Earnings to Conversion Cost Ratio | Purchased Services to Total Earnings Ratio | Profit to Conversion Cost Ratio | Profit to Sale Ratio | Value Added per Employee (Rs. lakhs) | Sales per Employee (Rs. lakhs) | Profit per Employee (Rs. lakhs) | Wages & Salaries to Sales Ratio |
|---|---|---|---|---|---|---|---|---|
| HMV | 0.65 | 0.83 | (0.38) | (33.70) | - | - | - | 37.7 |
| ICIM | 1.10 | 0.58 | (0.02) | (0.89) | - | - | - | 17.7 |
| NELCO | 1.20 | 0.48 | 0.009 | 0.24 | - | - | - | 9.9 |
| PIECO | 0.90 | 0.57 | (0.01) | 0.52 | 0.71 | 3.38 | (0.02) | 15.0 |
| PSI | 0.11 | 5.67 | (0.94) | (77.90) | - | 1.60 | (1.26) | 27.9 |
| SAMTEL | 1.70 | 0.36 | 0.45 | 6.20 | - | - | - | 2.5 |
| USHA | 1.11 | 0.48 | 0.40 | 7.20 | - | - | - | 5.5 |
| WESTON | 1.07 | 0.62 | 0.09 | 1.18 | - | - | - | 3.4 |
| ECIL | 1.08 | 0.98 | 0.06 | 2.50 | 0.490 | 1.69 | 0.040 | 20.6 |
| TATA UNISYS | 1.18 | 0.60 | 0.11 | 8.60 | 1.010 | 2.91 | 0.249 | 18.4 |
| SEMI CONDUCTORS | 0.44 | 0.77 | (0.20) | (19.60) | (0.031) | 1.34 | (0.260) | 15.1 |
| BEL | 1.12 | 0.24 | 0.17 | 7.30 | 0.586 | 1.45 | 0.107 | 23.9 |
| CMC | 1.06 | 0.59 | 0.03 | 1.50 | 0.680 | 3.72 | 0.550 | 14.6 |
| HCL | 1.44 | 0.41 | 0.28 | 7.50 | - | - | - | 9.6 |
| HIND RECTIFIER | 1.18 | 0.30 | 0.01 | 0.62 | - | - | | 23.6 |
| IDM | 1.10 | 0.58 | 0.003 | 0.16 | - | | - | 14.8 |
| ESSEN | 2.80 | 0.22 | 0.68 | 8.70 | - | - | - | 37.0 |
| O/E/N | 0.86 | 0.70 | 0.22 | 8.00 | 0.48 | 1.19 | 0.09 | 22.6 |
| ITI | 1.29 | 0.24 | 0.11 | 4.70 | 0.41 | 1.33 | 0.06 | 24.1 |
| WIPRO | 1.16 | 0.62 | 0.16 | 5.50 | 0.95 | 4.50 | 0.25 | 7.6 |
| HINDUSTAN TELEPRINTERS | 1.13 | 0.09 | 0.13 | 5.40 | - | 1.19 | 0.06 | 5.4 |
| BPL | 1.50 | 0.43 | 0.20 | 4.90 | - | 5.47 | 0.27 | 5.8 |

Note : Figure in brackets are negative numbers
Source : Appendices 1-8

### Total Earnings to Conversion Cost

Being the main source of funds for any industrial unit, Total Earnings (TE) as a proportion to Conversion Cost (C) should provide a reliable indication of the state of productivity in any industry. Of the 22 electronic units whose data could be secured (from different sources) there are five companies (PSI, HMV, PIECO, SCL and O/E/N) which have shown rather poor performance during the six year period (1984-1989) taken together into consideration. There are other units whose ratios are fairly good e.g. ESSEN, BPL, Samtel, HCL and ITI. The remaining twelve units have either maintained a steady score of unity or a little above. In some cases, a downward trend is discernable. These include ESSEN, IDM, HMV etc. (Appendix I) Fig. 1 gives a comparative picture of TE to C ratios of all the 22 companies.

### Purchased Services to Total Earnings (PS to TE)

It is a productivity indicator of considerable importance, as it provides a reliable assessment of managerial control on the use (or misuse) of some of the resources such as energy (fuels, electricity, gas, air etc), services (telephone, postage, insurance, etc.) and indirect materials including process materials etc. Fig. 2, provides an overall picture of how much purchased services are costing different companies for every rupee of their total earnings (Appendix 2). By and large there appears to be a certain amount of uniformity in this respect amongst various units. In the case of companies like PSI, SCL, O/E/N and HMV there is an obvious need for specific measures to control the use of such resources which contribute to high spendings; perhaps in the form of energy

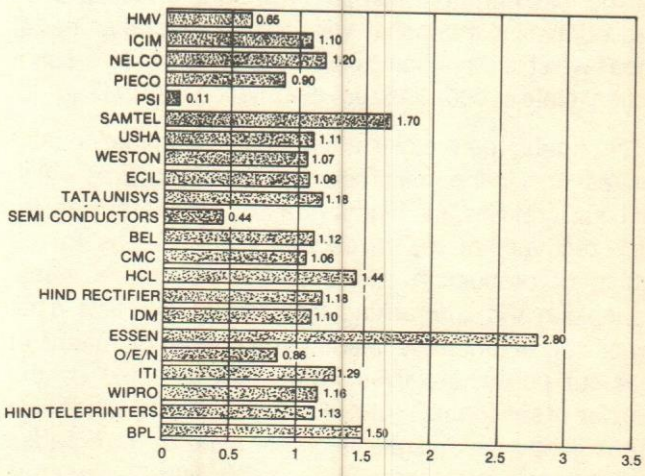



FIG. 1 : EARNINGS TO CONVERSION COST RATIO

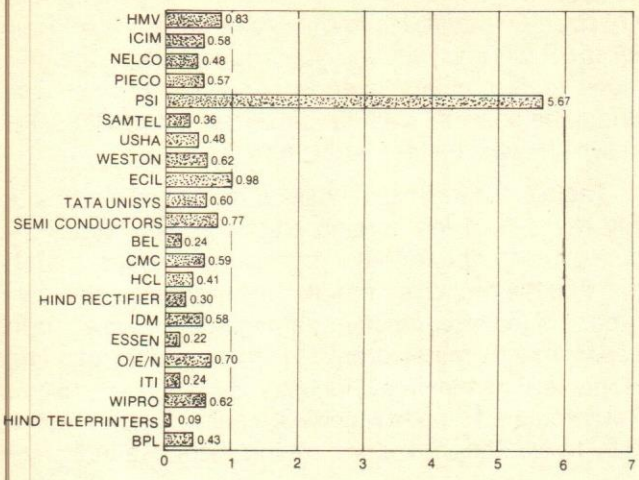



**FIG. 2 : PURCHASED SERVICES TO TOTAL EARNINGS RATIO**

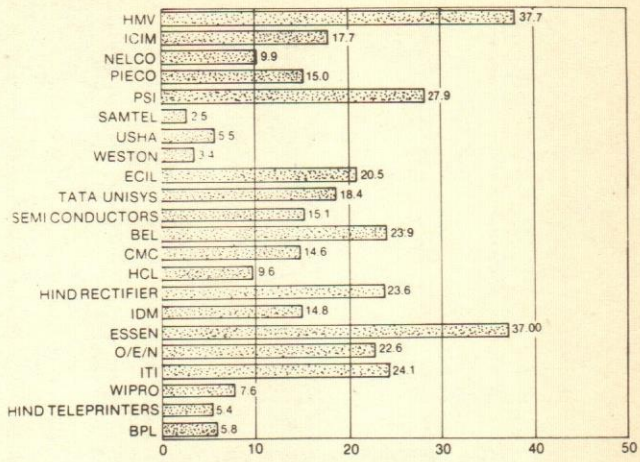



**FIG. 3 : WAGES & SALARIES TO SALES RATIO**

wastages and poor utilization of indirect materials etc. Companies like Hind Rectifier, Hindustan Teleprinters, ITI and BEL too, however, need to maintain a close vigil on the utilization of these and other resources to ensure that the trends already established continue in future also.

## Wages & Salaries to Sales

This is the most important 'Peoples' measurement from the productivity angle. It indicates how much 'people' are costing the company to get the level of sales it is achieving. For example, in the case of ESSEN; employee costs are only Rs. 3.70 for every Rs. 100 of sales whereas in the case of HMV and PSI it is as high as Rs. 37.70 and Rs. 27.9 respectively for getting a similar quantum of sales. There is, however, a wide variation in the ratio amongst 22 companies (see Fig. 3 and also Appendix 3).

Out of the 13 companies which are comparatively high wage islands, at least five viz. HMV, O/E/N, PSI, PIECO, and SCL need to give greater attention to the utilization of this important resource, viz., the people. It is not unlikely that these companies are carrying a larger complement of staff than what may be warranted by the current state of their operations.

## Porfit Performance

Indicators of great significance to any company's profit performance are: Ratio of Profit to Conversion cost and Profit to Sales percentage. While the first parameter provides information as to how much profit is generated for every Rs. 100 sales, the second one, which is more closely related to TE to C ratio , is a general measure of a company's profit performance. Since both these parameters are linked to each other, a productivity audit of any company must include both of them to obtain a reasonably correct idea of the company's profit performance.

Fig. 4 shows profit performance of all the 22 companies at a glance. Out of the 22 companies the profit performance of BEL, O/E/N, HCL, ESSEN and SAMTEL can be said to be very good, being a great deal above the average of the industry. In the case of HMV, Hind Rectifier, PSI, ICIM, PIECO, SCL and NELCO profit performance is generally on the low side and, therefore, calls for concerted measures to improve their performance. The remaining ten companies seem to be just making even by remaining close to the overall industry average (22 companies).

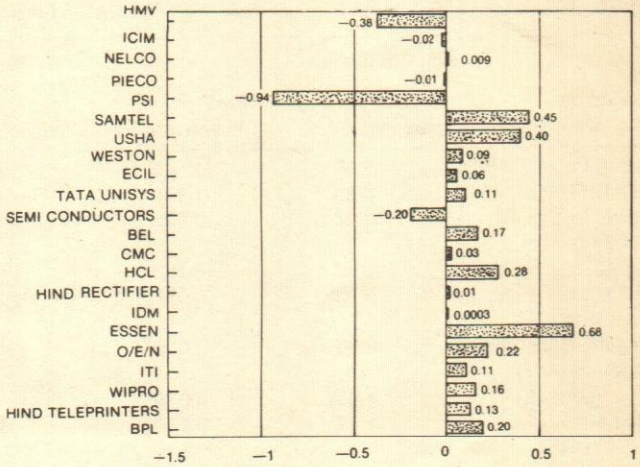



**FIG. 4 : PROFIT TO CONVERSION COST RATIO**

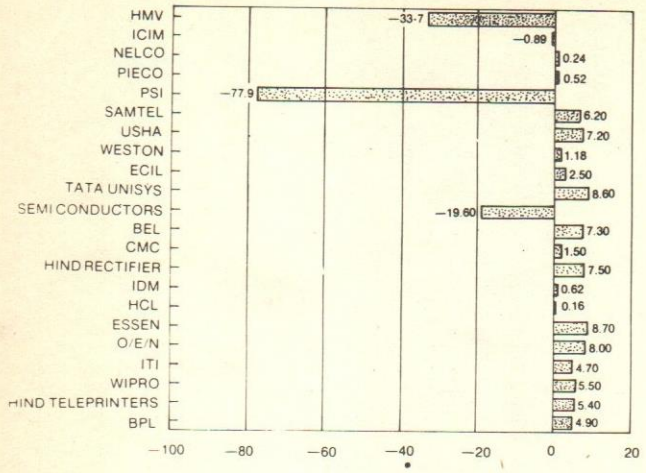



**FIG. 5 : PROFIT TO SALES RATIO (%)**

## Employee Productivity

This parameter is generally regarded as an indicator of a manufacturing company's performance efficiency. In India, the employee productivity is generally poor in comparison to other industrially developed countries.

The data on employee productivity could be obtained from only 12 of the 22 companies taken as a sample from the industry. Based on this limited data, we have worked out employee productivity under three heads e.g. Profit per Employee, Sales per Employee and Value Added per Employee (8 companies only). Figures 6-8 present a comparative picture of the employee productivity ratios in the electronic industry based on the three parameters. It seems that the employee productivity in some companies is much better than that of others. For example, profit per employee is very good in BPL, WIPRO and Tata Unisys whereas in PIECO, PSI, SCL, & ECIL it is either poor or very poor. Compared to this Sales per employee is fairly high in PIECO and CMC in addition to the three companies whose profit per employee is good. In terms of value added, the position is almost similar, with WIPRO & Tata Unisys showing better results than the others.

Table 6 shows in juxtaposition the employee productivity ratios of a few foreign electronic companies and some of the better performing Indian companies. It will be seen that the employee productivity is consistently low in the case of Indian companies demostrating once again the need for much greater attention to the utilization of human resources. The electronic industry, by and large, has not so far produced results which will inspire confidence in its ability to weather any storm. Being a sunrise industry, it

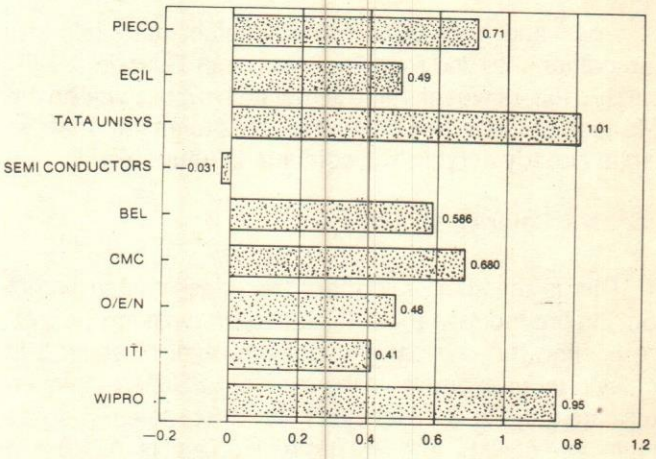



**FIG. 6 : VALUE ADDED PER EMPLOYEE (RS. LAKHS)**

Table 6: Comparison of Employee Productivity of Selected Indian Electronics Vis-a-Vis Foreign Companies

| Foreign Companies[1] | | | Indian Companies[2] | | | |
|---|---|---|---|---|---|---|
| Company (No. of employees) | Sales per employee (Lakh £) | Profit per employee (Lakh £) | Company (No. of employees) | Sales per employee (Lakh Rs.) | Profit per employee (Lakh Rs.) | |
| Sony Broadcast (435) | 3.05 | 1.560 | ECIL (76324) | 1.69 | 0.042 | 1. The data of foreign companies relates to the latest accounting year<br>2. Average of 5/6 year's data has been taken for Indian companies |
| ARMSTRAD (1424) | 4.39 | 1.170 | Tata Unisys (804) | 2.91 | 0.249 | |
| Ferrante Signal (24,818) | 0.33 | 0.030 | PIECO (9095) | 3.38 | 0.020 | |
| UEI (2282) | 0.62 | 0.122 | BEL (18765) | 1.45 | 0.107 | |
| Mat sushita Elec. (UK) (816) | 0.93 | 0.057 | CMC (1424) | 3.72 | 0.055 | |
| Hitachi Consumer Products (947) | 0.99 | 0.022 | BPL (203) | 5.47 | 0.270 | |
| NEC (UK 249) | 4.43 | 0.079 | ITI (31,687) | 1.33 | 0.060 | |
| Memorex Telex (USA) (416) | 1.77 | 0.180 | WIPRO (814) | 4.50 | 0.250 | |

Source : Foreign Companies basic data obtained from "The Time '1000' 1989-90", Times Books, London 1989.

has yet to go a long way but without adequate attention to achieving improved productivity, it may never reach it's expected potential. Problems, no doubt, are there and perhaps will continue to dog it like its counterparts elsewhere. A clear shift of its efforts towards productivity improvement may yet see them climbing welcome heights.

## Imports & Exports

Because of the constantly expanding domestic market, particualry for consumer electronics, the industry does not seem to have given adequate attention for building up electronic exports, the potential for which is reported to be so vast that even a tenfold increase in its present size may prove quite unequal to the task. The demand potential for electronic exports which has been growing at an annual rate of 30-35 percent in recent years, is likely to increase tremendously over the next few years. World Computer market alone is estimated to be in the neighbourhood of 230 billion dollars and is expected to grow to 500 billion dollars by 1995. The export potential in electronics is, therefore, promising and the Indian industry should not find it impossible, with appropriate efforts, to secure a good share in it.

The past performance of the industry (tables 7 & 8) does not however seem to inspire any such cofidence in its ability because of its apparent preoccupation with the easy gains from the domestic market. It appears that the industry is unwilling to make its mark in the highly competitive world market, incentives and liberalization notwithstanding. While exports have been steadily going up in terms of value year after year, from a modest begining in 1975, these have not gone beyond 6-9% of the total domestic production. The export of electronic items forms only an insignificant share in the total exports from India despite the special thrust it has been given during the past few years. In relation to world trade of 500 billion dollars our exports are infinitesimally small. Even small countries like Taiwan, Korea, Hong Kong & Singapore seem to have performed much better both on the production and export fronts. Their

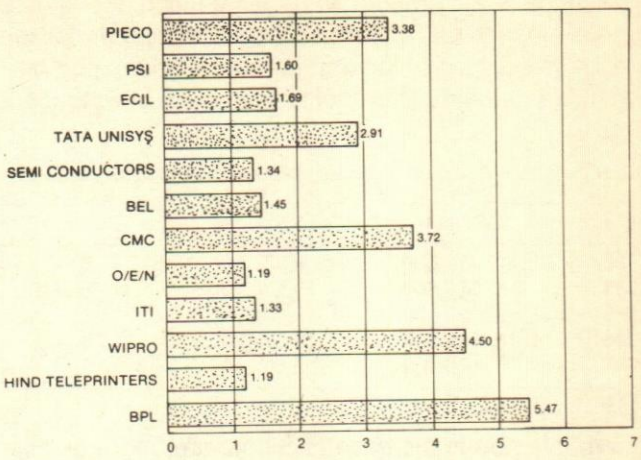



**FIG. 7 : SALES PER EMPLOYEE (RS. LAKHS)**

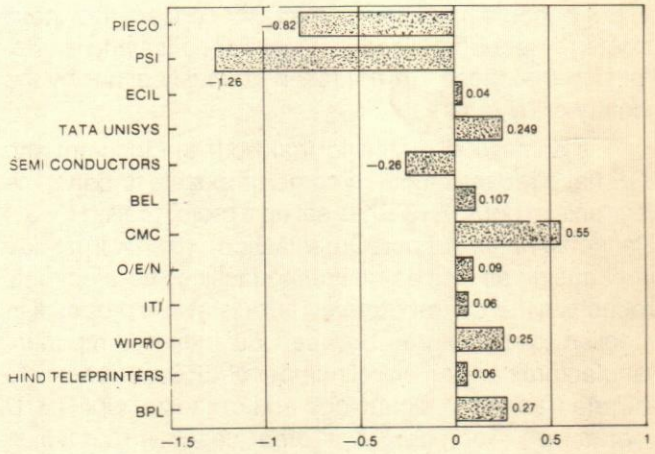



**FIG. 8 : PROFIT PER EMPLOYEE (RS. LAKHS)**

Table 7. Exports of Electronic Products from 1979 onwards

| Year | Exports Rs. crores | % growth over previous year | % share in total Exports | % share of production |
|---|---|---|---|---|
| 1979 | 46.6 | 17.7 | 0.7 | 7.2 |
| 1980 | 41.8 | −10.3 | 0.6 | 5.2 |
| 1981 | 56.4 | 34.9 | 0.7 | 6.5 |
| 1982 | 83.9 | 48.7 | 0.9 | 6.9 |
| 1983 | 114.5 | 36.5 | 1.2 | 8.4 |
| 1984 | 155.0 | 35.3 | 1.3 | 8.2 |
| 1985 | 154.5 | −0.3 | 1.4 | 5.8 |
| 1986 | 240.0 | 55.3 | 1.9 | 6.9 |
| 1987 | 312.0 | 30.0 | 1.9 | 6.6 |
| 1988 | 475.0 | 52.0 | 2.3 | 7.5 |
| 1989 | 775.0 | 63.0 | 2.7 | 9.3 |
| 1990 (E) | 1000.0 | 29.0 | – | 10.8* |

*Based on targeted production of Rs. 9210 cones
Source: DOE (1989 & 1990) Economic Survey, various issues
CMIE (1990) Economic & Political Weekly (1989)

Table 8. Performance of Electronic Industry during Seventh Plan (Rs Crores)

| Year | Production | | % | Export | | % |
|---|---|---|---|---|---|---|
| | Target | Actual | Achivement | Target | Actual | Achivement |
| 1985-86 | 3065 | 2880 | 93.9 | - | 178.0 | - |
| 1986-87 | 4255 | 3855 | 90.5 | - | 258.0 | - |
| 1987-88 | 5630 | 5285 | 93.8 | - | 343.0 | - |
| 1988-89 | 7810 | 7030 | 20.0 | - | 520.0 | - |
| 1989-90 | 10860 | 8300* | 76.4 | 1000 | 775.0* | 77.5 |

*For Calendar years
Source: DOE Annual Report, Working Group on 8th Plan.

share in the world production remains much above ours which at present is a woeful 0.5 percent. In this connection it will be interesting to look at the output and export performance of electronic products in respect of Singapore (table 9).

Table 9: Singapore's Export & Output of Electronic Products ($ 000)

| Year | Output | Exports | %age |
|---|---|---|---|
| 1983 | 10,783,600 | 8,372,600 | 77.6 |
| 1984 | 13,851,600 | 10,530,100 | 76.6 |
| 1985 | 13,023,400 | 10,894,700 | 83.6 |
| 1986 | 15,595,900 | 13,088,200 | 83.9 |
| 1987 | 20,618,100 | 17,167,400 | 83.2 |

Source : Trade Links Directory 1989-90

What is true in the case of Singapore, more or less, holds good for other countries too. Every plan period is preceded by a set of export and output targets which represent a minimum achievable expectation from the industry. But it should have been a matter of concern that these targets remain unrealized in most cases leaving an impression that these are not taken seriously either by the industry or by others.

It is somewhat gratifying that both the industry and DOE have recently mooted some proposals to boost the electronic exports. ET&T has set up a project called ESSO (Electronic Sales Support Organisation) which will provide warehousing as well as marketing facilities for electronic products in the United States. There is also a proposal to establish joint ventures between 50 Indian component manufactures and an equal number of EEC companies to facilitate transfer of technology and organize joint R & D programmes. The purpose in other cases is to develop exports from India to USA & EEC countries.

Recently a deputation from some of the electronic companies toured US with a view to promoting exports & also removing the misunderstandings created by some unfair dealigs indulged in by certain unscrupulous exporters.

## Export Processing Zones

In 1974 the Santacruz Electronic Processing Zone (SEEPZ) was setup. This Zone was meant exclusively for 100% export production of electronic items. The zone has 74 units at present and employs over 8000 persons. Beside SEEPZ, another six export processing zones (EPZs) were also set-up thereafter at different centres including Kandla, Madras, Cochin, Falta and Noida. While SEEPZ is exclusively meant for Electronic exports, EPZs also cater to the export of other merchandize. The performance of these 6 units during the last few years is shown in tables 10 and 11. Besides these six export zones, the seventh one at Vishakapatnam is also under formation. Basically meant to augment foreign exchange, the laudable objectives of the EPZs include generation of employment, attracting foreign investment and technology and upgradation of local skills. It is however, doubtful whether the EPZs have contributed to these objectives in any convincing manner. It seems most of the units in the Export Processing Zones have turned into assembly units without contributing anything palpably to their standards of performance and/or the quality of the products made by them. A recent CAG Report has adversely remarked about their effectiveness (Patriot, 1989). Mortality rates in most EPZs are high, employment potential is low and the concessions/incentives are utilized for importing goods from hard currency areas while the exports of finished goods are generally to the rupee trade areas. A recent study says 'The EPZs have also failed to help exports and industrial development through import liberalization. All import facilities are being utilized to import machinery & industrial raw

Table 10. Production of Electronic Products in EPZs from 1984-1989 (Rs. Crores)

| EPZ | Production | | | | | |
|---|---|---|---|---|---|---|
| | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 |
| SEEPZ | 103.5 | 85.0 | 100.5 | 109.7 | 144.2 | - |
| KEPZ | - | 16.0 | 38.1 | 12.6 | 6.4 | - |
| FEPZ | - | - | 5.4 | 2.1 | 3.9 | - |
| NEPZ | - | - | - | 5.3 | 8.8 | - |
| MEPZ | - | - | - | 0.3 | 0.7 | - |
| Total EPZ | 103.5 | 101.0 | 144.0 | 130.0 | 164.0 | 225.0 |
| Total Exports | 155.0 | 154.5 | 240.0 | 312.0 | 475.0 | 775.0 |
| % Contribution | 66.0 | 65 | 60 | 42 | 35 | 60 |

Source: Business Standard Annual. (1989)
DOE

Table 11. Performance of various Export processing Zones : 1988-89 & 1989-90 (Rs. Crores)

| Zone | 1988-89 | | | 1989-90 | | | |
|---|---|---|---|---|---|---|---|
| | Target | Achievement | % | Target | Achievement | % | |
| Kandla FTZ | 200.00 | 271.59 | 135 | 300.00 | 286.15 | 95 | |
| SEEPZ | 140.00 | 1851.19 | 132 | 200.00 | 236.29* | 118 | * Includes gems & jewellery exports also |
| NOIDAEPZ | 30.00 | 21.34 | 71 | 35.00 | 48.14 | 137 | |
| Madras EPZ | 30.00 | 24.04 | 80 | 40.00 | 22.73 | 57 | |
| Falta EPZ | 20.00 | 8.11 | 41 | 15.00 | 12.75 | 85 | |
| Cochin EPZ | 8.50 | 6.25 | 73 | 15.00 | 10.37 | 69 | |
| Total | 428.50 | 516.52 | 120 | 605.00 | 616.43 | 102 | |

Source : Reply to Unstarred question no 3860 answered in Lok Sabha on 6.4.1990.

materials from hard currency areas and final exports made to rupee trade areas. Thus, whatever way we might look at it, the major beneficiery of the strategy of import based export production and industrialization is the transnational corporation' (Banerji, 1989).

Contrary to expectations and despite all good intentions, exports of electronic products from India seem to be making a painfully slow progress, despite the fact that the scope for exports of electronics is almost unlimited. In the case of software exports alone, it is estimated that a business of 100 million dollars or more can be generated over the next few years. The current rates of exports may lend an impression of a spectacular rise but when compared with the performance of other nations of much smaller size and stature, these percentages pale into insignificance. It seems the industry needs a total restructuring of its production base by inducting latest technologies, improving product quality to international standards (both in components and electronic products) and building a supportive R&D structure of adequate size and quality. All this will mean fresh sizeable investments; but with the liberalized policies and adequate incentives, there should really be no hesitation to invest in electronic exports.

**Imports**

It seems that the industry is overdependent on imported technology, raw materials, components and sub assemblies. This is true in the case of all electronic products but is much more so in the case of consumer products like the TV which find ready acceptance under foreign brand names. According to BICP (1987), the domestic content in total electronic production of Rs. 3460 crores in 1986 was valued at Rs. 510 crores. In other words, the import content was nearly 85 percent. This was largely contributed by imported components and raw materials or parts, though in some cases the imported subassemblies also formed a fairly large part of it. Imported components, however, formed the single largest segment of the total content of electronic products manufactured in the country.

In the case of computers particularly PCs, the import content is no less than 80%. Barring the steel cabinet, the front panel and a few odd parts here and there, the industry is using mostly imported components for the Central Processing Unit (CPU), the Visual Display Unit and the Key Board of the PCs. While the turnover has increased to almost Rs. 1500 crores from a meagre Rs. 100 crores in 1980, there is hardly any decline in the import content of PCs. If the present policies and practices continue, the current position of import content is likely to become a permanent feature in the case of computers as is the case with other electronic products.

It is obvious that large scale indigenisation can be possible only if the industry concentrates on the development of a strong component base and the DOE promotes this as a national priority. Since reliable data on import of electronic products/parts/components is not readily available, we have to depend on secondary sources for this information. According to one such source (Economic & Political Weekly, 1989), the imports vary between 29 and 45 percent of the total annual production of electronics (table 12). While in the earlier years the import content of raw materials etc. was a little over 25% it has been gradually increasing over the years and seems to be approaching 50% except during 1988 and 1989. This inference is supported by our analysis of the material consumption of some of the electronic companies over the past few years (table 13). It is found that import of raw materials/components in some cases is as high as 85%. Other countries who entered the electronics field at about the same time, and have since made their mark in the world's major electronic markets, have successfully reduced this dependence. For example, in South Korea the percentage of imports to production had been brought down to 41 by 1985 from 45 in 1980. (Joseph, 1989). Because of the comparatively easy access to component imports, the Indian electronic industry has failed to make much progress in indigenizing the products. In their anxiety to induct the so called new technologies, foreign collaborations have been entered into without adequate safeguards, often resulting in multiple collaborations and being saddled with out dated technologies and restrictive terms & condi-

Table 12. Import trends in Eletronics

| Year | Production Rs. crores | Imports Rs. crores | % of production |
|---|---|---|---|
| 1975 | 364.5 | 105.7 | 29.0 |
| 1976 | 410.0 | 110.7 | 27.0 |
| 1977 | 508.5 | 167.8 | 33.0 |
| 1978 | 590.5 | 206.7 | 35.0 |
| 1979 | 645.5 | 224.5 | 34.8 |
| 1980 | 806.0 | 285.3 | 35.4 |
| 1981 | 856.0 | - | - |
| 1982 | 1205.0 | 456.2 | 37.9 |
| 1983 | 1360.0 | 691.4 | 50.8 |
| 1984 | 1890.0 | 847.7 | 44.8 |
| 1985 | 2660.0 | 1176.6 | 44.2 |
| 1986 | 3460.0 | 1584.2 | 45.8 |
| 1988 | 6300.0 | 1427.0 | 22.6 |
| 1989 | 8300.0 | 1141.0 | 13.7 |

Source : DOE
World Engg. Trade Statistics
Economic & Political Weekly (1989)
Business Standard (1988 & 1989)

Table 13. Imported and Indigenous content as materials consumed by some Electronic Companies 1984-1989

| Company | 1984 | | 1985 | | 1986 | | 1987 | | 1988 | | 1989 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Imp. % | Ind. % | Imp. % | Ind. % | Imp. % | Ind. % | Imp. % | Ind. % | Imp % | Ind. % | Imp. % | Ind. % |
| PSI | 72 | 28 | 54 | 46 | 73 | 27 | 59 | 41 | - | - | 49 | 51 |
| O/E/N | 61 | 39 | 58 | 42 | 55 | 45 | 35 | 65 | 46 | 54 | - | |
| WIPRO | 79 | 21 | 86 | 14 | 81 | 19 | 69 | 31 | 70 | | 30 | - |
| ITI | 34 | 66 | 48 | 52 | 61 | 39 | 56 | 44 | 44 | 59 | 41 | - |
| PIECO | 33 | 67 | 37 | 63 | 46 | 54 | 51 | 49 | - | - | 51 | 49 |

Source : Annual Reports of companies concerned.

tions. Such collaborations are often instrumental for the continued dependence on imports of the very items for which these were initially sought. The growing gap between imports & exports should be a matter of grave concern particulary in the light of the worsening balance of payment position. The current policy of 'flush-in and flush-out', it seems, needs a thorough review. The industry at one time was considered to be endowed with the potentiality of becoming India's largest exporter, but ironically it has turned out to be one of its biggest importers. In 1988 alone it is estimated that about Rs. 1600 crores were spent on the import of kits, components, & parts etc. The EP Zones have, no doubt, also contributed to this unenviable situation to a large extent. The only way out of the current difficult situation would, therefore, seem to be, a quick and systematic, building of a strong base in the component sector adequately equipped with the latest technologies and the backing of a strong R&D. No other soft options appear to be available right now.

## Components

Components are the building blocks of the industry and unless their manufacture is planned on a sound basis, the electronic products may continue to lack in quality, class and customer confidence. In 1987, 50% of the components valued at Rs. 700 crores were imported, in addition to Rs. 200 crores worth raw materials used for the locally produced electronic items (Telematics, 1989).

This shows that there is still a lot of leeway to be made up in the area of component manufacture. Although the production of components has been going up, we are still far from the self sufficiency goal, which is the main aim of recent industrial policy pronouncements. Table 14 shows the growth rate of the output of electronic components from 1979 onwards.

Apparently, the growth of component production has been somewhat erratic. It has been fluctuating untill 1983, whereafter it seems to have maintained an average growth rate of about 35%. Policy changes in the eighties have had their impact on the growth pattern of the electronic industry as a whole. But it seems there has been a general reluctance on the part of the private sector to invest in the component sector leading to a lop sided product structure in the industry. This is also borne out by the disproportionate increase in the number of electronic units going in for the manufacture of TVs & Computers which was the result of the sudden spurt in the demand for consumer electronics -mainly B&W and Colour TVs and Computers (table 15).

Most of the TV sets manufacturing companies, it seems, import complete kit and contribute little by way of value added before marketing them. This results in a heavy outflow of foreign exchange but enables a host of

Table 14. Growth in Production of Elecronic Components : 1979-1989

| Year | Components | | Professional Electronics | | Consumer Electronics | |
|---|---|---|---|---|---|---|
| | Output (Rs. crores) | Growth % | Output (Rs. crores) | Growth % | Output (Rs. crores) | Growth % |
| 1979 | 136.0 | 16.0 | 320.0 | 4.1 | 179.0 | 12.9 |
| 1980 | 163.0 | 19.8 | 412.5 | 28.9 | 214.0 | 19.5 |
| 1981 | 173.0 | 6.1 | 411.5 | -0.2 | 246.0 | 14.9 |
| 1982 | 214.0 | 23.6 | 605.5 | 47.1 | 337.0 | 37.0 |
| 1983 | 230.0 | 6.5 | 725.0 | 19.7 | 330.0 | -2.1 |
| 1984 | 303.0 | 38.6 | 896.5 | 23.6 | 587.0 | 77.9 |
| 1985 | 410.0 | 35.3 | 1135.0 | 26.7 | 10.30.0 | 75.5 |
| 1986 | 510.0 | 24.3 | 1531.0 | 34.9 | 1275.0 | 23.8 |
| 1987 | 700.0 | 37.2 | 2070.0 | 35.2 | 1820.0 | 42.7 |
| 1988 | 1025.0 | 46.4 | 2711.0 | 30.9 | 2400.0 | 31.9 |
| 1989 | 1440.0 | 40.4 | 3835.0 | 41.5 | 2800.0 | 16.7 |

Source : DOE Annual Reports
Electronic Information and Planning June 1988
Elcina Directory 1989

Table 15. Number of Companies Manufacturing Electronic Products

| Product | 1981 | 1983 | 1987 |
|---|---|---|---|
| B&W TB | 86 | 182 | 173 |
| CTV | 3 | 76 | 133 |
| Computers | 8 | 51 | 118 |
| Resisters | 23 | 42 | 46 |
| Capacitors | 27 | 29 | 29 |
| PCBs | 32 | 87 | 91 |

Source: (i) Directory of Electronics Manufacturers (1989)
(ii) Department of Electronics - Annual reports.

manufactures to continue in their business. Despite the importance of the component sector, because of its profound impact on other product groups, the response from the private sector in the form of new investments has been sluggish with the result that even today the dependence of the industry on imports continues. The import content of components has risen from 25% in 1980 and 30% in 1985 to 40% in 1988. While the current policy of liberalised imports cannot be faulted, the case for greater attention for developing the component sector, particularly micro-electronics should not go by default. To that extent a policy change may be quite in order to help revitalization of the component sector.

Recent additions in the capacity for the manufacture of CTV components is likely to alter the import scene favourably in a couple of years. New units are expected to come up to undertake manufacture of specialized components but even all these efforts are too meagre to make a worthwhile impact on the overall performance of the electronic industry. It is estimated that the demand for components may reach Rs. 7300 crores by 1994-95 and a hefty sum of Rs. 21,000 crores by the year 2000; but the gap between current capacity and production on the one hand and demand on the other, may continue to widen unless capital investments in the area are deliberately canalized into this sector. According to an estimate by the Federation of Indian Chambers of Commerce & Industry (FICCI), the component group has to grow at a rate of 32% annually during the Eighth Plan if a production of Rs. 30,000 crores is to be achieved by 1994-95. For this level of output FICCI, feels an investment of around Rs. 3000 crores would be necessary of which Rs. 2100 crores, will have to come from the private sector. The current trends in investment do not seem to lend confidence that investment of this order will be forthcoming which is essential for achieving economies of scale comparable to international standards.

Backed by adequate R&D efforts and state of the art technologies and maximum standardization of components, it should still be possible to build a strong base of electronic components with ample scope for competing with some of the advanced countries in the World's electronic markets. As things stand, even SCL, the only semiconductor manufacturing unit, remains inoperative after the devastating fire in February 1989 and still seems to be far away from revival.

FICCI maintains that of the total projected production of Rs. 6,500 crores worth components by 1994-95 it should be possible to export at least Rs. 1000 crore i.e. about 15% of the production. Currently the export of components is as shown in table 16. If the kind of investment envisaged from this sector materialize and the industry is able to harness suitable modern technologies it may be possible even to reach higher growth rates in exports during the Eight Plan period.

Table 16. Export of Electronic Components-1985-1989

(Rs. Crores)

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| Year | Value of Exports | % Growth | % share in Elec. Exports | % share in Components Elec. Prodn. | % share in total Prodn. |
| 1985 | 48.0 | - | 31.0 | 11.7 | 1.8 |
| 1986 | 63.7 | 32.7 | 26.5 | 12.5 | 1.8 |
| 1987 | 96.0 | 50.7 | 30.8 | 13.7 | 2.0 |
| 1988 | 128.0 | 33.3 | 26.9 | 12.4 | 2.0 |
| 1989 | 229.0 | 78.9 | 29.5 | 15.9 | 2.7 |

Source : DOE Annual Report, 1990 (Basic data only).

## Consumer Electronics

As table 17 shows consumer electronics registered the highest growth rate during the years 1984 and 1985. As a result, during the post 1980 period it has topped with an overall growth of nearly 40% as against 31% by the professional electronics and a mere 26% by the component sector. The main contribution to this high growth rate was from TV receivers which achieved an unprecedented growth

Table 17. Output of major Consumer Electronic Items

(Lakh Nos)

| Product | 1981 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 |
|---|---|---|---|---|---|---|---|---|
| B&W TV Sets | 4.37 | 6.6 | 10.0 | 17.9 | 21.5 | 32.0 | 44.0 | 40.0 |
| Color TVs | (negl.) | 0.5 | 2.8 | 6.8 | 8.5 | 11.0 | 13.0 | 12.0 |
| Radios | 6.6 | 60.0 | 62.0 | 75.0 | 75.0 | 80.0 | 80.0 | 80.0 |
| Tape Recorders Two in Ones | 4.8 | 9.0 | 12.0 | 20.0 | 26.3 | 30.0 | 35.0 | 40.0 |
| Elec. Watches | 0.75 | - | - | 2.8 | 5.8 | 11.0 | 15.0 | 35.0 |
| Calculaters | 1.13 | - | - | 1.2 | 1.4 | 3.3 | 4.5 | - |

Source: CMIE (1990) - Electronic Production
DOE (1990) - Annual Report
Electronics Information & Planning, June 1988
Electrical India 1988

rate of 66% in 1987. The impact of this one single item can be further gauged from the fact that it has a share of nearly 26% in the total electronic output. However, fears are already being expressed about the possible beginning of an era of stagnation in the TV industry (PTI, 1990).

By and large, consumer electronics is an assembly industry. It has, therefore, a direct linkage with the component sector. Without the indigenous component sector being reinforced, consumer electronics may continue to be a drain on our foreign exchange resources. The available evidence shows that expansion of the consumer electronics sector has largely been in the private sector. The Planning Commission has also noted the perference of the private sector, (small scale included), in the following terms "much of the investment by the private sector in the last 2 years is in the area of consumer electronics, petrochemicals and automotive sector...has resulted in...investment not forth coming in the priority activities...". The Planning Commission feels that this is largely due to "consumer products based on imported and penultimate stages of raw materials seem attractive because of lower capital costs and quick returns." The thinking of private entrepreneurs on this matter is illustrated by some of the views expressed in a workshop organised by the AIEI (now CEI) in 1979 (these would seem to persist even to day) "Some participants felt that we should develop first the equipment base...built on imported components". This will lead to a stronger base for component manufacture, they felt. The main reason for this view is that component manufacture involves high capital investment and the returns are less lucrative and slow in coming. The net value added data clearly indicates that, in the case of component manufacturers, this is high in comparison to those `manufacturing' consumer electronics. This is obviously due to the fact that assembly of CKD/SKD kits into salable products is much less labour intensive than the designing and production of components to uniform quality standards.

The production of major consumer items during the past few years is shown in table 17. While there has been a steady growth in the production of all consumer items from 1981 onwards, the two items which have shown negative growth are the two categories of TV receivers. Due to this, the overall growth rate for consumer electronics has come down to about 17% during 1989. However, the share of consumer electronics in the total electronics production for the year has also slipped down to 33.7% as compared to 38.1% in 1988 and 38.6% in 1987.

Fears are already being expressed that the demand for TVs particularly the B&W ones reached a saturation level and to revive it, a token price cut may be in order. This would seem to be a tough proposition but a proper productivity audit by the industry may yet reveal the areas where direct or indirect cost reductions are possible so as to enable the industry to bring down prices without seriously jeopardizing the profitability ratios.

In the area of exports, the consumer electronics sector has a lot of potenital. Its export performance during the past few years is shown in table 18. During the past five years, when the consumer electronics saw a fairly big rise, the exports continued to plod along at a mere 7 to 9% rising to a maximum of 10% in 1988. The concentration, of the industry seems to be more on meeting the rising domestic demand which had received a sudden propulsion due to the quick expansion of TV network. No attempts, it seems, were made to capture markets of Africa and other low economy markets of Asia. These markets are perhaps lost to India, atleast, for the present. The fact that, due to higher prices and, perhaps, also due to inferior quality and reliability of products, the Indian industry could not reach a sizable section of the domestic market for VCRs, two-in-ones etc. which are imported into the country even today, (through legal sources or otherwise) despite the heavy duty rates, should be an eye opener for the industry.

### Professional Electronics

Amongst the profesional electronics items, computers, control instrumentation & industrial electronics have maintained a high growth rate during the eighties. The Computer Sector is one of the fastest growing sub-sectors. Computer production in India is largely an assembly operation, often from imported kits, with heavy dependence on foreign technology. The computers manufactured in the country are protected from imports through high import duties. The prices of our products continue to be high in comparison to the world prices for similar products. There is little R&D effort or any long term indigenization programme drawn up for this sector so far. Computer periph-

Table 18. Export of Consumer Proudcts 1985-1988

(Rs. crores)

| Year | Value of Exports | % Growth | % share in Consumer Elec. Production | % share of total electronic production | % share of total Elec. Exports |
|---|---|---|---|---|---|
| 1985 | 14.0 | - | 1.4 | 0.5 | 9.1 |
| 1986 | 18.0 | 28.6 | 1.4 | 0.5 | 7.5 |
| 1987 | 30.3 | 68.3 | 1.7 | 0.6 | 9.7 |
| 1988 | 47.7 | 57.4 | 2.0 | 0.76 | 10.1 |
| 1989 | 57.0 | 19.5 | 2.0 | 0.69 | 7.4 |

Source : DOE Annual Reports (for basic data)

erals whose manufacture calls for comparatively lower skills account for more than half the price of the computer hardware.

While the production of computer & computer peripherals has been growing at the rate of 50% annually (CAG, 1989), as shown in table 19, there have been few attempts to put the industry on a sound footing either through process innovation or design development. The short-term objectives of the private sector are aptly captured by the Annual Report of one of the computer companies (PSI, 1989). "The period under review (1987-88) has been an extra-ordinary period for the Indian Computer Industry. While the market as a whole grew to Rs. 501 cores, this growth has been achieved primarily through large scale imports of kits from Singapore and Taiwan. The structure of the Indian Computer Industry consequently has undergone a sea-change. What was till a year back an industry fueld by Research and Development, has now become one where ability to secure imports at the cheapest price is the key". Although according to a recent news item (Times of India, August 17th, 1990), India has now joined a select band of nations actively engaged in the business of producing super computers, this does little credit to the industry, the super computer development project having been solely handled by the Centre for Development of Advanced Computing, set up by the DOE.

Table 19. Production of Computer and Computer Peripherals

(Rs. Crores)

| Year | Value | % Growth |
|---|---|---|
| 1984 | 920 | - |
| 1985 | 1550 | 68.0 |
| 1985 | 2800 | 80.6 |
| 1987 | 3750 | 34.0 |
| 1988 | 4860 | 29.6 |
| 1989 | 7000 | 44.0 |

Suggestions made by the BICP in their 1987 Report seemed to have had little impact on the structure of the industry. Standardisation and long term planning alongwith other suggestions did not seem to have been heeded to. The prices of the PC systems have no doubt come down as a result of keen competition and compelled some of the computer companies to reduce costs and improve productivity. Ideally, what has happened in the computer group, should have repeated itself in the rest of the electronics industry, so that it will be compelled to look for ways and means to improve productivity and raise quality standards so as to become competitive in the world market in every sector and not only in the computer peripherals. Industrial Electronics and Control Instrumentation (IECI) has wide scope for future expansion with increasing awareness of their practical applications in different industries

Table 20. Anticipated Consumption of Professional Electronics

(Rs. Crores)

| Item | Consumption | | Imports | |
|---|---|---|---|---|
| | 1992 | 1995 | 1992 | 1995 |
| Control Instrumentation & Indl. Electronics | 2145.5 | 3682.0 | 427.8 | 702.0 |
| Data Processing Equipt. | 1899.5 | 3432.0 | 329.5 | 327.0 |
| Broadcasting & Communication Equipt. | 1356.4 | 1980.4 | 75.0 | 85.0 |
| Strategic Electronics | - | - | - | - |
| Total | 5401.4 | 9094.4 | 823.3 | 1114.0 |

Source : Elcina-Indian Electronic Directory 1982.

particularly where hazardous and critical operations are involved. Environmental telemonitoring, crane operating controls, safety interlocking systems, industrial robotics etc. are just a few of such applications. The scope it seems is limitless. It only calls for imagination and innovative thinking. The total production in the IECI group is expected to grow from Rs. 1210 crores in 1989 to Rs. 1718 crores in 1992 and to Rs. 2987 crores in 1995. In the case of computers, the total production is likely to grow from the present Rs. 700 crores to Rs. 1895 crores in 1992 and Rs. 3432 crores in 1995 (Elcina, 1989).

The exports from this sub-sector have been comparatively low (table 21). In 1989 while computers and computer software exports reached a figure of Rs. 400 crores, exports of industrial electronics rose to a modest amount of Rs. 86 crores only (DOE, 1990) which was slightly better than Rs. 57 crores worth of exports of consumer electronics. Market potential for the export of computer and computer peripherals is vast particularly in countries of the developing world which appear to have remained ignored by the industry so far. FICCI envisages computer software to become a major growth area. By 1995 the world market is estimated to grow to about Rs. 600,000 crores. Although the projected exports from this group are put at Rs. 2000 crores in 1995 i.e. were 0.33% of the total market. There

Table 21. Exort of Professional Electronics

(Rs. crores)

| Year | Value of Export | % Growth | % share in Elec. Exports | % share in Prodn (Profess. Electronics) | % share in total Elec. Prodn. |
|---|---|---|---|---|---|
| 1985 | 92.5 | - | 59.9 | 8.1 | 3.5 |
| 1986 | 158.3 | 71.0 | 66.0 | 10.3 | 4.6 |
| 1987 | 185.7 | 17.3 | 59.5 | 8.9 | 3.9 |
| 1988 | 299.3 | 61.4 | 63.0 | 11.0 | 4.7 |
| 1989 | 489.0 | 62.4 | 63.1 | 12.7 | 5.9 |

Source : DOE Annual Reports (for basic data)

is, hopefully, future scope for doubling the exports of computer software. It will require the industry to put all its strength together as the competition in the area is also growing fast.

India's computer market is currently estimated at Rs. 1000 crores per year. By 1995 it is expected to rise to the level of Rs. 4,800 crores and Rs. 23,000 crores by the end of the century. As against this the world market in computers is currently put at 230 billion dollars and is estimated to grow to 500 billion dollars by 1995. There is, therefore, ample scope for a long term plan for exports in this sector.

**Future of Electronics Industry**

It is evident that the domestic electronics industry has still a long way to go to establish its image as a dependable, quality conscious industry both in the domestic and world markets. India has been, no doubt, a late starter in the area of electronics. It will, therefore, have to work harder and smarter to catch up with the nations which have already taken a big lead. The world trade in electronics is estimated to be around 500 billion dollars today. India's share in this market is no more than a fraction. If, therefore, India with its vast resources wishes to make a mark in the electronics arena it will have to cover a vast ground in order to meet the challenge it faces. Competition is and will continue to be intense but not beyond our capability to meet provided we plan our strategies carefully and follow them with determination, vision and the will to succeed.

The areas where we are still way behind and need to do a lot more are those of Micro-electronics, Opto-electronics, Information Storage and Electronic Ceramics etc. It may not be easy to dislodge the leader countries already well established in this field but without reaching the front line, we may also for ever remain a second class electronics nation. Only nations with adequate knowledge base in the advanced technologies are likely to forge ahead and stay in the forefront in this information age. The electronics markets are expanding at a breakneck speed and are expected to continue doing so for a long time to come. New products and new areas of application are being introduced in rapid succession. New technologies are being developed in all areas of electronics. It is reported that a Korean electronic company has produced a 16 megabit semi-conductor chips-the only third world nation to do so. Unless we keep pace with these developments we may continue in the followers role, never perhaps attaining the leadership.

During the 7th plan period, the targets largely remained unrealised, production being about 76% of the target in 1989-90. The projections for the future as table 22 shows are fairly ambitious but as compared to world electronics, our contribution to the world production by the end of the century is expected to reach about 5%. Currently (1989) the share of various countries in the World Electronics market is-USA 43% EEC countries 29%, Japan 18%, Korea 2% and others 8% (Korea Trade & Business, 1988). It will therefore be a remarkable achievement for India, if we can secure a 5% share in the World market. However, it appears that these demand projections may be realized only to the extent of about 50 to 60% by the year 1990. Unless therefore, concerted efforts both by the industry and the Governemnt are directed to achieve full expansion and modernisation of the existing units and/ or large capacities are created to achieve economies of scale and R&D efforts are co-ordinated between research institutes and the industry, the chances of achieving even these modest targets are remote. There is however one silver lining, Asian economic giants-Korea and Taiwan-are said to be facing economic decline due to reverses on the export front largely because of the tough attitude adopted by the US their major market. This may give an opportunity for India to make an entry into the US market by building contacts with top US firms. US market for electronics is the largest in the world and is growing at an averroge rate of 15% per annum in real terms.

Recently, liberalization of excise and import duties, improved duty drawback, other incentives and facilities should encourage the industry to move ahead confidently to achieve the growth rate envisaged in the projections shown in table 22. To dislodge the well entrenched Asian giants-Taiwan, Hongkong and Singapore will be by no means easy, but with co-ordinated efforts, India too can take its place amongst the front rank producers of electronic goods. A holistic approach to all aspects of the industry is needed, as partial and half hearted measures are unlikely to bring forth any worthwhile results.

Some of the possible measures which the domestic industry can adopt with advantage are :

(i) Install a system of productivity aduit so as to indentify those areas where productivity improvement efforts need to be concentrated to bring out costs at

Table 22. Anticipated Growth of Electronics

(Rs. Crores)

| Year | World Electronics | Indian Electronics | % Share |
|---|---|---|---|
| 1990 | 800,000 | 11,000 | 1.37 |
| 1995 | 1250,000 | 35,000 | 2.80 |
| 2000 | 1800,000 | 100,000 | 5.50 |

Source : Jiwarajka S.R. 1988.

par with international prices. At present prices of Indian electronic products are quite high, for example, a floppy disk drive costing approximately Rs. 875 in international market costs around Rs. 1700 in India.

(ii) Modernize and expand capacities to make itself competitive by ensuring economies of scale in respect of vital components. Currently scales of operations are said to be 5-10 times smaller than typical operations elsewhere in the world market.

(iii) Jointly sponsor R&D programmes in co-ordination with research institutes in such areas as micro-electronics, electronic ceramics etc.

(iv) Locate suitable collaborations for joint ventures in these areas where latest technologies are needed.

(v) Canalise investments in the priority areas, with a conspicuous approach for an accelerated growth of the component sector.

(vi) Encourage standardization of components to prevent multiplicity and overlapping of technologies and to ensure better changeability and maintenance of equipment.

(viii) Revitalize Electronic Export Processing Zones (EPZ) to improve their contribution to overall exports.

Besides these, Govt. policies in relation to electronic production and exports need to be kept under constant review so that these can be modified appropriately to suit the fast changing conditions in the world of electronics. Only joint efforts by the industry and the government are likely to lead to the kind of bright future, the electronic industry looks forward to. By the end of the Eighth Plan government anticipates its electronics sector would have turned into the largest in the country, bigger, even than the automobile and steel sectors.

The potential for employment growth in the electronics sector is also quite high. If the industry can grow at the anticipated rate (27% compound), it is estimated 9 lakh additional jobs will be generated.

**Conclusions**

Despite its growth at an average rate of 30-35 percent annually, Indian Electronics Industry has still a lot of ground to cover. It has great potentiality and can make substantial contribution to the country's economy. Although the industry started operations as far back as 1950, its importance as a strategic segment took sometime to register. By 1970 it began to be realized that the electronic industry has tremendous potential and its impact could be far reaching. Currently, there are 350 organized private sector units, 69 public sector units and about 2000 small scale units. The industry provides employment to a large number of people, both directly and indirectly. Total investment in the industry is estimated at Rs. 1600 crores or so.

Despite the high growth it has witnessed in the recent past, its capacity utilization is still abysmally low, in some cases going as low as 20 percent or less. The reasons for such poor performance are many, but the principal one is low volume production capacities spread over a large number of small units. Outdated technology is another contributory factor. The investments go into only those products which hold god prospects for quick and easy returns. However, the overall financial performance of the industry remains fairly satisfactory, being somewhat better in the private sector for obvious reasons.

On the productivity front the picture is equally dismal in the units belonging to both the sectors. It appears there is little organized effort for productivity improvement within the industry despite its importance being stressed from all quarters. Of the 22 units taken as sample for working out the prouctivity profile of the electronics industry there are hardly five or six units whose total productivity could be regarded as satisfactory. Employee productivity in electronics industry, like most other industries, shows a poor and downward trend, which is acknowledged by the industry also. One area where productivity seems to remain consistently poor is the Wages/Salaries as a percentage to Sales. Considering that employee productivity is also low, the need for improving this important 'peoples' productivity indicator becomes all the more important. There is, no doubt, that productivity imporvement must receive industry's immediate attention or else its potentiality as a sunrise industry will be seriously hampered.

The export of electronics products shows an upward trend, having increased several folds during the last two decades. However compared with total world trade of $ 500 billion, India stands nowhere. Starting almost at the same time even small nations like Taiwan, Singapore & Hongkong have gone far ahead. The primary reason for our failure to secure a reasonable share of world trade is our inability to compete in both price & quality. Besides, the enterpreneurs' preferance for quick profits by concentrating on the burgeoning domestic market, leaves little scope for the indsutry to direct sufficient energy to the task of building electronic exports. No doubt, recovering the lost ground will not be easy, the initiative having already

slipped out of our fingers, but to reach its full potential, there is no easy option available to the industry. The alternative of being dubbed as a second rate nation in the field of electronics is somehow too unpalatable.

The most disquieting aspect of our export efforts is the fact that the import content of the exported products is disproportionately high. In addition, the industry is heavily dependent on imported technologies, and raw materials. While the smaller nations which have forged ahead in the field of electronics have been systematically applying themselves to reduce their dependence on imports, reverse seems to be the case with our electronics industry. Even most of the EP units which have in any case become mere assembly units, now ironically have become avenues of foreign exchange outflow. It seems drastic policy changes and a total reversal of attitudes within the industry will be necessary to create favourable conditions for improving exports and reducing imports.

The future development of the electronics industry is undoubtedly linked to a number of factors, the major one's being (i) the creation of a strong component base, (ii) building of a dependable and exclusive electronics R & D, (iii) choosing foreign collaborations with circumspection and (iv) directing fresh investments in the industry to more critical & strategic areas. Last but not the least, the industry must go about the task of productivity improvement individually and collectively in all earnestness or else even its survival may get jeopardized.

## REFERENCES


**Banerji, Subrata,** 'FTZ', Journal of Indian Institute of Foreign Trade, April-June 1989.

**Bhatia, Snehlata et al,** 'Chasing a Shadow', Economic Times, Export Survey of Electronic Hardware, June 1989.

**Business Standard**, 'Dilemna over EPZ functioning', April 1990.

**Business Standard**, 'India 89, Mega Ambitions', 1990

**Centre for Monitoring Indian Ecnomy**, Electronic Production 1981-1988, April 1990.

**Centre for Monitoring Indian Economy,** Key Financial Data on Large Business Units, Nov. 1989 & May 1990 Volumes.

**Centre for Monitoring Indian Economy**, Production and Capacity utilization in 600 Industries, 1970-1980.

**Centre for Monitoring Indian Economy**, Trends in Company Finances: Industry Aggregate, Jan. 1989.

**Confederation of Engineering Industry**, Handbook of Statictics, 1988

**Elcina News**, 'Status of the Electronic Industry' July 31, 1989.

**Electrical India**, Vol. XXVIII, no. 23, Progress Programme of Deptt. of Electronics, 1987-88m 15th Dec., 1988.

**Electronic Component Industries Association**, Indian Electronic Directory, 1989.

**Electronics Information and Planning** An Overview of the Electronics Industry in India, June 1988

**Ex-Imp Times**, New Delhi, May 22, 1988

**'Facts for you', Electronic Industry**, Foreign Exchange Regulations, May 1990.

**Federation of Indian Chambers of Commerce & Industry**, New Delhi, Agenda Paper for 2nd Meeting of Industry Sub-Computer, Sept, 1989.

**Financial Express**, 'Importance of SSIs in national economy-II' 14th April 1990.

**Govt. of India, Ministry of Commerce**, Answer to Q. no. 242,a answered in Rajya Sabha or 29.3.90.

**Govt. of India, Ministry of Commerce**, Answer to Q. no. 3860 answered in Lok Sabha, on April 6, 1990.

**Govt. of India, Ministry of Commerce**, Answer to Q. no. 2120 answered in Rajya Sabha, on 29.3.90.

**Govt. of India, Ministry of Commerce**, Answer to Q. n. 9502 answered in Lok Sabha on 18.5.90.

**Govt. of India, Ministry of Industry**, Deptt. of Industrial Development, New Delhi, Report 1989-90.

**Govt. of India, Ministry of Commerce**, Rajya Sabha, Unstarred Q. no. 882, answered on 2nd Aug., 1988.

**Gupta, V.K.** 'Developing Indian Component Industry - A prescription', Infotel, July-March, 1990.

**IEEMA Journal** "Leema Prouduction Statistics", June 1989.

**IME**, Department of Commerce, USA, Market Assessment-Electronics, March, 1989.

**Jiwrajka, S.R.,** Report, presented to the Task Force on Electronic Components, 'Electronics by the year 2000'. 1990.

**Joseph, K.J.,** 'Growth Performance of Indian Electronics Under Liberalization', Economic & Political Weekly, April 19, 1989.

**Kalra, Rajesh,** 'The great Indian PC hoax', Times of India July 24, 1990.

**Kalra, Rajesh,** 'SCL Awaits sanction to come alive again', Times of India, May 24, 1990.

**Khatkhate, Deena,** 'Failure on Export Front', Times of India, May 26, 1990.

**Korea Business & Trade**, Nov. 1988

**Lahiri, Shymal**, 'Frontiers in Electronic's, Financial Express, 14th April 1990.

**Market Research Department**, Note on Status of Electronic Indstry in India

**Minocha, Naresh**, 'The Chips are down', Business Standard, Annual 1990.

**Patriot**, 'Export Processing Zones, Functioning Criticized', 19th Aug., 1989.

**PTI** Economic Service, Electronics, Nov 1, 1989.

**PTI** Economic Service, Electronics, Feb. 1, 1990.

**PTI** Corporate Trends, Industry Report Jan. 10, 1990.

**PTI** Corporate Trends, Special Report, Dec., 25, 1989.

**Srinivasan, R,** 'ET X T's benefactor is its worst enemy', Times of India, March 25th, 1990.

**Statesman,** 'Six Export Zones show good growth', 15th Aug., 1989.

**Suresh, N,**' India makes Supercomputer', Times of India, August 17, 1990.

**Telematics India**, New Delhi July, 1989, "Focus/Overview".

**Times 1000**, 1988-89, The Worlds Top Companies, 1988, Times Books, London.

**Times of India,** 'Electronic Production". 23rd May 1990.

**Times of India**, 'Marked Rise in Electronic goods Export' Aug. 13, 1990.

**Times of India**, New Delhi 'Samsung joins big-chip club', Aug 17, 1990.

**Times of India**, 'India, makes Super Computer Phototype', Aug. 17, 1990.

**Tiwari, N.D.,** Address by Minister for Industry Annual General Meeting, ACMA, IRTDA News letter, July 1988.

**Tradelinks**, Directory of Singapore Manufactures Association, Singapore.

## ABBRIEVATIONS

| | |
|---|---|
| BEL | Bharat Electronics Ltd. |
| BPL | BPL Systems & Projects Ltd. |
| CAG | Comptroller and Auditor General of India. |
| CEI | Confederation of Engineering Industry. |
| CMC | CMC Limited. |
| CMIE | Centre for Monitoring Indian Economy |
| DOE | Department of Electronics |
| ECIL | Electronic Corporation of India Limited |
| ELCINA | Electronic Component Industries Association |
| EPZ | Export Promotion Zone |
| ETNT | Electronic Trade & Technology Development Corporation |
| FTZ | Free Trade Zone |
| HCL | Hindustan Computers Limited. |
| HMV | Gramophone Company of India Ltd. |
| IC | Integrated Circuits |
| ICIM | International Computers Indian Manufacturers Ltd. |
| IDM | International Data Management Ltd. |
| O/E/N | O/E/N India Ltd. |
| NELCO | National Radio & Electronic Co. Ltd. |
| PIECO | Pieco Electronic & Electricals Ltd. |
| PSI | PSI Data Systems Ltd. |
| PTI | Press Trust of India |
| SCL | Semi Conductors Ltd. |

□

**Appendix I**

Ratio of Total Earnings to Conversion Cost

| Unit | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 |
|---|---|---|---|---|---|---|
| HMV@ | 0.75 | 0.71 | 0.64 | 0.57 | 0.63 | - |
| ICIM | 1.30 | 1.20 (15 m) | 1.09 | 1.19 | - | 0.96 (15 m) |
| NELCO | 1.20 | 0.85 (18 m) | 1.3 | 1.2 | 1.5 | - |
| PIECO | 1.12 | 1.09 | 1.03 | 1.13 | 0.47 (15 m) | |
| PSI | 0.26 | 0.51 | 0.30 (15 m) | - | 0.11 (18 m) | 0.009* |
| SAMTEL | 0.49 | 1.60 (17 m) | 2.07 | 2.02 | - | 1.60 (15 m) |
| USHA | 1.25 | 1.35 | 0.52 | 1.14 | 1.30 | - |
| WESTON@ | 0.51 | 1.43 (10 m) | 1.04 | 1.03 | 1.56 (14 m) | - |
| ECIL | 1.15 | 1.00 | 1.20 | 1.26 | 1.08 | 0.91 |
| TATA UNISYS | 1.49 | 1.06 | 1.22 | 1.02 | - | 1.22 |
| SEMI CONDUCTOR | 0.58 | -0.12 | 0.55 | 0.50 | 0.61 | - |
| BEL | 1.27 | 1.40 | 1.27 | 1.09 | 0.84 | 1.85 |
| CMC | 1.13 | 1.10 | 1.03 | 1.03 | 1.08 | 1.05 |
| HCL | - | - | - | 1.49 | 1.30 (13 m) | 1.55 |
| HIND RECTIFIER | 1.15 | 1.11 | 1.33 | 1.16 | 1.08 | 1.25 |
| IDM | - | 1.20 | 1.30 | 1.16 | 1.16 (16 m) | 0.58 |
| ESSEN | - | 4.50 | 2.40 | 2.50 | 3.30 (11 m) | - |
| O/E/N | 0.77 | 0.77 | 0.76 | 0.92 | 0.99 | - |
| ITI | 1.37 | 1.34 | 1.47 | 1.35 | - | 1.07 |
| WIPRO | 1.14 | 1.19 | 1.56 | 1.16 | 1.14 | - |
| HINDUSTAN TELEPRINTERS | 1.18 | 1.18 | 1.21 | 0.33 | 1.09 | 1.77 |
| BPL | 1.50 | 1.70 | 2.10 | 1.40 | 1.20 | - |

@ The figure pertain to the years 1983-87

* Pre-audit figures

m : months

Source : 1. Annual Reports of Companies
2. CMIE-May 1990 & Nov. 1989

## Appendix 2

Ratio of Purchased Services to Total Earnings

| Unit | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 |
|---|---|---|---|---|---|---|
| HMV@ | 0.78 | 0.77 | 0.82 | 0.87 | 0.89 | - |
| ICIM | 0.41 | 0.47 (15 m) | 0.53 | - | 0.65 | 0.53 |
| NELCO | 0.49 | 0.67 (18 m) | 0.42 | 0.50 | 0.41 | - |
| PIECO | 0.40 | 0.48 | 0.51 | 0.89 | - | 1.09 (15 m) |
| PSI | 2.12 | 1.16 | 2.02 (15 m) | - | -5.50 (18 m) | 65.50* |
| SAMTEL | 0.93 | 0.34 (17 m) | 0.30 | 0.30 | - | 0.40 (15 m) |
| USHA | 0.46 | 0.40 | 0.91 | 0.44 | 0.43 | - |
| WESTON@ | 1.48 | 0.44 (10 m) | 0.58 | 0.65 | 0.42 (14 m) | - |
| ECIL | 0.30 | 0.38 | 0.32 | 0.39 | 0.41 | 0.43 |
| TATA UNISYS | 0.52 | 0.64 | 0.59 | 0.66 | - | 0.59 (15m) |
| SEMI CONDUCTOR | 0.69 | -0.35 | 0.78 | 0.50 | 0.46 | - |
| BEL | 0.20 | 0.17 | 0.20 | 0.28 | 0.35 | 0.25 |
| CMC | 0.50 | 0.55 | 0.80 | 0.64 | 0.46 | 0.50 |
| HCL | - | - | - | 0.43 | 0.48 (13m) | 0.36 |
| HIND RECTIFIER | 0.31 | 0.33 | 0.27 | 0.32 | 0.34 | 0.28 |
| IDM | - | 0.52 | 0.48 | 0.58 | 0.55 (16 m) | 1.16 |
| ESSEN | - | 0.16 | 0.25 | 0.22 | 0.23 (11 m) | - |
| O/E/N | 0.78 | 0.74 | 0.81 | 0.65 | 0.64 | - |
| ITI | 0.19 | 0.20 | 0.17 | 0.25 | - | 0.33 |
| WIPRO | 0.58 | 0.59 | 0.60 | 0.63 | 0.66 | - |
| HINDUSTAN TELEPRINTERS | 0.09 | 0.09 | 0.09 | 0.36 | 0.09 | 0.06 |
| BPL | 0.39 | 0.36 | 0.31 | 0.46 | 0.55 | - |

@ The Figures for the Years 1983-1987

* Pre-audit figures

m : months

Source: Annual Reports of Companies
CMIE-May 1990 & Nov. 1989

## Appendix 3

Ratio of Profit to Conversion Cost

| Unit | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 |
|---|---|---|---|---|---|---|
| HMV | (0.44) | (0.28) | (0.400) | (0.54) | (0.20) | - |
| ICIM | 0.07 | 0.07 (15 m) | 0.070 | 0.02 | - | (0.21) (15 m) |
| NELCO | 0.09 | 0.12 | 0.020 | 0.04 | 0.05 | - |
| PIECO | 0.06 | 0.03 | (0.005) | 0.02 | - | (0.10) (15 m) |
| PSI | 0.18 | 0.25 | 0.090(15 m) | - | 1.28 (18 m) | 2.00* |
| SAMTEL | 0.17 | 0.49 (17 m) | 0.520 | 0.47 | - | 0.43 (15 m) |
| USHA | 0.52 | 0.29 | 0.220 | 0.05 | 0.97 | - |
| WESTON@ | 0.09 | 0.08 | 0.100 | 0.09 | 0.09 | - |
| ECIL | 0.01 | 0.06 | 0.170 | 0.07 | 0.09 | 0.002 |
| TATA UNISYS | 0.26 | 0.20 | 0.130 | 0.04 | - | 0.08 (15 m) |
| SEMI CONDICTORS | 0.04 | (0.70) | (0.380) | (0.37) | 0.006 | - |
| BEL | 0.21 | 0.18 | 0.170 | 0.18 | 0.17 | 0.16 |
| CMC | 0.06 | 0.04 | 0.020 | 0.04 | 0.04 | 0.01 |
| HCL | - | - | - | 0.32 | 0.26 (13 m) | 0.28 |
| HIND RECTIFIER | 0.08 | (0.04) | (0.030) | 0.008 | (0.008) | 0.14 |
| IDM | - | 0.14 | 0.200 | 0.13 | (0.004) (16 m) | 0.63 |
| ESSEN | - | 1.93 | 0.420 | 0.40 | 0.82 (11 m) | - |
| O/E/N | 0.05 | 0.14 | 0.140 | 0.31 | 0.34 | - |
| ITI | 0.13 | 0.09 | 0.150 | 0.08 | - | 0.10 |
| WIPRO | 0.14 | 0.19 | 0.160 | 0.16 | 0.14 | - |
| HINDUSTAN TELEPRINTERS | 0.08 | 0.11 | 0.120 | 0.19 | 0.13 | 0.11 |
| BPL | 0.23 | 0.31 | 0.560 | 0.19 | 0.04 | - |

@ The figures are for the years 1983-1987

* Pre-audit figures

m : months

Figures in brackets are negative

Source: Annual Reports of Companies
CMIE May 1990 & Nov. 1989.

## Appendix 4

Percentage of Profit to Sales

| Unit | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 |
|---|---|---|---|---|---|---|
| HMV@ | (36.90) | (23.40) | (31.10) | (50.50) | (20.20) | - |
| ICIM | 3.70 | 3.70 (15 m) | 3.30 | 1.10 | - | (13.80) (15 m) |
| NELCO | 2.80 | (3.50) | 0.58 | 1.00 | 1.01 | - |
| PIECO | 2.10 | 1.20 | (0.18) | 0.77 | - | (4.40) (15 m) |
| PSI | 9.10 | 10.30 | 4.40 (15 m) | - | (134.60) (18 m) | (815.40) * |
| SAMTEL | 4.30 | 7.30 (17 m) | 7.50 | 6.20 | - | 5.40 (15 m) |
| USHA | 11.70 | 9.30 | 5.70 | 1.05 | 0.20 | - |
| WESTON@ | 2.60 | 0.69 | 0.80 | 1.14 | 1.20 | - |
| ECIL | 0.39 | 2.80 | 6.20 | 2.60 | 3.40 | 0.11 |
| TATA UNISYS | 14.90 | 17.80 | 10.60 | 3.30 | - | 5.80 (15 m) |
| SEMI CONDUCTOR | 2.30 | (51.00) | (22.60) | (28.30) | 0.42 | - |
| BEL | 9.90 | 8.10 | 7.60 | 7.40 | 7.50 | 6.00 |
| CMC | 4.20 | 2.50 | 2.00 | 1.60 | 1.80 | 0.47 |
| HCL | - | - | - | 9.90 | 8.20 (13 m) | 6.00 |
| HIND RECTIFIER | 2.90 | (1.50) | (0.90) | 0.29 | (0.37) | 0.54 |
| IDM | - | 5.70 | 7.90 | 5.70 | 0.20 (16 m) | (47.30) |
| ESSEN | - | 15.50 | 6.50 | 5.00 | 9.30 (11 m) | - |
| O/E/N | 2.18 | 8.40 | 3.60 | 11.60 | 12.80 | - |
| ITI | 6.50 | 4.20 | 0.20 | 3.30 | - | 4.40 |
| WIPRO | 0.60 | 7.40 | 5.50 | 5.30 | 4.70 | - |
| HINDUSTAN TELEPRINTERS | 5.10 | 7.00 | 5.40 | 9.60 | 5.20 | 3.00 |
| BPL | 6.60 | 7.40 | 9.30 | 4.50 | 1.00 | - |

@The figures are for the years 1983-1987

* Pre-audit figures

m : months

Figures in brackets are negative

Source : 1. Annual Reports of Companies
2. CMIE - May 1990 & Nov. 1989.

## Appendix 5

Value Added per Employee (Rs. Lacs)

| Unit | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 |
|---|---|---|---|---|---|---|
| PIECO | 0.600 | 0.600 | 0.630 | 0.800 | 0.920 | - |
| ECIL | 0.290 | 0.363 | 0.498 | 0.533 | 0.595 | 0.64 |
| TATA UNISYS | 0.973 | 0.896 | 0.960 | 0.780 | - | 1.43(15m) |
| SEMI CONDUCTORS | 0.119 | (0.530) | (0.124) | (0.090) | 0.271 | - |
| BEL | 0.436 | 0.486 | 0.525 | 0.613 | 0.656 | 0.80 |
| CMC | 0.540 | 0.520 | 0.550 | 0.630 | 0.830 | 0.85 |
| O/E/N | 0.300 | 0.410 | 0.470 | 0.660 | 0.570 | - |
| ITI | 0.318 | 0.330 | 0.432 | 0.406 | 0.556 | - |
| WIPRO | 0.790 | 0.750 | 0.930 | 1.080 | 1.030 | - |

Note : Figures in brackets are negative.
m = months
Source 1. Annual Reports of Companies
2. CMIE - May 1990 & Nov. 1989.

## Appendix 6

Sales per Employee (Rs. Lacs)

| Unit | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 |
|---|---|---|---|---|---|---|
| PIECO | 2.370 | 2.690 | 3.330 | 4.030 | - | 4.49 |
| PSI | 1.500 | 2.300 | 2.50 (15m) | - | 1.700 (18m) | 0.38* |
| ECIL | 0.896 | 1.018 | 1.524 | 2.002 | 2.149 | 2.47 |
| TATA UNISYS | 3.070 | 1.740 | 2.270 | 2.560 | - | 4.61 (15m) |
| SEMI CONDUCTOR | 1.020 | 1.510 | 1.600 | 1.220 | 1.280 | - |
| BEL | 0.832 | 0.984 | 1.145 | 1.521 | 1.771 | 2.42 |
| CMC | 1.570 | 2.030 | 3.130 | 3.960 | 4.240 | 5.43 |
| O/E/N | 0.840 | 0.940 | 1.070 | 1.250 | 1.770 | - |
| ITI | 0.790 | 0.950 | 1.380 | 1.570 | 1.930 | - |
| WIPRO | 2.200 | 3.200 | 5.000 | 5.300 | 5.200 | - |
| HINDUSTAN TELEPRINTERS | 0.540 | 0.580 | 0.920 | 0.940 | 1.350 | 1.76 |
| BPL | 3.170 | 4.330 | 5.740 | 5.310 | 7.740 | - |

Note : *Pre-audit figure
m = months
Source 1. Annual Reports of Companies
2. CMIE-May 1990 & Nov. 1989.

**Appendix 7**

Profit per Employee (Rs. Lacs)

| Unit | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 |
|---|---|---|---|---|---|---|
| PIECO | 0.05 | 0.03 | (0.006) | 0.03 | - | (0.20) (15 m) |
| PSI | 0.13 | 0.24 | 0.11 (15m) | - | (2.36) (18m) | (3.06)* |
| ECIL | 0.003 | 0.028 | 0.095 | 0.051 | 0.072 | 0.022 |
| TATA UNISYS | 0.46 | 0.31 | 0.24 | 0.085 | - | 0.266 (15m) |
| SEMI CONDUCTORS | 0.024 | (0.77) | (0.36) | (0.35) | 0.005 | - |
| BEL | 0.082 | 0.079 | 0.057 | 0.112 | 0.132 | 0.146 |
| CMC | 0.065 | 0.050 | 0.063 | 0.065 | 0.075 | 0.025 |
| O/E/N | 0.02 | 0.08 | 0.04 | 0.15 | 0.23 | - |
| ITI | 0.05 | 0.04 | 0.09 | 0.05 | 0.03 | - |
| WIPRO | 0.14 | 0.23 | 0.28 | 0.28 | 0.25 | - |
| HINDUSTAN TELEPRINTERS | 0.02 | 0.04 | 0.05 | 0.09 | 0.07 | 0.05 |
| BPL | 0.21 | 0.32 | 0.53 | 0.24 | 0.08 | - |

Note : *Pre-Audit figure.
m = months

Source: 1. Annual Reports of Companies
2. CMIC - May 1989 & Nov. 1989.

**Appndix 8**

Percentage of Wages/Salaries to Sales

| Unit | 1984 | 1985 | | 1986 | 19870 | 1988 | | 1989 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| HMV@ | 34.3 | 35.4 | | 34.2 | 42.80 | 40.80 | | - | | @ The figure are for the years 1983-1987 |
| ICIM | 18.7 | 18.5 | (15 m) | 15.7 | 15.40 | - | | 20.3 | (15 m) | |
| NELCO | 12.2 | 12.1 | (18 m) | 10.8 | 9.40 | 7.60 | | - | | |
| PIECO | 16.3 | 14.5 | | 13.7 | 13.30 | - | | 17.3 | (15 m) | |
| PSI | 20.3 | 15.8 | | 17.9 | - | 36.50 | (18 m) | 109.6 * | | |
| SAMTEL | 3.8 | 2.4 | (17 m) | 2.2 | 2.40 | - | | 2.5 | (15 m) | * Pre-audit figures |
| USHA | 15.6 | 12.0 | | 10.6 | 4.60 | 2.90 | | - | | |
| WESTON@ | 3.6 | 2.8 | | 2.9 | 3.80 | 3.90 | | - | | |
| ECIL | 25.6 | 26.9 | | 20.2 | 17.26 | 18.10 | | 21.3 | | |
| TATA UNISYS | 11.3 | 24.7 | | 19.8 | 21.30 | - | | 17.2 | (15 m) | m : months |
| SEMI CONDUCTORS | 8.3 | 14.8 | | 12.5 | 18.20 | 17.80 | | - | | |
| BEL | 29.9 | 28.6 | | 27.4 | 23.10 | 22.30 | | 20.1 | | |
| CMC | 25.1 | 19.0 | | 14.2 | 12.70 | 15.20 | | 13.1 | | |
| HCL | - | - | | - | 9.40 | 11.70 | (13 m) | 8.8 | | |
| HIND RECTIFIER | 23.1 | 22.6 | | 20.8 | 22.00 | 29.50 | | 24.7 | | |
| IDM | - | 13.6 | | 13.3 | 12.50 | 16.70 | (16 m) | 20.6 | | |
| ESSEN | - | 1.6 | | 3.9 | 5.20 | 3.30 | (11 m) | - | | |
| O/E/N | 23.0 | 24.6 | | 23.5 | 21.90 | 21.20 | | - | | |
| ITI | 32.5 | 28.6 | | 22.2 | 21.20 | - | | 22.5 | | |
| WIPRO | 6.6 | 7.4 | | 5.5 | 5.30 | 4.70 | | - | | |
| HINDUSTAN TELEPRINTERS | 5.1 | 7.0 | | 5.4 | 9.60 | 5.20 | | 8.0 | | |
| BPL | 8.2 | 5.5 | | 4.1 | 6.70 | 6.20 | | - | | |

source : 1. Annual Reports of Companies
2. CMIE-May 1990 & Nov. 1989.

# Total Factor Productivity in the Indian Economy During 1950-51 - 1987-88

NPC Research Section

In an earlier study, we arrrived at capital and labour productivity ratios and their corresponding indices (base 1980-81) for the various broad sectors of the Indian economy. (Productivity Vol. 31, Nol 1 April-June 1990)[1]. In the present study, the effort is to arrive at the total productivity indices for all the sectors excluding services like Banking and Insurance, Real Estate and Business services. The services sector has been excluded because of the fact that the value added in these sectors has been contributed largely by the labour alone and hence is measured by the wages and salaries paid.

In arriving at these total productivity indices, we have used the method of Arithmetic Index or the Kendrick index. The Index of Total Factor productivity according to this method is given by a weighted combination of labour and capital productivity indices, the weights being the respective factor shares in the net output during the base year.

$$TFPI_t = WoLPI_t + (1\text{-}Wo)\ KPI_t$$

where

$TFPI_t$ = Total Factor Productivity Index during the yeart t

$LPI_t$ = Labour Productivity Index during the year t

$KPI_t$ = Capital Productivity Index during the year t.

Wo = Share of wages (including the incomes of the self employed) in the base year (1980-81)

The labour and capital productivity indices used here are the same available in our work mentioned earlier (Productivity Vol. 31, Nol. 1, April-June, 1990). The shares of wages for the broad sectors and for the total economy are those developed by Brahmananda (1982)[2]. It may be recalled that Brahmananda (1982) had arrived at distribution of factor shares in various sectors for periods 1950-51, 1960-61, 1970-71 and 1980-81. Factor shares used here are for the year 1980-81. We have also assumed that the factor share distribution in 'Agriculture and Allied Activities' will be the same as 'Agriculture (crop prouction and Live Stocks)' in Brahmananda (1982).

[1] Inadvertantly, the capital productivity index for the total economy for the period 1950-51 to 1959-60 had been given erreneously in the article. The corrected figures are : 1950-51 = 61.17, 1951-52 = 61.51, 1952-53 = 62.21, 1953-54 = 65.04, 1954-55 = 66.62, 1955-56 = 67.09, 1956-57 - 69.69, 1957-58 = 67.38, 1958-59 = 71.40, and 1959-60 = 71.56.

[2] Brahmananda P.R., Productivity in the Indian Economy, Himalaya Publishing House, Bombay, 1982.

Table 1. Total Factor Productivity (1980-81=100)

| | 1950-51 | 1951-52 | 1952-53 | 1953-54 | 1954-55 | 1955-56 | 1956-57 | 1957-58 | 1958-59 | 1959-60 |
|---|---|---|---|---|---|---|---|---|---|---|
| Agriclture & Allied Activities | 92.3 | 91.6 | 92.7 | 97.8 | 98.5 | 95.6 | 98.9 | 92.3 | 100.3 | 97.6 |
| Mining & Quarrying | 395.5 | 308.9 | 291.0 | 264.5 | 234.6 | 219.8 | 230.7 | 239.1 | 234.5 | 233.1 |
| Manufacturing | 154.2 | 135.7 | 126.2 | 124.0 | 123.0 | 120.1 | 113.1 | 102.4 | 99.9 | 99.2 |
| Electricity, Gas & Water Supply | — | — | — | — | — | — | — | — | — | — |
| Construction | 95.3 | 98.1 | 88.5 | 82.8 | 75.8 | 77.3 | 77.6 | 65.5 | 70.0 | 71.0 |
| Trade & Commerce | 216.0 | 206.5 | 205.8 | 206.0 | 213.3 | 219.0 | 218.4 | 205.6 | 201.4 | 199.4 |
| Transport, Storage & Communication | 76.7 | 76.7 | 75.9 | 76.1 | 76.7 | 77.0 | 78.4 | 77.6 | 77.5 | 78.0 |
| Total* | 102.8 | 100.8 | 100.2 | 103.8 | 104.3 | 102.2 | 103.7 | 96.4 | 100.9 | 99.2 |

Excluding Real Estate, Finance and Business Services, Public Administration Defence and other service.

| | 1960-61 | 1961-62 | 1962-63 | 1963-64 | 1964-65 | 1965-66 | 1966-67 | 1967-68 | 1968-69 | 1969-70 |
|---|---|---|---|---|---|---|---|---|---|---|
| Agriculture & Allied Activities | 101.9 | 100.6 | 97.0 | 97.9 | 105.4 | 91.6 | 88.7 | 100.9 | 99.0 | 104.0 |
| Mining & Quarrying | 220.8 | 196.7 | 187.9 | 164.6 | 142.2 | 154.8 | 147.6 | 143.8 | 143.6 | 142.8 |
| Manufacturing | 99.3 | 104.1 | 109.8 | 110.9 | 113.0 | 107.1 | 102.0 | 97.5 | 100.0 | 108.3 |
| Electricity, Gas & Supply | 173.8 | 166.7 | 157.1 | 161.9 | 150.1 | 141.6 | 137.3 | 136.8 | 144.2 | 142.5 |
| Construction | 74.6 | – | – | – | – | – | – | – | – | – |
| Trade & Commerce | 211.8 | 213 1 | 204.1 | 198.2 | 198.6 | 179.4 | 175.7 | 168.4 | 166.0 | 163.3 |
| Transport, Storage & Communication | 78.5 | 77.8 | 78.2 | 77.2 | 74.0 | 72.5 | 70.1 | 72.2 | 73.2 | 75.1 |
| Total* | 102.4 | 102.0 | 99.7 | 101.1 | 105.6 | 94.5 | 93.3 | 99.6 | 99.3 | 103.9 |

| | 1970-71 | 1971-72 | 1972-73 | 1973-74 | 1974-75 | 1975-76 | 1976-77 | 1977-78 | 1978-79 | 1979-80 |
|---|---|---|---|---|---|---|---|---|---|---|
| Agriculture & Allied Activities | 110.3 | 105.5 | 97.6 | 102.5 | 98.7 | 109.6 | 100.3 | 108.1 | 107.7 | 90.6 |
| Mining & Quarrying | 128.4 | 124.4 | 126.0 | 119.5 | 119.8 | 124.3 | 112.6 | 103.3 | 99.9 | 93.8 |
| Manufacturing | 108.0 | 107.4 | 106.8 | 107.1 | 105.1 | 100.2 | 105.0 | 106.9 | 114.6 | 105.1 |
| Electricity, Gas & Water Supply | 136.1 | 137.8 | 128.0 | 118.0 | 114.5 | 128.6 | 135.4 | 125.5 | 132.1 | 115.7 |
| Construction | 114.7 | 110.3 | 108.1 | 96.8 | 90.0 | 99.7 | 104.9 | 110.5 | 103.0 | 92.9 |
| Trade & Commerce | 145.1 | 127.2 | 115.6 | 107.9 | 101.9 | 105.2 | 102.7 | 105.2 | 108.8 | 99.8 |
| Transport, Storage & Communication | 74.3 | 73.4 | 76.5 | 76.3 | 83.0 | 88.1 | 92.6 | 90.9 | 94.8 | 96.7 |
| Total* | 106.7 | 103.3 | 98.3 | 100.2 | 97.9 | 104.4 | 100.9 | 106.2 | 108.1 | 95.9 |

| | 1980-81 | 1981-82 | 1982-83 | 1983-84 | 1984-85 | 1985-86 | 1986-87 | 1987-88 |
|---|---|---|---|---|---|---|---|---|
| Agriculture & Allied Activities | 100.0 | 103.1 | 98.8 | 107.4 | 105.0 | 103.1 | 98.6 | 97.8 |
| Mining & Quarrying | 100.0 | 106.8 | 105.6 | 110.7 | 114.5 | 111.5 | 118.4 | 93.8 |
| Manufacturing | 100.0 | 104.5 | 107.9 | 114.5 | 117.8 | 124.6 | 131.9 | 130.6 |
| Electricity Gas & Water Supply | 100.0 | 102.6 | 98.9 | 109.0 | 122.8 | 129.1 | 136.7 | 137.1 |
| Construction | 100.0 | 101.6 | 92.6 | 96.5 | 96.3 | 99.3 | 99.8 | 101.5 |
| Trade & Commerce | 100.0 | 101.8 | 102.3 | 102.9 | 102.4 | 104.9 | 104.5 | 107.3 |
| Transport, Storage & Communication | 100.0 | 107.5 | 113.1 | 118.2 | 123.6 | 134.5 | 138.7 | 136.8 |
| Total* | 100.0 | 103.4 | 101.7 | 108.0 | 106.8 | 109.5 | 111.6 | 108.5 |

* Excluding Real Estate, Finance and Business Services, Public Administration Defence and Other Services.

Compiled by
N.K. Nair
A.K. Burman

# Energy Consumption Trends in Vanaspati Industry 1988-89

NPC Energy Management Division

Vanaspati industry has an installed capacity of 14.8 lakh tonnes with an estimated annual production of 10 lakh tonnes indicating a capacity utilisation level of 68%. Energy accounts for 35% of the manufacturing cost. The industry consumed 3.4 lakh tonnes of coal, 15,000 kl of fuel oil and 4000 lakh kwh estimated at a cost of Rs. 85 crores.

The specific energy consumption indicates variations due to the type of boilers installed, variety of raw oils processed, the type of operation—batch or continuous—heat recovery system employed, operational and maintenance practices etc. As part of the Energy Audit Studies conducted by the NPC at the instance of the Department of Power information was collected from 18 units through a questionnaire. The specific energy consumption was found to vary as in table-I.

Table-I

| Energy Used | Units | Consumption of Vanaspati per ton | Per tonne Average |
|---|---|---|---|
| Coal | tonne | 0.21-0.63 | 0..34 |
| Electricity | kwh | 351-634 | 400.00 |
| Steam | tonne | 0.8-2.9 | 1.50 |

The Energy Audit Studies indicated the salient points which influence the specific energy consumption viz.

**Thermal**

a. Boilers
- Most of the coal fired boilers have operating thermal efficiency in the range of 45-75%
- — Operational and maintenance practices influence the thermal efficiency by 10-15%
- — Economisers add 8-10% thermal efficiency
- — Fluidised Bed Boilers operate at 80% plus thermal efficiency.

b. Condensate Recovery
- — Ranges from 20 to 80%
- — Affected by steam trap selection, operation and maintenance practices of steam traps, by pass line operation etc.
- — Live steam use more with low condensate return.

c. Insulation & Steam Leakages
- — Intermediate oil storage tanks unlagged or inadequately lagged.
- — Steam line Insulation and the severity of steam leakages.

d. Heat Leakages
- — 70% of the units have no heat recovery in autoclaves.
- — No heat recovery in batch deodourisers
- — Low grade heat recovery from deodourised oil.

e. Refining
- — Only 35% of the units employ continuous refining

f. Deodourisation
- — 60% units have Batch, 10% Semi-Continuous and 30% Continuous Deodourisation

**Electrical**

a. Electrolytic Cells
- — Performance of Knowles Cells varies from 4.5 to 6.5 kwh/$m^3$ of Hydrogen.
- — Bipolar electrolysers consume 4.6 kwh/$m^3$ of Hydrogen.

b. Hydrogen Compression
- — Pressure varies from 31 psig to 350 psig at delivery/storage and 10 to 75 psig in autoclaves.

c. Refrigeration System
- — Lowest cold temperature varies from 2° C to 15° C;

d. Pumping System
- — Piping network and matching rated pump discharge with electric motors.

By improving the operational and maintenance practices and by switching to Fluidised Bed Boilers, continuous refining, continuus deodourisation, Bi-polar electrolysers, rationalising Hydrogen compression, Refrigeration systems and pumping systems, it is estimated that 350 lakh kwh of electricity and 89,000 tonnes of coal consumption can be avoided.

Compiled by
V. Raghuraman

# Water Pollution Audit in Soft Drinks Manufacturing Units

**NPC Pollution Control Division**

Soft drink refers to all non-alcoholic carbonated flavoured or sweetened beverages based either on natural fruit pulp or synthetic concentrates. This industry comes under the purview of the Ministry of Food Processing and the units are licensed under F.P.O. (Fruit Products Order). As per the F.P.O. classification, the units are classified on the basis of their licensed annual production capacities as given below :

| | |
|---|---|
| Home & Cottage Scale | < 50 TPA |
| Small Scale | 50-100 TPA |
| Large Scale | > 250 TPA |

The total annual soft drinks production by the Large scale units alone is estimated at 105 million cases or 2520 million bottles. Both the Small and Home & Cottage Scale units together, produce approximately another 300 million cases of soft drinks per year.

As part of the National project on "Preparation of a comprehensive industry document on Food processing industry", National Productivity Council, conducted Water Pollution Audits in six Large Scale soft drink manufacturing units. Of the six units monitored, three units manufacture soft drinks based on synthetic concentrates and the remaining three units manufacture natural fruit pulp based soft drinks.

## Status of Pollution

In the Soft Drinks manufacturing process, industrial wastewater is generated from the following sections :

1. Sugar Syrup preparation section,
2. Beverage preparation section,
3. Bottle filing section and
4. Bottlewashing section.

The wastewater from the first three sections, known as plant room discharges are batch discharges and low volume high BOD conc. in nature. The waste water from the bottle washing section is a continuous discharge and high volume low BOD conc. in nature.

Detailed wastewater survey i.e. flow measurement and composite wastewater sample collection for assessing the quality, was carried out in the plant room and bottle washing sections of all the six units. The measured daily wastewater flow and relevant wastewater characteristics - BOD, COD, and TSS, from the bottlewashing and plant room sections - are given in table I. The specific waste generation factors, i.e., per ton of production in terms of flowrate, Bio-chemical Oxygen Demand, Chemical Oxy-

Table 1: Wastewater Flowrate and Characteristics from Bottlewashing section, Plant room discharge, and combined Wastewater

| Unit No. | Synthetic/ Fruit Based (B-Bottled) | Product Capacity (TPD) | Bottlewashing wastewater | | | | Plant Room Discharge | | | | Combined Wastewater | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Flowarate ($m^3$/day) | BOD mg/1 | COD mg/1 | TSS mg/1 | Flowrate $m^3$/day | BOD mg/l | COD mg/l | TSS mg/l | Flowrate $m^3$/day | BOD mg/l | COD mg/l | TSS mg/l |
| 1. | Synthetic | 45.0 | 170.0 | 313 | 604 | 80 | 42 | 2807 | 8012 | 147 | 212 | 802 | 2072 | 93 |
| 2. | Synthetic | 30.0 | 82.4 | 164 | 318 | 50 | 26 | 3086 | 6952 | 185 | 108 | 863 | 1930 | 83 |
| 3. | Synthetic | 19.0 | 50.0 | 113 | 289 | 38 | 8 | 3941 | 7676 | 312 | 58 | 640 | 1308 | 75 |
| 4. | Fruit Based | 9.0 | 127.0 | 93 | 179 | 32 | 83 | 684 | 1034 | 184 | 210 | 328 | 517 | 92 |
| 5. | Fruit Based | 4.0 | 32.0 | 120 | 213 | 20 | 7 | 2465 | 4319 | 577 | 39 | 541 | 950 | 120 |
| 6. | Fruit Based | 12.0 | 66.0 | 66 | 174 | 35 | 27 | 2045 | 3143 | 531 | 93 | 634 | 1036 | 179 |

Table 2: Computed Specific Waste Generation Factors

| Unit No. | Specific Waste Generation Factors | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Bottlewashing Wastewater | | | | Plant room Discharge | | | | Combined Wastewater | | | |
| | flowrate ($m^3/t$) | BOD (kg/t) | COD (kg/t) | TSS (kg/t) | Flowrate ($m^3/t$) | BOD (kg/t) | COD (kg/t) | TSS (kg/t) | Flowrate ($m^3/t$) | BOD (kg/t) | COD (kg/t) | TSS (kg/t) |
| 1. | 3.8 | 1.2 | 2.3 | 0.3 | 0.9 | 2.6 | 7.5 | 0.1 | 4.7 | 3.8 | 9.8 | 0.4 |
| 2. | 2.7 | 0.5 | 0.9 | 0.1 | 0.9 | 2.8 | 6.3 | 0.2 | 3.6 | 3.1 | 6.9 | 0.3 |
| 3. | 2.6 | 0.3 | 0.7 | 0.1 | 0.4 | 1.6 | 3.2 | 0.1 | 3.0 | 1.9 | 3.9 | 0.2 |
| 4. | 14.2 | 1.3 | 2.5 | 0.5 | 9.3 | 6.4 | 9.6 | 1.7 | 23.6 | 7.7 | 12.2 | 2.2 |
| 5. | 8.2 | 1.0 | 1.8 | 0.2 | 1.8 | 4.4 | 7.8 | 1.0 | 10.0 | 5.4 | 9.5 | 1.2 |
| 6. | 5.5 | 0.4 | 1.0 | 0.2 | 2.3 | 4.6 | 7.1 | 1.2 | 7.8 | 4.9 | 8.0 | 1.4 |

gen Demand and Total Suspended Solids are computed and shown in table 2.

In order to optimise the capital investment and operating costs, the following two different treatment alternatives for achieving an effluent BOD of 30mg/l, have been worked out;

Alternative 1 : Treatment of combined wastewater in a two stage aerobic activated sludge process.

Alternative 2: Two stage aerobic activated sludge process—pretreatment of plant room discharges in the first stage and treatment of wastewater from the bottle washing section along with the pretreated plant room discharge in the second stage.

Table 3. Computed Capital & Operating costs in Rs. Lakhs, of both the Wastewater Treatment alternatives.

| Unit | Alternative 1 | | Alternative 2 | | % Cost reduction for alternative 2 compared to alternative 1 | |
|---|---|---|---|---|---|---|
| | Capital Cost | Annualised Operating Cost | Capital Cost | Annualised Operating Cost | Capital Cost | Operating Cost |
| 1. | 5.6 | 3.60 | 5.0 | 3.4 | 10.7 | 5.0 |
| 2. | 3.9 | 1.85 | 3.4 | 1.7 | 12.8 | 8.0 |
| 3. | 2.7 | 1.10 | 2.4 | 1.0 | 11.1 | 9.0 |
| 4. | 5.2 | 2.20 | 4.6 | 1.9 | 11.5 | 13.5 |
| 5. | 2.3 | 0.90 | 1.9 | 0.8 | 17.4 | 11.0 |
| 6. | 3.5 | 1.60 | 3.0 | 1.4 | 14.3 | 12.5 |

Compiled by
Rajeev Wadhwa &
L. Panneer Selvam

□

municipal finance, and increased resources for municipal waste treatment and disposal operations.

## JUST-IN-TIME SYSTEM: 'INCREASED STRESS'?

Introducing a 'just-in-time' system of working can provide a more challenging role for staff but may also bring with it higher levels of stress than a more traditional production system, according to the results of a recent research by Roger Martin and Paul Jackson of Sheffield University.

Speaking at a British Psychological Society Conference, Jackson presented their findings on 'just-in-time' production in a company which manufactures computer boards, quotes the international journal Personnel Management, (Feb. 1990).

The researchers looked at operators' responses and perceptions about the new system four weeks before its introduction in August 1988 and again in April last year. Three areas were looked into: the level of control over their tasks, the demands placed on them and the challenge of the job.

In a number of areas such as work method control, cost responsibility and task repetition, those surveyed reported little change under the new system, but in terms of demands on them during the production process there was a greater feeling of pressure than for those who still worked on the 'traditional' production line. Those working on the 'JIT' system felt less control over the pacing of their work. However, a 'traffic light' system for the timing of batches rather than a more stop-start method in the previous system gave workers a greater feeling of control in this aspect of their work. 'Just-in-time' brought with it a greater sense of using a variety of skills, and there was a greater breadth of role with workers being asked to do more.

The researchers admitted that changes introduced by the company outside the area of the 'just-in-time' system during the period of their research had an effect on their findings. The somewhat rapid introduction of harmonisation programme had resulted in greater job dissatisfaction among staff working both on the 'just-in-time' and the traditional production line. Workers had expressed concern about the new appraisal systems and other areas of change.

From the company point of view, the introduction of 'just-in-time' production was a success in that it had reduced the board production time considerably and improved the quality. However, 'JIT' made heavy demands on staff and needed a high degree of operator commitment and involvement if it was to work effectively.

At another session, BPS delegates were told that most human resource directors in the financial services sector are now playing a more strategic role but it is still more reactive than proactive. This was one of the conclusions of a study of personnel management in 17 financial institutions carried out by Eileen Cronin of Manchester Business School. Cronin told delegates how extensive change within the world of banking and building societies had led to major changes in corporate strategy. The key for many was improving quality but also cutting costs.

From her interviews with human resource directors, Cronin found that the majority were involved in discussions about strategic planning. This was often a recent development. Some personnel functions were coping well in managing culture change and servicing corporate and business strategies but others were facing severe difficulties. One personnel director reported that he was having great difficulty fulfilling his company's expectations and felt he had to tell them that it would not be possible to find the human resources that they demanded in order to expand.

In answer to the demographic changes, financial institutions were looking more at fixed-term contracts, the use of older workers, mid-career entry and more flexible working, but there was little evidence of any long-term planning. Training and development was seen as a priority by many of those interviewed. As one human resource director said: "It is of crucial strategic importance." However Cronin found that in one of the companies surveyed some managers were having training for the first time in 20 years.

All of the financial institutions surveyed had introduced performance related pay and saw this as an important strategic tool. The introduction of change is much easier for commerical organisations where objectives can be clearly defined and where managers have the power to implement this change than for the 'not-for-profit' sector, including the public sector, charities and some co-operatives, John Beishon of the Consumers' Association told the Conference. But this did not mean that changes could not be made, said Beishon.

He saw three key characteristics of public sector organisations which made them resistant to change. These were isolation from the environment, strong internal cultures and rigidity of structure and staffing.

Beishon believed that the system could be 'destabilised' by changing one of these factors. "For example,

simply banning existing staff from having any role in the recruitment of new staff could be very effective in the middle term in introducing new thinking and experience," he said.

In the public sector more attention was paid to staff protection than in the commercial sector, according to Beishon, and there was no doubt that this was a major obstacle to the introduction of necessary change. "The challenge is to find appropriate ways of balancing the respective interests".

Access to power was also an important issue. "Public interest organisations" had a more complex and distributed power structure than commercial organisations where the power base was usually fairly evident-in most cases from shareholders and their representatives, directors or boards.

The identification of where power resided in the public sector was an important element of any change programme, Beishon told delegates, and where power was diffused widely throughout an organisation, this may prove to be an insurmountable obstacle to the impelmentation of change.

## TRAINING POLICIES AND STRATEGIES

"No longer can the developing countries rely solely on their low labour costs as their main bulwork against competition in the international trade since higher productivity in the industrialised countries often more than offsets their higher unit labour costs. The developing countries are therefore caught between the pull of coping with the technological changes happening around them and the push towards achieving productivity improvements to maintain their competitive position in the market place"; according to the Report of a Regional Workshop on Training Policies and Strategies in the Context of Changing Technology and Productivity Improvements. The Workshop was organised by the Fellowship and Training Programme of the Commonwealth Secretariat in collaboration with the Govt. of India and the National Productivity Council. The Report maintains that human resource development holds the key to diffusion of new technologies and their applications at the plant level leading to productivity improvement. "What is required is a new vision of continued education and training for national resurrection in each Commonwealth country to meet the training and retraining needs of workers, managers, scientists and technologists in a period of dramatic technological changes and the ever increasing and demanding role which the existing training establishments at the national, industry and enterprise level, have to play"; according to the Report.

Major recommendations of the Regional Workshop included :

(1) Corporate Plans at the micro level should contain a section on critical skills required for achieving the objectives of the Plan and methodologies to be adopted for meeting the needs of these critical skills.

(2) Acentral research organisation needs to be strengthened or created, as the case may be, which may regularly study occupational changes and required skills besides the numerical projections of the total numbers. This research institute should maintain a close link between industries, government agencies, educational as well as training institutions and employees' organisations.

(3) The process of transfer of technology should include specific programmes required for training of employees for successful implementation, assimilation and utilisation of technology. At the stage of project formulation man-power training needs should be given due consideration and methodologies for obtaining these training skills, atleast the critical skills which are presently not available, must be thought of as part and parcel of the feasibility report.

(4) Special attention needs to be focussed on developing positive attitude and work culture for achieving productivity growth. Special projects to bring about attitudinal changes may be thought of at the national, industry and organisational levels.

(5) The budgetary allocation for training needs to be substantially increased. To augment the training needs at the national level, creation of a fund for skill development through a cess should be considered.

(6) To motivate employees to act as trainers, it was suggested that trainers should be given special consideration for career development. The workshop also felt that managers should also work as faculty members and co-ordinate training activities of the employees under their jurisdiction.

(7) Government should subsidise training programmes for upgrading the skills of employees in the small scale sector.

(8) International co-operation in the field of training should focus on change agents, catalysts and insti-

tution building to provide a filip to the training activities with in the country.

## INDUSTRIAL ENERGY EFFICIENCY PROJECT - A PROPOSAL

"It is estimated that for achieving the projected demand for coal, oil and power sectors for the period up to 2004-05, an investment of the order of Rs. 4500 billion would be required. This order of resources does not seem to be with in our reach at present. Hence, there is an imperative need for innovative strategies to deal with the situation"; according to a Project Proposal formulated by the National Productivity Council for the Energy Management Centre (EMC). The Proposal adds "Until now, the approach to energy planning has been mainly directed towards augmenting energy supply. However, the time has, perhaps, now come when due attention is also to be paid to curbing wasteful consumption". According to the Proposal, the Inter Ministerial Working Group has estimated that with an investment of Rs. 290 billion, energy savings of the order of Rs. 540 billion could have been achieved in the industrial sector in 1982-83.

Since the first Oil crisis there have been efforts to cut down energy consumption. Some fiscal incentives were offered by the government in the form of tax and duty reliefs, credit facilities for the purchase energy conservation devises etc. The schemes like that by the Industrial Development Bank of India's Energy Audit Subsidy Scheme and the Equipment Finance for Energy Conservation Scheme etc have generated interest. Unfortunately, all these measures have not led to any significant impact on the national energy consumption scene. Industry specific studies indicate reduction in energy intensities in some sectors. It is well accepted that much more needs to be done to bring down energy intensity in the industrial sector of the economy, with the rising energy prices during seventies through mid eighties and with the vast potential for energy conservation, a low key response from the industrial sector is an enigma. Since all energy prices have risen in real terms over this period, there could be other reasons for the poor industrial response, according to the Proposal.

After the first oil crisis, the Fuel Policy Committee (1974) emphasized the role of coal as a major fuel in the country's energy economy. Since coal reserves in India are of inferior grades, the scope for reducing the energy intensity through interfuel substitution in the industry has remained limited. Even otherwise it could have been achieved only by raising coal prices to a level that would have triggered an inflationary spiral. Further, the Indian economy has been constrained in its fuel options by the periodic balance of payment problems and the resources crunch. The scope for promoting energy conservation through pricing policies needs to be viewed in a broader perspective. While there would exist possibilities, their future path would require a careful charting out with reference to the appropriate fuel policies. A long time has elapsed since 1974 and a fresh look at the fuel policy is perhaps necessary. The fuel pricing policies which emerge from such exercises would provide appropriate signals to the industrial sub-sectors with respect to the technologies they should invest in. The energy conservation options would, thus, have to emerge out of the broad fuel options, adds the Proposal.

The Proposal holds that while such policies may take time to shape, there is much that can be done to improve the current pricing policies with respect to gas and electricity. In the pricing of gas the principle of comparative advantage deserves due attention. In the case of petroleum products and electricity it may be necessary to approximate prices to the cost of supply to the users. As far as coal is concerned, it has been observed that the price differentials among various grades of both coking and noncoking coal are such that they encourage application of high grade coals in sectors which do not need it. While energy pricing requires to be reviewed for facilitating appropriate investment choices in the selection of equipment and technology there are a number of non-pricing barriers to conservation such as lack of motivation and awareness, technical, economic, institutional and legislative that need to be taken care of to facilitate adoption of energy conservation practices in the industrial sector.

## SECTORAL ENERGY DEMAND ANALYSIS

The Energy Policy Divison of the Planning Commission had recently arrived at energy demand projections for India upto 2004-05 based on what is called the MEDEE-S Approach. The essential features of this approach are :

(1) Energy demand is directly related to the end use.

(2) The relationship between the end use activity levels and the macro-economic parameters is captured.

(3) The model permits analysis with reference to technological options and fuel-mix choices in major end use activities.

(4) The approach captures structural changes in the economy.

According to the Executive Summary of the Draft Report by the Energy Policy Division, the MEDEE-S approach is based on the dis-aggregation of the total energy demand into relevant end-use categories, indentification of the techno-economic factors that determine the energy demand and building up of alternate scenarios with reference to technical and economic parameters.

According to the 'Base Case' variant of the MEDEE-S Model, the total energy requirements of the economy is likely to double during the period 1986/87-2004-05; from 197 MTOE to 396 MTOE, i.e. at the rate of about 4 percent per annum. The share of commercial energy in total energy consumption will increase from 42.7% in 1986-87 to 74% in 2004-05. The average annual growth of commercial energy consumption will be 7% during this period. The growth rate of commercial energy consumption in household and transport sector worked out to be much larger; 9.9 per cent and 8.2 percent respectively. The demand for electricity from the industrial sector arrived at by the Study was 147 TWH, 200 TWH and 277 TWH during 1994-95, 1999-00 and 2004-05 respectively. The demand for oil products from the same sector will be 8.6 MTOE, 12 MTOE, and 16.8 MTOE respectively for the same years during the same period

There will be an additional demand for 3 MTOE, 4.4 MTOE and 6.2 MTOE of diesel. The demand for coal from the industrial sector has been placed at 108 MT in 1994-95 which is expected to grow to 146 MT in 1999-00 and to 195 MT in 2004-05. The total feedstock demand of the sector is likely to be 8.8 MTOE, 10.2 MTOE and 11.7 MTOE during the years 1994-95, 1999-00 and 2004-05 respectively. The base case scenario incorporated the effect of energy conservation to some extent. However, if the specific energy consumption levels of 1986-87 were to continue, it would result in an additional fossil fuel consumption of 3.6 MTOE and an additional electricity requirement of 14.0 TWH in 2004-05, according to the Executive Summary.

The total passenger traffic has been projected by the Planning Commission Study at 3020 BPKM and freight traffic at 1334 BTKM by the end of the century. By the year 2004-05 the corresponding traffic estimates are placed at 4100 BPKM and 1768 BTKM respectively. The total requirement of petroleum products (MS, diesel, and ATF) by the end of the century is estimated at 49.4 MTOE. In the year 2004-05 the demand for petroleum products from the transport sector is placed at 66.4 MTOE. The demand for diesel and electricity in the year 1999-00 for a 5.5 percent growth in GDP will be 44.8 MTOE and 5.7 TWH respectively. The corresponding demand estimates for a 7 percent growth in GDP are 58.4 MTOE and 6.9 TWH respectively. In the 'Base Case' the share of road in total freight traffic will be 59 percent by the end of the century. However, if this share is increased to 62 percent, the total requirement of petroleum products will increase by 1.1 MTOE. Also the electric traction constitutes 35 percent of the rail traffic during 1999-00. If this is increased to 40 percent, the diesel demand will decline by 0.22 MTOE. This will also result in the demand for electricity going up by 0.8 TWH. The share of public transport in passenger traffic works out to 80 percent. If this is increased to 86 percent the energy intensity of passenger traffic declines from 5.64 MTOE/BPKM to 5.15 MTOE/BPKM. For every tonne of petrol saved the diesel demand will correspondingly go up by 0.33 tonnes. This will result in a net saving of foreign exchange of Rs. 2346 per tonne of petrol saved. There is a distinct advantage in promoting public bus transport from the point of view of reducing the overall energy intensity of the sector, according to the Study.

The total estimated energy requirements for the households sector for cooking in 1994-95 and 2004-05 are 132.3 MTOE and 148.9 MTOE respectively. The share of traditional sector is expected to go down from 94 percent in 1986-87 to 69 percent in 2004-05.

## SIZE OF HOLDING, INTENSITY OF LABOUR INPUT AND LAND PRODUCTIVITY

According to Dr. K.N. Raj, the well-known Economist, the traditional technology in agriculture enabled the owners of the small holdings not only to make more intensive use of labour on the land available to them but also to show higher productivity per unit of land than the larger ones. Though this inverse size - productivity relationship has been attributed to smaller holdings having a higher proportion of irrigated area, greater cropping intensity and cropping patterns of higher value, their ability to exploit these sources of productivity was itself a reflection of the greater ability of labour relatively to the land operated by them. There has also been evidence of more investment per hectare in small holdings based in part on borrowings but largely on direct use of labour for various forms of construction. While even such holdings have been found to supplement family labour with hired labour, particularly in periods of peak activity, there is little doubt that it was the availability of cheaper family labour that made it possible for them to achieve levels of producitivity comparable to and often higher than in the larger holdings.

According to Dr. Raj's study contained in his book 'Organisational Issues In Indian Agriculture' (Oxford,

Delhi, 1990), though the smaller holdings continue to have the advantages of cheaper family labour, modern agricultural technology has made it possible to raise the yields on the larger holdings to a degree that the inverse size - productivity relationship no longer holds in the regions where it has been adopted. However, it has done so without changing significantly the inverse relationship observed all along between size of holdings and intensity of labour input. "The explanation for this seems to lie not only in the greater access that operators of larger holdings have to financial resources for securing the necessary inputs, but in the problem of supervision and control of hired labour. This has evidently induced them to undertake mechanisation without increasing significantly the use of hired labour, even though such investment could have led to land-augmenting effects and made it possible to use labour for promoting cropping patterns of higher value and even multiple cropping on a more extensive scale. There is evidence that, while the inverse relationship between size of holding and intensity of labour input was getting limited to the lower size groups (in atleast certain regions) in the middle of the 1950s it had spread to the entire spectrum by the middle of 1970s with the largest farms tending to increase labour use much less than the smaller ones", states the Study.

## HOW TO MEASURE POVERTY

"Poverty is not the same as inequality, where as poverty is concerned with the absolute standard of living inequality refers to relative living standard. At maximum inequality one person has everything and clearly, poverty is high. But minimum inequality (where all are equal) is possible with zero poverty (where no one is poor) as well as with maximum poverty (where all are poor)"; according to the World Development Report, 1990 of the World Bank, published by the Oxford University Press. Specifically the Report defines poverty as the inability to attain a minimal standard of living. To make this definition useful, the Report exhorts to answer the following questions :

* How do we measure the standard of living?
* What do we mean by a minimal standard of living?
* How do we express the overall severity of poverty in a single measure or index?

According to the Report, household incomes and expenditures are inadequate yardsticks for the standard of living as long as they include own production. Neither measure, however, captures such dimensions of welfare as health, life expectancy, literacy and access to public goods or common property resources. Being able to get clean drinking water, for example, matters to ones' standard of living but it is not reflected in consumption or income as usually measured. Households with access to free public services are better off than those without, even though their incomes and expenditures may be the same. Because of these drawbacks, the Report supplements a consumption based poverty measure with others such as nutrition, life expectancy under 5, mortality and school enrollment rates.

All the poverty measures are judged in relation to some norm. The choice of the norm is particularly important in the case of consumption based measures of poverty; according to the Report.

A consumption based poverty line can be thought of as comprising two elements; the expenditure necessary to buy a minimum standard of nutrition and other basic necessities and a futher amount that varies from country to country, relfecting the cost of participating in the every day life of society; continues the Report. "The first part is relatively straight forward. The cost of minimum adequate calorie intakes and other necessities can be calculated by looking at the prices of the foods that make up the diets of the poor. The second part is far more subjective, in some countries indoor plumbing is a luxury but in others it is a necessity".

The perception of poverty has evolved historically and varies tremendously from culture to culture. Criteria for distinguishing poor from non poor tend to reflect specific national priorities and normative concepts of welfare and rights. In general, as countries become wealthier, their perception of the acceptable minimum level of consumption changes; according to the Report. "The poverty threshold rises slowly at low levels of average consumption, but more sharply at higher levels". The simplest way to measure poverty is to express the number of poor as a proportion to population. This `head count' index is a useful measure although it is often criticised because it ignores the extent to which the poor fall below the poverty line. The income shortfall, or poverty gap, avoids this drawback. It measures the transfer that would bring the income of every poor person exactly upto the poverty line, thereby, eliminating poverty; adds the Report.

## KEY STRATEGIC THEMES AND THE ISSUES FOR DEVELOPING COUNTRIES

The Industrial Development Decade for Africa Mid-Term Evaluation Report states that there is no prosperous

industry without efficient enterprises and the capability to change is an important criterion of selfreliance today. In other words, using resources productivity is the key to generating most of the benefits that industry can yield: rapid growth, new employment opportunities, greater economic independence, application of technology, building knowhow, and a more integrated economic structure. Conversely, analysis of industry's disappointing performance in the past decade shows that some policies intended to achieve these benefits, can be counter productive if they discourage productive use of resources or constrain the demand and supply conditions needed for successful industrial development. These are revealed by William F. Steel in his article 'Key Strategic Themes and Issues' for IDDA II contained in Industry Africa, the Journal of the IDDA published by the UNIDO.

A strategy for raising agricultural development is essential for a pattern of industrialization that is sustainable and equitable, whereas past important substitution has been confined largely to the higher income urban market. The failure of many investments to raise productivity, which is necessary for "infant industries" to mature and offset their initial high costs, has been particularly disappointing. One reason for the poor productivity performance has been the inadequate parallel build-up of appropriate technological and human capabilities, including the ability to make technical decisions, implement both projects and policies, adapt technology to local needs and materials and carry out production; according to the article. Another reason is the bias towards large-scale, import-intensive industries, which have undertaken little technological innovation whereas smaller firms have proven highly adaptable to adverse conditions. The importance of these capabilities is not a new discovery. Industrialization has long been advocated as a means of gaining them through experience. But skill development does not occur automatically. The Republic of Korea invested heavily in the type of education and skills needed for future industrial expansion. Africa's past investment in education has not been oriented towards industrial skills, and resources today for the necessary education and training are limited. Educational focus should be functional, on skills such as engineering that are applicable across a range of industries. Firms need incentives to provide more in-house training or to organize industry-wide programmes.

It is not so much state ownership *per se* that lies behind the poor performance of many public industries, but the failure to develop enterpreneurial and managerial skills and to respond to commercial criteria and incentives; adds the article. There is broad agreement that small and medium-scale industries can play a crucial role in this development process and that private entrepreneurs hold the key to dynamic industrial growth. Meanwhile the public sector must attempt to put its industries on a sound basis with the resources at its disposal.

A stable economic and political environment is particularly important if people are to take long-term risks. Substituting market forces for direct allocation of scarce resources can reduce the diversion of entrepreneurial efforts into trading and lobbying. A well-functioning legal system to ensure that property is protected and contracts are enforced is also essential for a positive business environment. More generally, the political leadership needs to create the impression that private investment is respected as part of the development effort. Only when the business environment encourages entrepreneurs to come forward does it make sense to invest in entrepreneurship development programmes to strengthen supply.

Whereas most countries have recognized publicly the important role that small-scale industries can play, fewer have given such recognition to the informal sector. Nor have effective programmes been developed for supporting informal enterprises. Outside Africa, many successful programmes are essentially self-help efforts. Special institutions and programmes designed to provide credit or technical assistance to the informal sector are often very costly and reach only a few individuals. Where government regulations and agents make life difficult for informal entrepreneures, the most effective assistance may be shifting to a policy environment that leaves them alone, according to the article.

## EDUCATED UNEMPLOYMENT IN ASIA

Despite that the Asian & Pacific region has become a major economic power centre in the world and also despite that the economic development in this part has brought about a dynamic exapnsion of employment opportunities, the problem of educated unemployment still remains, because the speed of educational expansion normally exceeds that of economic development. The structural imbalance between the skill requireemnts of the business sector and the traditional curriculam provided by the educational institutes may give rise to new types of unemployment and underemployemnt. Thus, the Asian countries may need to consider to what extent the society can accomodate the unemployment of highly educated people as an unavoidable process of economic development; according to a recent study on 'Educated Unemployment

It is recognised that SOEs seem to have corporate growth cycles like that in private sector - with three major phases viz., sheltered phase, supportive phase and self-propelling phase. To an extent, SOEs in general are established to perform "official functions business like" but normally turn out to be performing "business functions official-like". While recognizing that controlling agencies of SOEs are often blamed for creating rules that lead to ineffectiveness, inefficiency, low productivity or even failure of SOEs, on the basis of exceptional experience where controlling agencies can be big boosters for ailing SOEs, it is suggested that the controlling agencies be catalysts.

In regard to institutional restructuring strategies, it is observed that the on-going trend towards privatization represents the conversion of bureaucratic-state owned enterprises into delegated and risk-taking organizations. It was suggested that privatization should be discussed not with respect to the criterion of ownership, but that of improvement of management. The report seems to lay greater emphasis on privatization than on other strategies such as mergers and diversification.

*G.R.S. Rao,*
*Director,*
*Rajaji International Institute of Public Affairs and Administration, Bolarum, Hyderabad - 500 010*

**Hand Book of Construction Management** : *P.K. Roy, New Delhi, Macmillan India, 1990, 406p, Rs 220*

The name 'Construction Business' smells foul for every reader because of what one has been hearing or experiencing about the business. Very little has been talked, discussed, and read about the construction business by a common man, as compared to what he might be knowing about other business, be it manufacturing, trading, or, service industry. Construction Business is perhaps a combination of all these, and much more.

To put it up on a global comparison *vis a vis* other business, the total turnover of this sector might as well acquire the topmost slot. However, the business is so much diluted and widely spread across the globe, that it has lost it's own identity.

The author has made an earnest effort in this handbook to provide the construction business it's due share of recognition, and also tried to realise that it is a force to be reckoned with, and a subject by itself.

Outwardly seeming to be so simple, the construction business is as complex as any other business, with all it's nuances, pitfalls, and promises. Every aspect of the management of a business has to play an equal role in the construction field too.

While looking at the title of the book, one might be expecting a lot about the architectural and civil engineering aspects, however the book is totally silent on these two, which is perhaps so, because, it is assumed, that the work is meant only for those who know their business, as far as the work is concerned, but do lack the basic knowledge required, as far as the management of the same is concerned.

As the term management goes, it is the way of co-ordinating all the resources available like men, materials, machines, and ofcourse all encompassing are the two parameters viz: the money and the procedures and controlling systems.

The salient features of the book are the basic principles of management of the business :

*Planning:* This includes the site selection, deals and transactions involved in property, be it the land or the building. The need for network techniques, and their importance in controlling the cost and time overruns, and thereby avoiding heavy penalties in this business are highlighted. This also helps the reader in understanding the control aspects of cashflow management.

*Contracts:* This chapter goes in detail about the probable pitfalls in the business, be they in the area of entering into the contracts, commitments, agreements or any other form of written or unwritten statutory implications in the business. This chapter is perhaps the onhand and practical experience of the author, but which, if neglected can make or mar the business for anyone who might venture into it.

While highlighting all such pitfalls and traps in all such systems, the book failed to provide specific answers or solutions to the same. But this is perhaps understandable also, as the subject by itself is so wide and varying so much in nature across the world that it is impossible to cover every thing in a single book of this size.

*The Material Management:* While Design of the work accounts for the actual consumption of the materials, depending upon the features built as per the expertise of the architect or the civil engineer, it is the working capital management which warrants the materials management aspects. Every thing connected with the materials has been highlighted. All the relevant items like purchase, storage, handling, issues, accounting, scrap disposals and the connected paperwork and procedures, including taxation have been listed elaborately.

*Man Management:* This part covers all the relevant aspects, not only regarding skill requirements, but also the statutory provisions together with their implications on hiring and firing of the personnel. A host of personnel management aspects have been touched upon, which have any relevance, whether direct of indirect, with the subject.

*Equipment Management:* This part is aimed at the problems associated with the cost of using the equipments. What and What not, How and how not, When and when not to hire or buy the equipments have been discussed. For those, who in their enthusiasm have got contract might overlook some of the fundamental aspects. The book, in very simple and clear words, explains the possible pitfalls, and warns the would be constructor much before the damage is done, only if he bothers to spend a little to know about time. The author gives the impression that sweet talk and business are two different things to be dealt separately. The book also aims at both, the contractor and the owner. For a large sized construction firm, the book does provide enough material in the area of organising the show, as regards the personnel management, and also the business management. The same also holds good for a small time construction organisation, on a selective basis.

*Financial Management:* All the basic nuances of financial management have been covered in this part, perhaps realising the fact that it is ultimately the money that matters. Different types of insurance and contract claims, together with their implications and procedures to claim rebates and compensations are detailed here.

*Others:* In addition to the primary requirements of the system, the author has also referred to various other connected items and support services in the form of computerisation of the working systems, and also the design support systems like computer aided design (CAD). However the reference seems to be only indicative and not elaborate.

Finally the author has prepared a compendium of 112 questions to the construction manager to assess his own capability, both in the way of professional management and personnel management.

A reader who has been earlier exposed to the management of any organisation may not find this book interesting as the treatment is only of a bird's eyeview nature and a global assembly or encyclopedia of various terms and techniques used in management of any business venture, as the problems are the same everywhere. However, for those of the constructors, who have gone into the business just because it is perhaps the seemingly most paying business, the book is a massive compendium of every term that will mean either success or failure for him in the business. Although one will find all the terminology connected with the business referring to 'What should be done', but to know 'How to do it', the reader has definitely to look into the detailed literature on the specific subject elsewhere.

*K.R. Chari,*
*Director*
*National Productivity Council,*
*Hyderabad.*

**Planning for the Millions** *Anand Sarup & Sulbha Brahme, New Delhi, Wiley Eastern Ltd., 1990, 183p, Rs. 30*

The book has been written with the sole objective of evaluating the planning process followed in India during the last forty years in relation to the objectives laid down in Indian constitution. By and large, the objective has been achieved in toto. The subject matter given in the book is quite adequate for the purpose and presented nicely in thirteen chapters in addition to the introduction chapter and Statistical Appendices.

In the introduction and the first two chapters, the shortcomings of the centralised planning process have been highlighted and efforts have been made to establish the superiority of the decentralised planning. Use of sophisticated language and huge amount of statistics; red tapism; disproportion of expenditures in some areas; conflicting priorities etc. are some of the necessary evils of centralised planning which have been well projected in the book. As a corrective measure, the authors suggest the decentralised process of planning.

The next three chapters, i.e. 3rd, 4th, and 5th are devoted to explain the social, cultural, political and economic conditions and resources available alongwith the good and bad effects of colonialism. The narration is so perfect that it seems to be adequate to satisfy the need of every section of th society, i.e. political leaders, planners, scholars, executives, social workers, academicians etc. The narration includes information about geo-climatic conditions, natural resources, weather, caste system, conditions of women, economic structure, social structure and so on and so forth. All this information is available in Chapter Three of the book. The details about the impact of colonialism on the employment structure, exploitation of Indian economy, population, education etc. are available in Chapter Four. This chapter also gives some idea about the initial commitment of the government of free India. The situation in respect of various aspects which prevailed at

the time of independence has been well narrated in the Chapter Five.

The authors have also tried to review the organisational-structure and operational-mechanism of the Planning Commission. The material provided on this aspect is of a narrative nature. It explains the formation of the Planning Commission with its working in details. No doubt for the common readers this narration is very useful. The discussion could be made more attractive, useful and practical by examining the present activity oriented planning from the angle of area needs.

Four decades of planning has been examined from both the angles : growth and distributive justice. At many places there is a mention of probable factors which have affected the development planning either adversely or positively. While enumerating the achievements, the authors have mentioned the increase in agricultural production; industrial production: infrastructural facilities and services; power generation; entry into the international market through competition, increase in the number of people trained in science and technology, banking structure etc. Although these are very encouraging results yet they are short of the needs of a growing population, this is the observation which the authors made. How the population growth has adversely affected the planning process has been explained in a very convincing way.

The authors have projected successfully that all the states of the country could not get the benefits of development equally. Per capita income, road, electrification, health, education, vehicle per 1000 population, size of land holding, irrigation facilities and local production techniques based industrialisation are some of the parameters on which inter -state disparities has been shown. According to the authors allocation of resources, ownership of natural resources and distribution of financial resources through financial institutions etc. are some of the factors responsible for the inequalities and disparities in the country.

The impact of four decades of planning on rural community and women has been examined on the basis whether the planning has brought any desirable change in the social and cultural values; power structure, outlook of the males towards women etc. The authors, with the help of some case studies established the facts that no significant change could take place. They go upto the extent that there are policies and programmes which intensified the sufferings of the lower caste and class people in the rural areas. The position of women particularly in the rural areas has become unbearable because of the introduction of labour saving devices in agriculture. It has been stressed that the feudal power-structure has not permitted to percolate the benefits of the developmental policies and programmes to the oppressed classes which include women.

The authors have pointed out that because of huge amount of black money in circulation: role of black money in elections: control of the upper class people on mass media-news-paper and electronic media; duality in educational structure have helped not only in concentrating the wealth, productive assets in a few hands and at a few places but also in polluting the decision making mechanism of the common voters. As per information given by the authors, the percentage of the assets of 5 super giant houses in 1987 - 88 was 48 which speaks the story of inequalities and disparities.

As a remedial measure, the authors of the book recommend four basic changes (i) the objectives of the developmental planning should give more emphasis on generating gainful employment in rural India : (ii) this needs a new organisational and operational mechanism; (iii) the planning process should follow the bottom top approach and (iv) there should be a uniform educational policy for the country.

*Jagpal Singh,*
*Senior Scientific Officer,*
*Centre for Rural Development*
*and Appropriate Technology*
*Indian Institute of Technology,*
*New Delhi - 110 016.*

**HRD Missionary** : *TV Rao, New Delhi, Oxford & IBH, 1990, 88p, Rs 75.*

Capital and natural resources of a country are passive factors of production; human beings are the active agents who accumulate and activate the capital, exploit the natural resources, build social, economic and political organisations and carry forward national development. Of the key resource factors - human, physical and financial - which determine an organisation's capability for economic growth and development, the human factor is considered to be most strategic and critical. An organisation may possess abundant physical resources and the necessary machinery and capital equipment, but unless there are men who can mobilize, organise and harness the organisation's resources for production of goods and services, it cannot make rapid economic growth. Hence, one of the major tasks confronting the development of an organisation is the 'building up of human resources'.

The book, in the words of the author, aims at 'clarifying the roles of HRD manager and outlining the scope of HRD function'. The book is divided in two parts. Part I is devoted to the definition of HRD, structuring of HRD function, qualities of HRD managers etc., while Part ii focusses mainly on HRD instruments. The book addresses itself to some of the important questions in the area of HRD, such as (i) What is the role of HRD Manager? (ii) How should one organise the HRD function? (iii) What should be the position of HRD Manager and what are his characteristics and qualities? (iv) What are the dangers that the HRD Manager faces? Answers to all these and many more related questions have been very rightly and appropriately presented in various chapters of the book.

Chapter 1 provides an introduction to the field of HRD. and distinguishes it from the personnel function of an organisation. Chapter 2 explains the multiple goals of HRD, while Chapter 3 discusses the relationship between the HRD mechanisms, processes, outcomes and organisational effectiveness. The tasks to be performed by HRD Departments constitute Chapter 4 of the book. Tips and suggestions for organising and structuring the HRD function have been presented in Chapter 5,while Chapter 6 coherently states the qualities of HRD managers. There are certain areas which need special attention of the HRD manager. These have been included in the next two Chapters of the book. The remaining pages of the book, comprising Part II, are devoted to HRD implementation. Questionnaires and can very well be used by HRD managers to guage their competencies, HRD climate, training effectiveness, performance appraisal effectiveness etc.

This part of the book is useful both for senior executives handling HRD function and the researchers in the field of HRD. The material presented is useful as a guide and direction for carrying out additional research in this area.

The text is very precise, brief and to the point and provides the necessary material for the purpose of understanding the emerging area of HRD. The author is to be congratulated on his coherent organisation of the material and his clear, uncluttered style of presentation. However, it would have been better had the author included some actual case studies in the area of HRD. A brief discussion about the practices of some of the most successful HRD departments from the Indian industry would have added a new dimension to the book.

*R.K. Malik*
*Department of Commerce*
*Shyam Lal College (Even.)*
*University of Delhi*
*Delhi - 110 032*

**Strategies for Third World Development** : *John S. Augustina, New Delhi, Sage Publications, 1989, 156p, Rs. 145.*

Development is not a new concept. Conventionally believed to be based in the Judaeo-Christian tradition, the concept actually has had its origins which gave rise to a number of theories of evolution, linear or cyclical. The sixties witnessed a powerful wave of contributions to the debate on development in the name of modernisation. An important element of these contributions was a complete rejection of deterministic formulations, cognizance of the colonisation factor, and appreciation of the relative autonomy of the third world states to decide their own course of action. Development made a direct reference to a variety of humane goals, with the quality of human life as its touchstone. The modernisation debate represents a milestone in the journey of the concept of development.

That does not however underestimate the need for a frequent revision of the concept because more than the format or a logical statement of definition, the substantial aspects of development are important and in a fast changing world, comprehensive revisions are more regularly warranted. The present book is welcome precisely and foremost for this reason.

An excellent combination of eight essays by eminent persons from academics as well as development field this book gives an overall view of the economic, political, psychological, theological analyses of development and presents some field experiences.

Nobel laureate economist J. Tinbergen sets the broad direction of the debate, discussing divergent origins of values and norms but finally pleading for certain basic human rights. L.S. Venkatramanan takes an overview of the development situation in the third world in different sectors of development drawing heavily from the works of Frank Charles R.Jr. and Webb Richard. His focus is on the redistributive policies, and presents a real but bleak future for the poor in the third world. His observations on the realities of public distribution policies and production technologies are valuable.

Ashish Nandy discusses the concept of development in the context of the health-ill health debate. He summarises his contribution neatly by rejecting the ego-defensive meditational approach with a total unconcern for the deficiency needs of the majority and also the spirit denying consumerism of the rich. He writes,"... there is not only Maslow's rule on the hierarchy of needs but there is also a half-articulated anti-Maslowian logic which says that if freedom can be an ego-defence and not a real substitute

for bread, bread too can be an ego-defence and a real substitute for freedom".

In his contribution John Augustine discusses the transition in the minority expression of the Christian community in India. He takes an overview, also substantiated by a few empirical works, of the traditional-institutional and the recent anti-institutional forms of socio-political participation of the Christians of India. He observes," If Christianity in India is to develop a truly Indian identity with a real Indian Christian mission, it must perforce gradually shed its institutional complexion and evolve a more real and essentially Indian connotation by entering into the mainstream of the current Indian socio-political and cultural turmoil. He recommends extra-institutional Christian participation in development as an effective way. He further cautions that the effects of this participation will get neutralised if it continues to be based upon the European, British, and American sources of funds. Christian missions and Christian activists will find this discussion very useful. K.C. Alexander discusses various rural development programmes in the African and Asian countries. While the review is informative much of its potentiality remains underutilised in the absence of a comparative analysis. Ratna Ghosh addresses herself to the question of use of modern communication technology in education in the broader context of development in a very neat and analytical essay.

M.M. Puri discusses the primacy and importance of politics in development and recommends participative planning. His essay is very informative and analytical. Both, the students of politics as well as the field practitioners will find it very useful. The Arole couple of Jamkhed reveal the success story of the famous Jamkhed primary health care project. It is an interesting reading. In his analytical article V.K. Bawa focusses upon the environmental debate and the developmental technology. He catagorises the environmentalists into four groups viz, cornucopians, environmental managers, self-reliance soft technologists, and deep ecologists. The environmental debates are becoming crucial and concept building, as well as theory building exercises are lagging behind the substantial discussions. In this context such an attempt is welcome. However Bawa does not use this classificatory exercise further to any analytical ends. An extremely useful collection of essays that this book is, it is recommended for libraries and individual buyers.

*Pravin Patkar*
*Tata Institute of Social Sciences*
*Deoner, Post Box-8313*
*Bombay - 400 088.*

**Excellence Through Participation: Quality the only way** *Tata Mc Graw-Hill, New Delhi, 1989 pp. 575*

There has been a lot of talk on Japanese style of management during the last 10-15 years. Several techniques have become popular and synonymous to Japane management such as Just-In-Time, Total Quality Control, Quality Circles etc. Quality Circles which is one of the most popular techniques, is practised by a large number of countries including USA, UK, Sweden, Ausralia, Korea, China, Philippines, Thailand, Malaysia and India. Quality Circles are based on the concept that the people who actually perform the jobs in an organisation are the best experts to identify and solve their work related problems. The mobilisation of creative potentials of human beings in an organisation is fundamental to its growth and success.

It is in this context that the book under review is a welcome document. The book contains the proceedings of the International Convention on Quality Control Circles held in New Delhi during December 1989. It is, therefore, heartening to review the efforts of a large number of experts and practitioners who made the ICQCC'89 a grand success. The text is primarily aimed at providing an integrated concept of Quality Circles and case studies from different situations.

The book has been divided in to eight parts. The first part includes the keynote address and gives the status of quality circles in Japan, Korea, USA and Mexico. The second part includes two papers dealing with the impact on the economy. Both the papers provide the necessary framework for laying the foundation for quality and competitiveness. The third, fourth and fifth parts which represent the nucleus of the volume deal with Productivity through Total Quality, Human Resorce Development and Operation of the Quality Circles. These parts convey a clear message to the reader about the contribution of quality circles to team building, impact on organisational culture and general methodology of operations of quality circles. There seems to be a general consensus across the world about quality circles being the best available process to combat the tight business siutation and promote ideal employee relatons and company growth. Quality Circles open the door towards improvement of quality of worklife. It provides a real opportunity for individuals to influence their working environments, to have some say as to what goes on in connection with their work.

The sixth part of the book provides the role-relationship of Quality Circles with trade unions and management to enhance effectiveness. It also includes performance evaluation of QCCs, monitoring and recognition. The in-

house convention organised by several organisations provides unique opportunity to members to present their cases. QC achievements are also highlighted in QC newsletters and house journals of organisations which are provided to each employee.

The seventh and eighth part of the book contains case studied from manufacturing and service sectors respectively. The case studies presented in ICQCC-89 and contained in the present volume cover aspects like productivity improvement, cost reduction, safety and workimproment in engineering industries, process plants, ports, banks, hospitals etc. A glance through the case studies provides an idea about the contribution of Circle members. All of them have used analytical aids and problem solving techniques such as brain-storming, cause and effect diagram, parats analaysis, check-sheets, control charts and stratification diagrams.

The utility of the book would have multiplied manyfold if a summary of the presentations, conclusions and recommendations was included in the book. The book has also not taken cognisence of the status of Quality Circles in India.

*Ajit Singh*
*Director (Indl. Engg.)*
*National Productivity Council,*
*New Delhi.*

□

| | |
|---|---|
| We perceive, as a rule, what we expect to perceive; we see largely what we expect to see; and hear largely what we expect to hear.<br><br>*—Peter F. Drucker* | The world is multidimenstional. Yet most of us are capable of seeing only one dimenstion at a tiime.<br><br>*—Peter F. Drucker* |

# Productivity Abstracts

## NPC Documentation Section

**Economic consideration in wastewater treatment with duckweed for effluent and nitrogen renovation, Oron Gideon,** *Research Journal of the water Pollution Control Federation, Vol. 62(5), July/Aug 1990, p. 692-696.*

Duckweed is one of the floating aquatic macrophytes with a preference for ammonia uptake. The ammonia is assimilated into valuable nitrogen compounds that can subsequently be used for animal feed or agricultural fertilization. Outdoor experiments were conducted by the author in shallow miniponds (20 and 30 cm deep) to evaluate the performance of the duckweed species, Lemna gibba, as a stripper for domestic waste water. The results indicated that under adequate operational conditions the quality of accepted secondary effluents meets irrigation reuse criteria. The annual yield (dry matter) of duckweed, which is harvested two to three times a week is anticipated to be about 55 ton/ha, with a protein content close to 30%. The benefit of the additional byproduct means a reduction in wastewater expenses in the range of $ 0.020 to $ 0.050/ $m^3$.

**Flocculants for industrial wastewater treatment, Chaurasia Sunita, Rai J.P.S. & Shukla N.P.,** *Indian Journal of Environmental Protection, Vol. 10(5), May 1990, p. 363-366.*

Industrial wastewater effluents have complex composition and a modification to the composition is usually necessary to remove the pollutants. Recent developments in the field of the effluent water treatment involve the use of newly developed flocculants which act as settling agents and coagulants. They aggregate the suspended matter into large flocs which may be easily removed from the wastewater. The present paper deals with the various types of floccoulants available and their application to the different types of industrial wastewater and suspensions.

**Guaranteeing bank loans to smaller entrepreneurs in West Africa, Balkenhol Bernd,** *International Labour Review, Vol. 129(2), 1990/2, p. 245-253.*

Small and medium-sized enterprises, whose employment and training potential is acknowledged by all, have great inability to provide sufficient security. After recalling profitability of loans - the cost of resources, administrative costs, provisions against default, the lending rate - the author analyses the guarantee funds for their lack of success. He suggests that a more effective approach would be to set up mutual guarantee associations, with the bank and replenish their capital with member's contributions. The tradition of solidarity in African Society is an asset governments should not ignore if they wish to make institutional credit more accessible to the small producer.

**Industrial policy in India during the eighties-An evaluation, Bhatia D.P.,** *Quarterly Economic Report of the Indian Institute of Public Opinion, Vol 33 (2), April - June, p. 34-44.*

There has been a marked change in the industrial policy during the eighties compared with that in the fifties, sixties and first half of the seventies. The earlier policies of self-reliance, employment generation and equitable distribution of productive assets have given place to openness, technology imports and export-led industrialisation. In the wake of this, it appears that industrial sector has lost its independence. Consequently, dependance on foreign aid has increased, employment programme has received a set back and the productive assets are tending to be more unevenly distributed. Whereas contribution of technology in the industrial progress of an economy cannot be ignored, the way it has been imported and the volume of inflow pose problems.

**Industrial relations in Jammu and Kashmir, Gani A,** *Indian Journal of Industrial Relations, Vol 26 (i), July 1990, p. 53-63.*

The paper attempts to examine the state of industrial relations in Jammu and Kashmir. A brief historical perspective is given first followed by a sectoral analysis of the conflict proneness "Miscellaneous Group of Industries"comes out to be most conflict prone in the state, which interestingly confirms the validity of Kerr-Siegal thesis of "isolated mass of workers being more conflict prone then others". However, no uniform and regular trend is discernible. The study concludes that both the direct and third party dispute settlement measures have, by and large, not been successful in the state. What is required is

the creation of a good infrastructure for the management of industrial relations in the state before the situation goes beyond limits.

**Intra-SAARC trade : A dwindling feature, Beg Masroor Ahmad**, *India Quarterly - Journal of International Affairs, Vol. XLVI (1), p. 47-89.*

Inspite of SAARC countires 'participation in two major schemes of multilateral trade cooperation, the region lagged behind the rest of the world in expanding their trade. Over a period of time, the share of intra-regional trade can also be seen in a relative sense. Thus, the dependance of these countries upon developed countries has increased and foreign trade has failed to act as an engine of growth in this region.

This paper examines the :

1. Declining exports and import growth rates of SAARC countries;
2. SAARC countries aggregate exports and imports share in world exports and imports and its burgeoning trade balances; and
3. Intra - regional exports and imports share of SAARC countries and SAARC share in its total exports and imports to the rest of the world.

**Maturation issues for the Ombudsman, Calden E, Gerald and Valdes A. Daisy**, *Management in Government, Vol. 21 (1-3), April - Dec. 1989, p. 1-19.*

The institution of Ombudsman has come to be widely accepted as an effective instrument in democratic countries for smoothening the rough edges in the relationship between the citizen and the administration. The ombudsman not only helps increase the public confidence in administration, but also has a cautioning effect on public officials against maladministration. Nevertheless, this institution is also criticized by many as an unnecessary and expensive frill. The authors feel that there should be a periodical self-review of its performance by the institution. The government and the people need to be reassured periodically that the ombudsman is good value, and is necessary for guaranteeing human dignity, more effective government and better bureaucratic performance. They pose six issues that are critical to the performance of this institution, viz. the issues of politics, jurisdiction, resources, credit, professional judgement and consistency, as well as bureaucratization.

**Measures of industrial protectionism : Relevance for trade and labour policies, Scandizzo Pasquale Lucio,** *Labour, Vol. 3(3), Winter 1989, p. 129-167.*

Protectionist policies are often supported by an unholy alliance of industrial lobbies and labour unions, under the assumptions that trade barriers will favour higher profits, wage rates and employment. Even when one takes the narrow view of self-interest in a single producing sector, however and protectionism lobbyists and negotiators. The paper reviews the methodologies developed to measure the extent and derive operational guidelines to evaluate alternative trade policies.

**New generation of organised workforce in India :** *Implications for managements and trade unions,* **Sengupta Anil K,** *Indian Journal of Industrial Relations, Vol. 26(1), July 1990, p. 1-13.*

The labour relations scene in India has witnessed two important developments : (i) erosion of managerial authority, and (ii) increasing shift of power in trade union from the hands of the leaders to those rank and file workes, during the last two decades. These developments are related to the social composition of the workforce. The present workforce is young, literate, more skilled, belongs to upper castes and is urban in origin. Workers of today also attach high importance to intrinsic factors, such as lack of recognition for achievement, absence of adequate promotional facilities and opportunities for training and development. The managers, therefore need to be responsive not only to the lower level needs of workers, such as money and security, but also to their higher order social-psychological needs. The trade union leaders too would have to draw their strength from the support of the rank and file.

**Organizational politics against organizational culture: a psychoanalytic perspective, Baum S. Howell,** *Human Resource Management, Vol. 28 (2), Summer 1987, p. 191-210.*

The author asks why conventional organizational politics arouses anxieties that induce workers to withdraw emotionally from organizations, precluding an integrative culture. He examines the kinds of aggression, power, politics, and unconscious processes that make it difficult for workers to feel loyal to their organizations and looks at prospects for changing concepts about organization loyalty and identification.

**Regional rural banks and rural credit - Some issues Velayudham T.K., Sankaranarayanan V.,** *Economic and Political Weekly, Vol. 25(38), Sept, 22, 1990, P. 2157-2164.*

Regional rural banks (RRBs), an innovative feature of Indian banking, have in the last few years been at the centre controversy. The issue involved in the controversy include the non-viability of the RRBs and the question of parity of their staff's pay scales and service conditions with

those of commercial banks. One influential view that emerged advocated merger of the RRBs with their sponsor banks. However any other important issues involved have been, by and large, glossed over. This paper takes stock of the role and problems of these banks in perspective and draws inferences to aid policy formulation.

**Resource base erosion and sustainable development in South Asia : Hussain Akmal,** *Economic and Political Weekly, Vol 25(33), Aug. 18, 1990, p. 1847-1855.*

According to the author as we look to the future, an urgent need is felt for a new approach to development : A perspective within which people in their diverse locations can acquire control over the decisions that affect their immediate existence, in which autonomy of communities and states can be sought from the tentacles of an international financial system that is serving as a conduit for transferring real resources out of the fragile resource base of the poor; in which production and economic growth are conducted to sustain life rather than serving to undermine it. In exploring these questions, this paper examines the resource potential of South Asia and the extent of its degradation and presents an outline of an approach to sustainable development through establishing a link between two levels of development praxis - grassroots organisation on the one hand and regional co-operation on the other.

**Rounding off to powers of two in continuous relaxations of capacitated lot sizing problems, Roundy Robin,** *Management Science, Vol 35(12), Dec. 1989, p. 1433-1442.*

In the capacitated version of the Divide and Conquer algorithm for lot sizing in multi-stage production/inventory problems, feasibility is often lost when the recorder intervals are rounded off to powers of two. The author proposes a new algorithm for rounding off policy. The author shows that the relative increase in cost that occurs when the intervals are rounded off using this algorithm cannot exceed 44%, and that for systems with a single capacity - constrained machine (including the ELSP), the cost increase cannot exceed 6%. Computational experience with industrial data sets indicates that the algorithm performs very well.

**Rural telecommunications-Improvement & popularisation, Gupta D.K.,** *Telematics India, Vol 4(1), Oct. 1990, p. 13-14.*

Taking telephones to the Indian villages remains an unfulfilled promise. The growth of telecommunications in rural India has been abysmal during the last four decades. Apart from thin penetration, very little use of the available resources have been made. Quantitative and qualitative improvement in communication and other services will, in the long run, be economical. The author who is an expert in telecommunications tells how this could be done.

**Speed and strategic choice : How managers accelerate decision making, Eisenhardt K.M.,** *California Management Review, Vol. 32(3), Spring 1990, p. 39-54.*

Strategy making has changed. No longer is the carefully conducted industry analysis or deliberate strategic plan a guarantee of success. Speed matters. A strategy that takes too long to formulate is at least as ineffective as the wrong strategy? But, how do decision makers make fast, yet high-quality, strategic choices? This article describes the powerful tactics that fast decision makers use. They maintain constant watch over real time operating information and rely on quick, comparative analysis to speed cognitive processing. They favour approaches to conflict resolution which are rapid and yet maintain group cohesion. Finally, their reliance on the private advice of experienced counselors and on integration with other decisions bolsters their confidence to decide quickly in the face of big stakes and high uncertainty.

**The Aluminium industry's self-confidence, Bird Anthony,** *Minerals and Metals Review, Vol, 16(8), Aug. 1990, p. 75-79.*

According to the author the capacity estimates do not tell us anything about the state of the aluminium industry's expectations today. They reflect the degree of confidence which aluminium companies had at some stage in the past, when the decision to construct these plants was taken. To find the industry's current degree of confidence, the author feels we must be able to make capacity projections into the medium term, rather than just the short term.

**The budget as a tool of R&D management, Bharol Ram Chowdhry,** *Management and Labour Studies, Vol. 15(4), Oct. 1990, p. 182-189.*

For a nation's industrial and technological development, R & D is of great importance. If one examines the R&D budgets of various nations of the world, one finds that developed countries spend between 2 and 5 per cent of their GNP on R&D, while developing countries allocate between 0.5 and 2 percent for the same purpose. This paper deals with the purpose of an R&D budget, the elements of a budget, procedures for its formulation, mobility of resources and zero-base budgeting. Some suggestions are also made at the end by the author.

**The good, the bad and the ugly-manager's attitudes to training, Vallely Jan,** *Works Management, Vol 43(8), Aug. 1990, p. 13-17.*

Training, whether for managers, supervisors or the workforce, is vital to the long-term performance (or even survival) of the company. The first Manufacturing Industry Training Survey reveals the unpleasant truth about managers' attitude to this thorry issue as well as some grounds for hope. The author interprets the results.

**The social dimension of European integration, Mosley G. Hugh,** *International Labour Review, Vol. 129(2), 1990/2, p. 147-164.*

Can social policy remain a national concern while economic relations are being increasingly internationalised? The 1992 European internal market programme poses this issue in immediately practical terms owing to the present diversity in both levels and styles of social protection. Failure to achieve even basic community-wide labour standards could result in de facto "deregulation" by enabling firms to evade national standards and encouraging individual states to exploit their "comparative advantage" in social costs for national economic purposes. This article discusses the prospects for effective EC - wide social regulation of employment and the potential for destructive "social competition" in the absence of such supranational regulation.

**Tribological performance of $MoS_2$-$B_2O_3$ compacts, Klenke C.J.,** *Tribology International, Vol 23(1), Feb 1990, p. 23-26.*

A recent investigation suggests that selected oxides perform well as additives in molybdenum disulphide ($MoS_2$) because of their ability to soften at asperity contacts with the result that the solid lubricant can attain and retain referred tribological orientation.

This research alone by the author determined the effectiveness of boric oxide ($B_2O_3$) when used as an additive in $MoS_2$, for substrate temperatures ranging from 21°C to 316°C. This range was used to allow the asperity contact temperature to vary below and above the softening point of $B_2O_3$. It was found, that a moderate friction additive acting abrasively, occurred when the asperity contact temperature was well below the softening point of the oxide. When the asperity contact temperature neared the softening point of the oxide, the friction, coefficient increased dramatically and wear volume was reduced. The author postulates that $B_2O_3$ acted adhesively at the interface, resulting in a higher coefficient of friction, and wear decreased due to an attainment of a preferred orientation by the $MoS_2$.for asperity contact temperatures significantly above the softening point of $B_2O_3$, the friction coefficient returned to about the same value as for temperatures below the softening point. It is specualted that wear continued to increase moderately because of localized meeting of the B2O3, permitting the $MoS_2$ to be removed from the interface. These observations support a hypothesis that an additive, such as boric oxide, can soften as the asperity contact temperature approaches the softening point temperature of the additive so that the overall tribological conditions may be improved resulting in recuced interfacial wear. Significant changes in temperature, load or sliding velocity would, of course, dramatically alter the wear characteristics observed at the interface

**Trouble at the top - Senior executives in crisis, Speller J. Lynn,** *Harvard Business School Bulletin Vol. 66(3), June 1990, p. 28-31.*

Mental illness and substance abuse in the workplace are costly in their effect both on personal lives and on the organisation as a whole. When the afflicted individual is a senior executive, a difficult situation becomes even more complex, and the potential for damage to the firm is heightened.

The author, who is a graduate of Harvard Business School and Harvard Medical School and a practicing psychiatrist, is an expert on the phenomenon of the troubled executive. The article presents his views, and those of other authorities in the field, on the nature, scope and treatment of problems that too often remain hidden behind a mask of denial.

**Using statistics to scale the peaks of quality, Caulcutt Roland,** *Process Engineering, Vol 71(9), Sept. 1990, p. 49-52.*

To conclude his series on quality, the author explains how a 'hill-climbing approach' and regression analysis can be used to optimise the process.

This article is devoted to advanced statistical techniques for process improvement. The author argues that one cannot achieve substantial quality improvement in the process industries without the use of statistical techniques. However the author cautions that widespread statistical training alone would not guarantee quality improvement. For this to be achieved it is crucial to choose the right tool for the job.

**Worker's Participation in management for inovative industrial relations, Dattar B.N.,** *The Indian Worker Vol 38 (47 & 48), Aug 20-27, 1990, p. 13-17.*

Over the last ten twelve months the concept of workers participation in mangement (WPM) seems to

have acquired considerable importance in discussions about the country's labour scene. For some of the political parties, including the Janta Dal, participative management became a part of their election manifesto. On coming to power the National Front Government made refrence to it in the President's Inaugural Address to the new Parliament, thereafter it has taken serveral other steps including discussing it at a high level tripartite seminar and introducing a Bill on the subject in a session of the Parliament. The expectation is that the debate on the proposed legislation will start in the next session. It is in this context that the author feels that the working class, as indeed the general public, should be provided with an understanding of what WPM may involve. And that is the provocation for this write-up which sets out the historical perspective on the subject before tracing silent current developments followed by some comments on the proposed bill.

**World market trends, Saxena S. Shankar,** *Indian Management, Vol. 29(6), June 1990, p. 19-23.*

For continuous growth in exports an efficient application of international marketing management process and techniques is a must. The countries who are competitive enough to act quickly in relaion to required changes can be sure of success and take advantage of opportunities emerging in different parts of the world. In this article the author analyses the world market trends.

**Zinc and zinc alloy-coated sheet in Western Europe-with a speical view of the German scene, Meuthen Brend, Stahl Hoesch AG, Dortmun,** *Metallurgical Plant and Technology Interntional, Vol. 13, 3/1990, p. 70-75.*

Continuous sheet galvanising has become a significant part of the downstream strategies of the West European steel companies. A large variety of products are now available: Hot-dip zinc, zinc-iron alloy, and zinc-aluminium alloy coatings, as well as electrolytic zinc and zinc-nickel alloy coatings. The annual output has surpassed 9.5 million tonnes. More than 20 new galvanising lines were put into operation during the 1980's. Hot-dip coating includes the production of specialities. High-efficiency planting techniques have been developed and installed. New products include organic composite-coated sheet. German steel companies have been serving the construction market through captive prepainting lines and building components plants. The German automotive industry can be characterised by a variety of anti-corrosion strategies. International standardisation of galvanised sheet, has gained increasing importance.

Compiled by
Manju Kalra
Asstt. Director
National Productivity Council
New Delhi 110 003

□

# Books in Brief

NPC Documentation Section

**Econometrics (New Palgrave Series) :** *J. Eatwell and M. Milgate. London, Macmillan, 1990, 304p, £19.50.*

In the sixty years since the Econometrics Society was founded for the advancement of economic theory in its relation to statistics and mathematics, econometrics has evolved to become a central part of applied economics. Its two parent disciplines of economic theory and statistical inferene have combined to produce a separate subject with its own distinctive techniques. The articles in this volume, reprinted from 'The New Palgrave: A Dictionary of Economics', provide an authoritative account of this branch of economic analysis.

**Encyclopedia of Tribology (Tribology Series Vol. 15)**: *C. Kajdas, E. Wilusz and S. Harvey. London Elsevier, 1990, 500p, £98.05.*

The compilation of this work has been prompted by the multidisciplinary nature of the tribology, the conflicting theories and approaches to it and the fact that definitions of the same phenomenon often differ widely. It covers the entire field of lubrication, friction and wear, i.e. the science and technology of interacting surfaces in relative motion, including the chemical and biological aspects. Readers are referred to the relevant literature for most of the terms listed.

**Forging the Productivity Partnership**: *William Sandy. New York, Mc Graw-Hill, 1990, 224p.*

This publication is constructed to be a step-by-step overview of how to create the "People advantage" for an organization or part of the organization. It shows how to develop and implement a human performance improvement strategy that works in today's workplace and that shows up in such practical results as improved profit, higher market share and greater customer satisfaction. It also shows how to get people to work together better-managers and staffs, different functional disciplines as they hand off their work to one another, even traditional adversaries—because nobody today can afford energies leaking out at the intersects where people blend their skills.

**Human Response Development** : *S.K. Chakraborty, New Delhi, Wiley Eastern, 1990, 232p, Rs. 250.*

The volume begins with a full-length written address, delivered in person, by the then Vice-President of India, Sri R. Venkatraman. It then goes on to includes pieces by entrepreneurs, top managers, academics, consultants. The reader will find exhaustive handling of core issues like quality of work life, work ethics, leadership, team work - matters of utmost urgency and importance to all varieties of Indian organizations.

**Human Resource Development in the Building Industry :** *Vinita Shah. Bombay, National Institute of Construction Management and Research 1990, 132p, Rs 150.*

The study reported in this publication is an investigation into the technical skills, social quality and job market conditions of the building workers in Metropolitan Bombay. The findings have been used to suggest strategies of skill formation and human resource development with the objective of improving productivity and quality in building and standard of living workers.

**Improving Agricultural Structure in Asia and the Pacific.** *Tokyo, Asian Productivity Organisation, 1990, 379p.*

This publication is the report of the APO Seminar on Improvement of Agricultural Structure organized in Japan in 1989. The objective of seminar was to evaluate the impact of institutional structure on agricultural development among member countries and to identify appropriate policy measures for its improvement. The main subject issues discussed were : land tenure system, marketing system, credit delivery system, farmers' cooperatives and the policy environment impinging on the performance of agricultural sector.

**India and Southeast Asia, Indian Perceptions and Policies** : *Mohammed Ayub. New York, Routledge, 1990, 105p, Rs 125.*

The primary focus of the book is on the strategic and political dimensions of Indian foreign policy towards and interactions with Southeast Asia. Ayub's conviction is that economic considerations although increasingly important

for India, have received much less recognition from the foreign policy establishment. Indeed, Indian foreign policy is seen as not keeping pace with the fast changing nature of economic development in the Southeast Asian region.

**International Directory of Government**. *London, Europe Publications, 1990, 650p, $140.*

This publication contains more than 12,000 entries for government ministries, department, agencies and corporations together with senior ministers and key personnel. This volume is essential for everyone requiring speedy access to authoritative and impartial information on governments throughout the world. It will be of particular benefit to government departments, embassies, university and public libraries, newspapers, businesses and international organizations.

**Management Training for Productivity** : *Edited by M.K. Singh and Anant Mahadeven. New Delhi, Discovery Publishing House, 1990, 368p, Rs. 375.*

This compilation attempts to bring together the experiences of various management experts and professionals in the key area of management development through strategic and tailored training programmes. It encompasses all aspects of human endeavour and application, it seeks to bring about a positive awareness of "what can be" as opposed to "what is".

**New Waves in Quality Management** : *An Integrated Approach for Product, Process and Human Quality, Tokyo, Asian Productivity Organisation, 1990, 105 p.*

The new approach to quality management requires the interlinking and integration of different dimensions of quality considerations and practices. These considerations led the APO to organize a workshop on "Quality Management - an Integrated Approach" in the Republic of China in 1989. The present publication includes selected papers presented by the resource persons and a summary of discussions of the symposium.

**Privatizing and Marketing Socialism** : *Ed. by J.S. Prybyla. New Delhi, Sage Publications 1990, 184p, £14.95.*

Contributors from Hungary, Poland, the United States, the USSR and Yugoslavia here consider what is now the central economic and political conundrum facing Eastern Europe, the Soviet Union and China : how to transform centrally planned economies into forms of market socialism' which can interact advantageously with the capitalist economies. Among other problems they consider the reasons why reform is so difficult and the feasibility of halfway solutions.

**Productivity Measurement - A guide for Managers and Evaluators** : *Robert O. Brenkerhoff and Dennis E. Dressler. New Delhi, Sage Publications, 1990, 128p, $25.0*

This book presents a thorough overview of the basics of productivity measurement, and at the same time provides a practical and straight forward guide to designing and using effective productivity measures. Concepts are clearly covered and accompanied by practical guidelines that can be used by managers, researchers, evaluators and others to help design and implement effective productivity measurement efforts in virtually any organization.

**Research Methods in Human Resources Management**: *Neel W. Schmitt and Richard J. Klimoski. Ohio, South-Western Publishing Co, 1990, 492p, $39.80.*

This book deals with such topics as the nature of research questions, research methods, research designs and the analysis and interpretation of research data. In short, it covers most areas that one might find in any upto date and comprehensive social science research methods text. It reviews the problems or functions that face those involved in designing, developing, implementing or managing the elements of human resources programs found in most modern work organisation.

**Science and Technology in the State and Union Territories** : *Ed. by P. J. Lavakare and C.P. Sehgal. New Delhi, Wiley Eastern 1990, 622p, Rs. 450.*

The present publication describes S&T plans and activities during 1985-90 as well as programmes of Central S&T Agencies in the area of agriculture, remote sensing, energy, environment, entrepreneurship development, science popularisation, etc. in the States. It has been highlighted that while all States Union and Territories have set up States S&T councils/Departments, their activities have to be further strengthened to make development programmes through the application of S&T more effective.

**Software Maintenance and Computers** : *David H. Longstreet, IEEE Computer Society, 1990, 294p, $66.*

The text familiarizes programmers with some of the basic concepts of software maintenance and teaches them to apply the techniques of software maintenance to attain the benefits of its applications. It also allows researchers who are undertaking new projects to analyze a substantial amount of literature on results of past research from around the globe.

**Structural Analysis Using Computers** : *W.M. Jenkins, London, Longman, 1990, 400p, £18.95.*

This publication is in three parts. Part 1 deals with

structural forms and materials; stress, strain and stress resultants; stiffness method; influence lines and surfaces etc. Part 2 deals with workshop; verificaton and hand calculations; assessment of approximate methods; parametic studies; studies of structural types step-by-step and analysis, note on the use of units, etc. Part 3 deals with computer programms, Platruss, Bass, specification, listing, validation data, planfram, Bas specifications etc.

**Technologies for Wasteland and Development,** *Ed. by I.P. Abrol and V.V. Dhruva Narayana. New Delhi, Indian Council of Agricultural Research, 1990, 400p, Rs. 100.*

Technologies for the management of degraded lands have been generated at several research centres of the ICAR. They are being constantly improved upon as more knowledge on the nature of degradation process and their management is being gained. It was the objective of this publication to bring together the 'State of Art' as far as technologies for rehabilitation of degraded lands are concerned. The problems of arid and semi-arid regions are discussed in section II and III, and salt-affected soils and their management including problems of waterlogging have been presented in section V. The problem of water erosion which is perhaps the most series land degradation phenomenon, is discussed in section IV. Apart from specific technologies, the social and economic issues involvd in adopting these technologies on a field scale have been dealt in separate articles.

**Technology and Organizations** : *Paul S. Goodman, Lee S. Sproull and Associates. Oxford, Jossey-Bass Publishers, 1990, 282p, $ 27.95.*

This book argues that the impact of technology cuts so deep that it calls for new answers to the complicated question : what is an organization? The book brings together experts in the fields of psychology, sociology, economics, managements, engineering, and to computer science to examine the diverse ways in which technology in altering organizational functioning and the character of organizational life - explaining its effects on the individual workers, the work group, and the organization as a whole. It also pinpoints the critical issues, senior managers must consider when determining how to fully exploit new technologies, providing, examples of successful implementation strategies.

**The Corporate Image - Strategies for Effective Identify Programmes** : *Nicholas Ind. London, Kogan Press, 1990, 206p, £ 25.00*

This book explores the relationship between corporate identity and corporate strategy or, more precisely to determine how a corporate identity can help a company to gain and sustain competitive advantage. It also shows how various types of identity programme can be started up effectively through the informed selection of consultants and the setting of feasible objectives. It demonstrate show best to communicate corporate identity as a coherent message throughout the organisation.

**The Future 500-Creating Tomorrow's Organisations Today** : *Craig R.Hickman and Michael A. Silva. London, Unwin, 1989, 274p, £2.95.*

This publication shows how business leaders can immediately begin to apply dramatic lessons in eight crucial spheres : the global market place, private - public sector relationships, collaboration vs competition, creative capital investment strategies, ethics and social responsibility, new organisational forms, integrated corporate subcultures, and the fulfilment of individual needs and desires. The authors turn their attention to the organisations that will dominate international enterprise in the next century.

**The Indian Economy and its performance since Independence** : *Edited by R.A. Choudhary Sharma Gamkha and Aurobindo Ghose. New Delhi, Oxford University Press, 1990, 306p, Rs. 240.*

This collection of essays is the outcome of a conference in 1985. Few would have predicted then the sort of problems with which India is faced today, notably the twin deficits and a policy coming under strain at the seams. This has meant that these issues and the possible responses get no coverge. However, the collection does contain matter which could help initiate debate about India's longer-term development.

**The Phoenix Factor - Lessons for Success from Management Failure** : *David Cluttarbuck and Sua Kernaghan. London, Weidenfield & Nicolson, 1990, 216p, £15.00*

This is a book about business failure. It is about dreams that turned to nightmare. It is about proud names an edifices that collapsed in sudden catastrophe when the rotton core was unable to support the public face; or simply withered away until, like a senile politician, only the empty husk remains. It is an essential read for everyone concerned with keeping business healthy. For many companies, it could provide the understanding that makes the difference between failure and success.

**The Political Economy of Unorganised Industry - A Study of the Labour Process** : *Manjit Singh. New Delhi, Sage Publications, 1990, 234p, Rs. 190.*

The purpose of this study is to clear part of this conceptual confusion by studying the labour process in the

unorganised industrial sector thorough a detailed case study. The author maintains that in order to arrive at a meaningful definition of the 'unorganised sector', it is necessary to trace the history of the various forms of industrial capital and to place the sector in the overall social relations of production. The publication is in two parts. In the first part, the author traces the growth of industrial capital and the path of relations of production in Europe and India. The second part of the book presents an analysis of the woollen hosiery industry of Ludhiana.

**Total Quality - An Executive's Guide for the 1990s** : *Ernst and Young Quality Improvement Consultancy Group. Homeword, Dow Jones-Irwin, 1990, 248p.*

This book provides excellent reading for top management and those working for them. Technical concepts are introduced clearly, but without technical complexity. It provided a good overview of total quality and worthwhile reading for all levels of management in companies attempting to improve quality.

**Tribology of Plastic Materials** : *Y. Yamaguchi. London, Elsevir, 1990, 370p, £ 77.15.*

Over the past twenty-five years the author's experiments on the sliding behaviour of plastic materials and their applications in machine elements have produced a substantial amount of data and allowed practical theories to be formulated. In this book he expounds current theories of friction and wear and goes on to describe experiments aimed at improving tribological performance by means of polymer blending and composite production. He then explains how the data obtained from these experiments may be applied to sliding machine parts.

**Value Analysis in Design** : *Theodore C. Fowler, New York, Van Nostrand Reinhold, 1990, 302p, $54.*

This publication introduces in step-by-step fashion, the rigorous eight stage value analysis job plan which can be applied to a limitless number of products and organisational processes. Supported by 36 case studies that demonstrate the extraordinary versatility of modern value analysis, it goes on to offer readers the steady guidance that will enable them to institute an ongoing value analysis system, whatever the environement.

**525 ways to be a Better Manager** : *Ron Coleman and Giles Barrie. England, Gower Press, 1990, 134p, £19.50.*

This book examines the twelve Key aspects of management and provides clear, commonsense advice. Each section contains a planning format designed to help you turn your reading into a personal commitment to affective action.

Compiled by
S.N. Vig
Documentation Officer
National Productivity Council
New Delhi 110003.

□

Quality and productivity are two sides of the same coin. Everything you do to improve quality improves your productivity.

*—Lee Lacocca*

It is only when they go wrong that machines remind us powerful they are.

*—Peter F. Drucker*

# Select Bibliography on Public Sector Management


1. AGARWAL, NP : Raw material consumption in public sector enterprises. *Commerce*, 156 (4016), May 14, 1988, p 18-22.
2. AGGARWAL, SURYA PRAKASH : Audit control over public enterprises. *Indian Journal of Commerce*, XLI (155), April-June 1988, p 31-44.
3. ALAGH, YOGINDER K : Pricing planning and strategy in public enterprises. *Public Enterprise*, 7(3&4), May & June 1987, p 243-253.
4. ANANTHANARAYANAN, S & KHURANA, RK: Financial performance of government companies during 1986-87. *Company News and Notes*, 26(9), Mar 1989, p 1-16.
5. APPA RAO, B : State financial industry in Andhra Pradesh : One out of every six units sick (two parts) *Business Standard*, Nov 18 & 19, 1987, p5.
6. ATMANAND : Bihar's public enterprises : Constraints and options. *Economic Times*, Oct 24, 1989, p7.
7. BAGCHI, AMIYA KUMAR : The role of public enterprises in India. *Asian Development Review* 5(2), 1987, p89-100
8. BANERJI, SUJIT : Key issue in public sector *management*. Mainstream, 25(37), May 30, 1987, p33-36.
9. BHATIA, BM : Fiscal imbalance and public sector. *Indian Express*, Jan 14, 1988, p6.
10. BHATT, VV : On competitive impulses and public enterprises performance. *Economic and Political Weekly*, 24(21), May 27, 1989, p50-M54.
11. BHATTACHARYA AK : Public Sector : Profitability profile mixed. *Data Bank*, 1989, p101-107.
12. CHAKRAVARTY, SUMIT : Autonomy to public sector for revitalisation. *Yojana* 31(7), April 16, 1987, p7-21.
13. CHATTOPADHYAY, P: Central government enterprises : An eighteen year profile. *Facts for you*, 10(9), March 1989, p11-19.
14. CHATTOPADHYAY, P : Export Sales up. *Financial Express*, April 24, 1989, p4-5.
15. CHATTOPADHYAY, P: Intercorporate loans in PSUs: scope for monetary indiscipline. *Business Standard*, June 15, 1988, p5.
16. CHATTOPADHYAY, P: Price perferences: Retained to help the public sector. *Business Standard*, Nov 1987. p7.
17. CHATTOPADHYAY, P: PSU funds : Coping without govt funds. *Business Standard* Dec 17, 1988.
18. CHATTOPADHYAY, P: PSU Performance : Casual reporting blurs picture. *Business Standard*, June 2, 1988, p5.
19. CHATTOPADHYAY, P: PSU: Room at the top. *Economic Times*, Jan 30, 1989, p5.
20. CHATTOPADHYAY, P : Public Sector Competitiveness : Remedies can become liabilities. *Business Standard*, Sep 10, 1988, p5.
21. CHATTOPADHYAY, P : Public sector undertakings : Internal resource generation sluggish. *Business Standard*, Feb 14, 1989, p5.
22. CHATTOPADHYAY, P : Public Sector units : Bolstering losses. *Business Standard*, Aug 18, 1988, p18.
23. CHATTOPADHYAY, P : Relevance of capacity costing for public sector units. *Hindu*, Sep 10, 1987, p18.
24. CHATTOPADHYAY, P : Streamlining public sector units to boost foreign exchange earnings. *Hindu*, Jul 27, 1989, p17.

25. CHATTOPADHYAY, P: What holds up public sector profitablity. *Commerce*, 154 (3963), May 2, 1987, p7-16.

26. CHELLIAH, R J: Re-assessing the role of the public sector. *Hindu*, Mar 8, 1988, p8.

27. CHOPRA, KS: Scrap inefficient units. *Economic Times*, Feb 13, 1988, p5.

28. DATTA, T : The memorandum of misunderstanding (two parts). *Financial Express*, Dec 29 & 30, 1988, p5.

29. DATTA GUPTA, J.K: Public enterprises energy cost: Steps to lower the soaring bill. *Business Standard* Sep 27, 1989, p7.

30. DAYAL, ISHWAR : Public sector autonomy : MOU are not emough. *Economic Times* April 16, 1988, p5.

31. DEY, PRADIP KUMAR : Public sector and Indian economy. *Business Standard*, Dec 20, 1988, p5.

32. DHARIWAL, M.S & KAUR, SARBJIT : Industrial development of India since independence (with special reference to publiic sector). *Indian Journal of Commerce*, XLI (154), Jan-Mar 1988,p109-112

33. DIKSHIT, SANDEEP : Do not privatise streamline. *Financial Express*, Apr 24, 1989, p4.

34. DUTT, RC : Public enterprises in India : Genesis and perspective. *Mainstream*, 25 (37), May 30, 1987, p17-23.

35. Dutt, RC: Public sector : Soft option of privatisation. *Mainstream*, 26(20), Feb 27, 1988, p19-20.

36. ECONOMIC TIMES RESEARCH BUREAU : Contribution to exchequer rising. *Economic Times*, Apr 6, 1989, p1.

37. ECONOMIC TIMES RESEARCH BUREAU : Cumulative deficits increase. *Economic Times*, Apr 6, 1989, p1.

38. ECONOMIC TIMES RESEARCH BUREAU : Employment growth rate slackens, *Economic Times*, Apr 6, 1989, p1.

39. ECONOMIC TIMES RESEARCH BUREAU : Foreign exchange earning up by percent. Construction companies earn less. *Economic Times*, Apr 6, 1989, p1.

40. ECONOMIC TIMES RESEARCH BUREAU : Net profits growth rate up. *Economic Times*, Apr 6, 1989, p1.

41. ECONOMIC TIMES RESEARCH BUREAU : Oil sector key to improving profits and profitability : Growth rates in assets net worth dip. *Economic Times*, Jun 2, 1988, PI-III.

42. ECONOMIC TIMES RESEARCH BUREAU : Public Sector companies : Earnings go up by 7.9% *Economic Times*, Sep 7, 1989, p1.

43. FAROOK KHAN, A & AHMAD, KHALIG : Role and significance of PE. *Indian Journal of Commerce*, XLI (156), Jul-Sept. 1988, p54-64.

44. GANGULY, NIRMAL : Public sector-retrospect and prospect. *Yojana* 31(22), Dec 1-15, 1985, p23-26.

45. GANGULY, S : Public enterprises : Learning strategies. *Economic Times*, Jan 5, 1987, p5.

46. GOURI, GEETA : Equity in pricing of PEs. *Financial Express*, April 16, 1987, p5.

47. GUPTA, ANAND P : Financing public enterprise investments in India. *Economic and Political Weekly*, 23(51) Dec 17, 1988, p2697-2702

48. GUPTA, ARVIND : Issues before public sector enterprises. *Financial Express*, Jul 9, 1987, p5.

49. GUPTA, ARVIND : Public sector holding company : Need for rationalisation. *Economic Times*, Mar 6, 1987, p5.

50. GUPTA, K : Improving public sector profitability. *Economic Times*, Apr 20, 1988, p5.

51. IYER, RAMASWAMY R : The profitability of public enterprises. *Economic Times*, Jan 20, 1989, p1.

52. JAIN, AMIT KUMAR : Profile and steps to improve performance. *Mainstream*, 26(20), Feb 27, 1988, p23-26.

53. JAIN, LC : Monitoring public investment : A creative investment. *Economic and Political Weekly*, 23(23), June 4, 1989, p1149-1151.

54. JATAR, SCN : Privatisation of PSE's. *Financial Express*, Mar 28, 1990, p11.

55. JOSHI, NAVIN CHANDRA : Public sector : Autonomy and accountability. *Business Standard*, July 19, 1988, p5.

56. JOSHI, SAMIR : Public enterprises and development of industrially backward regions. *Commerce*, 156, (4000), Jan 16, 1988.

57. KANNAN, S : Control of cost overruns in public sector. *Financial Express*, Sep 15, 1988, p5.

58. KASBEKAR, SR : Privatisation : No panacea for all ills. *Economic Times*, June 11, 1988, p5.

59. KAUL, MOHAN : Public enterprise management : strategies for success. *Vikalpa* 15(1), Jan-Mar 1990, p.3-13.

60. KERALA, DEPARTMENT OF ECONOMIC AND STATISTICS : A report on the growth of employment in public sector undertaking during the sixth five year plan. Trivandrum, Kerala Government, 1986, p5.

61. KHOLI, KEDAR N : Financing public sector development expenditure : The Asian experience. *Asian Development Review*, 5(2), 1987, p1-30.

62. KHURANA, RK : Review of government companies. *Company News and Notes*, 25(12), Jun 1988, p1-6.

63. KRISHNASWAMI, OR : Public enterprises : An apprisal. *Financial Express*, Mar 10, 1989, p5.

64. KRISHNAMURTHY, V : Govt. and PEs.: Managing the interface. *Economic Times*, Sep 5, 1987, p5.

65. LAKHOTIA, RN : Public sector in 2001 A.D. *Economic Times*, Jun 29, 1987, p5.

66. LAKMI, NARAIN : Public enterprises : Need to set an objectives direction. *Economic Times*, Apr 23, 1987, p5.

67. MADA, KU : Financial instiutions and public enterprises: Larger aid sharper monitoring. *Business Standard*, Jan 2, 1988, p5.

68. MAHINDRA, KESHAB : Public Sector : A recipe. *Economic Times*, Dec 22, 1988, p5.

69. MISHRA, RK : Management of state level public enterprises in Orissa (Two parts). *Financial Express*, Jan 6&7, 1989, p5.

70. MISHRA, RK & NANDGOPAL, R : Financial implications of privatisation of public enterprises in India. *MDI Management Journal*, 2(2), Jul 1989, p31-40.

71. MISHRA, RK & NANDA GOPAL, R : Public enterprises : Performance in N.E. region. *Economic Times*, Jul 27, 1989, p5.

72. MISHRA RK et al: Financing of public enterprises in India. *Public Enterprise*, 9(1), Mar 1989, p31-43.

73. MISHRA, RK et al: Public sector in Bihar : An anlaysis (Two parts). *Financial Express*, Nov 21 & 22, 1988, p5.

74. MITTAL, DUTT KUMAR : Declining employability of investments. *Financial Express*, Apr 24, 1989, p6.

75. MITTAL, DUTT KUMAR : Declining share of labour in revenues of public enterpriss 1974-75 to 1985-86. *Indian Economic Journal*, 36(2), Oct-Dec 1988, p82-87.

76. MOHAN PILLAI, P : Whither state sector enterprises in Kerala. *Economic and Political Weekly*, 25(788), Feb 17 & 24, 1990, pM9-M16.

77. MUNIRAPPA, B : Public Sector vs private sector. An intersector comparison. *Southern Economist*, 27(4), Jun 15, 1988, p11-14.

78. NAIDU, KR & RAO, BR: Public enterprises : Capacity grossly underutilised (Two parts), *Business Standard*, Dec 3&4, 1987, p5.

79. NAIR, NG : Internal ailments of public sector. *Financial Express*, Aug 10, 1988, p5.

80. NARASIMHULU, K & REDDY, AR : Growth, Structure and development of public enterprises in India. *Southern Economist*, 26(182), May 1&15, 1987, p77-79.

81. NARESH KUMAR : Resource mobilisation from international markets. *Financial Express*, Apr 24, 1989, p5.

82. NIGAM, RAJ K : Public sector: Rise to commanding hights (three parts). *Business Standard*, Nov 30, Dec 2&3, 1989, p5.

83. NILAKANT, V : A framework for understanding change in public sector enterprises. *Economic and Political Weekly*, 22(35), Aug 29, 1987 pM111-M114.

84. OZA, BK : Industrial profile of India : Recent trends The role of public sector. *Indian Journal of Commerce*, XLI (153), Oct-Dec 1987. p66-73.

85. PANDEY, KM : Capital-loan mix and profitability in central public enterprises in India. *Indian Journal of Economics*, LXIX (272) July 1988 (Annual), p31-40.

86. PANDEY, KM: Public enterprises : Appropriate pricing polity. *Economic Times*, Apr 10, 1987, p5.

87. PRADHAN, BASAN K : Public sector in India : Changing perspectives. *Vision*, 5(3&4), Jan & Jun 1986, p1-8.

88. RAMACHANDRAN, KS: Public sector divising. *Financial Express*, Feb 18, 1989, p5.

89. RAMACHANDRAN, KS : State enterprises in Asia. *Financial Express*, Aug 1, 1988, p5.

90. RAO, ASHOK K : Issues regarding public sector that need public debate. *Social Scientist*, 15(6), Jun 1987, p55-66.

91. RAO, ASHOK K : Public sector : No, short-cut to success (two parts), *Business Standard*, July 8 & 9, 1987, p5.

92. RAO, KV: White paper on public sector: An exercise in shadow boxing. *Business Standard*, Nov 18, 1988, p5.

93. RAO, KV & Prasad, G:Financial problems of public enterprises in India. *Public Enterprises*, 7(2), Feb 1987, p129-139.

94. RAO, SL: Public sector and the marketing concept. *Economic and Political Weekly*, 24(47), Nov 25, 1989, pM178-M18a.

95. RAO, SRK: Dominant public sector : Socialism through inflation. *Business Standard*, Jan 18, 1989, p5.

96. RATNAM, CS VENKATA : Emoluments in public sector enterprises : Review of Pay Committee's report, *Economic and Political Weekly*, 24(21), May 27, 1989, pM61-M66.

97. RAVENRA KUMAR : Turning public sector units : Diversification holds the key. *Economic Times*, Jan 19, 1988, p5.

98. REDDY, Y.VENUGOPAL : Bureau of public enteprises : the Andra Pradesh model (Two parts). *Economic Times*, Jan 2&3, 1990, p5.

99. REDDY, Y. VENUGOPAL : Privatisation in A.P. : Where are the gains. *Financial Express*, Jul 19, 1988, p5.

100. REDDY, Y. VENUGOPAL : Privatisation of public enterprises : Determining the criteria (Three parts). *Business Standard* Mar 30, 31 & Apr 1, 1988.

101. REDDY, Y. VENUGOPAL : Privatisation and U.K. experience : Differences in context (two parts). *Business Standard*, Jun 10 & 11, 1988, p5.

102. REDDY, Y. VENUGOPAL : White paper on public enterprises : Evolution and issues. *Financial Express*, Nov 29, 1989, p7.

103. REDDY, Y. VENUGOPAL : Who wants MOU. *Financial Express*, Apr 24, 1989, p4.

104. SADHAK, H : Improving efficiency in public sector. *Yojana*, 31(11), Jun 16-30, 1987, p18-21.

105. SAHAI, BALDEO :The tragedy of public sector (Two parts). *Financial Express*, Sep 29 & 30, 1988, p4.

106. SAHAI, BALDEO : Forty years of public sector. *Financial Express*, Jan 28, 1988, p5.

107. SAHAI, BALDEO : Profit Rise. *Financial Express*, Apr 24, 1989, p4-5.

108. SAHAI, BALDEO : Public sector : Precept and Practice *Economic Times*, Feb 5, 1987, p5.

109. SANKAR, TL et all: State level public enterprises in India : An overview. *Economic and Political Weekly*, 24(8), Feb 25, 1989, pM33-M40.

110. SAPRU, RK: Public sector enterprises - Some issues of role on international business operations. PU *Management Review* 9, (182), Jan 1986 & Dec 1986, p55-60.

111. SARKAR, SUBHASH CHANDRA : Why public sector is not succeding. *Commerce*, 156 (4000), Jan 16, 1988, p5-8.

112. SASTRY, KS : Models for performance evaluation of public enterprises - A global survey and analysis. *Chartered Accountants*, 37(7), Jan 1989, p621-625.

113. SATHE, VASANT : Management of the public sectors. MDI *Management Journal*, 2(1), Jan 1989, p45-51.

114. SEETHARAM, GN : Auotomy of a success in public sector. *Mainstream* 27(54), Oct 7, 1989, p22-26.

115. SENGUPTA, PALAS R : Social commitment and efficiency measurement in Indian public enterprises. *Public Enterprise*, 8(4), Dec1988, p299-306.

116. SHARMA, KK : Public sector : Crucial role marred by ills. *Business Standard*, Nov 21, 1987, p5.

117. SHIV KUMAR, K : Zero-based budgeting for transport corporation. *Financial Express*, Apr 24, 1989, p6.

118. SIKORSKY, DOUGLAS : Public enterprises : How is it different from the private sector - A review of literature. *Institute of Public Enterprises Journal,* 10(2), Apr-Jun 1987, p41-88.

119. SINGH, BP &SINGH, MEERA : Public enterprises in India. The new imperatives. *Southern Economist,* 28(7), Aug, 1,1989, p11-13.

120. SINGH, RADHA RAM : Public sector units : What ails their productivity. *Economic Times,* Feb 1, 1989, p5.

121. SODHIA, KC: Public sector performance : An appraisal. *Financial Express,* Jun 30, 1987, p5.

122. SRINIVASAN, G: New dimensions in the personal policies of Indian public sector units :Some case studies. *Indian Journal of Commerce* XLI (153), Oct-Dec 1987, p51-63.

123. SURESH KUMAR : Phenomenal growth of public sector. *Economic Times,* Jan 20, 1989, p1.

124. TANDON, BC : Leasing out public enterprises : An alternative to privatisation (two parts). *Financial Express,* Dec 17 & 18, 1987, p5.

125. TANDON, JK : Working of public sector in India. *Indian Journal of Commerce,* XLI (154), Jan-Mar 1988 p103-108.

126. TANDON, PRAKASH : New design for India's public sector. *Mainstream,* 25(37), May 30, 1987, p25-30.

127. TANZI, VITO : The public sector in the market economics of developing Asia. *Asian Development Review,* 5(2), 1987, p31-57.

128. TRIVEDI, PRAJAPATI : Govt. enterprises interface. *Financial Express,* Jun 27, 1989, p5.

129. TRIVEDI, PRAJAPATI : Performance evaluation system for mamoranda of understanding. *Economic and Political Weekly,* 24(21), May 27, 1989, pM55-M59.

130. TRIVEDI, PRAJAPATI : Plight of public enterprises. *Financial Express,* Apr 9, 1987, p5.

131. TRIVEDI, PRAJAPATI : Public enterprise performance information system: A proposal. *Economic Political Weekly,* 23 (48), Nov 26, 1988, pM140-M146.

132. VAIDYANATHAN, R : Financial Management in public sector enterprises. *Financial Express,* Jul 14, 1987 p5.

133. VENKATASWAMY, G : Ecology of state government enterprises : Complexity causes ambiguity. *Business Standard,* Aug 4,1987, p5.

134. VENKATSWAMY, G : State govt enterprises : Factors curb autonomy (two parts). *Business Stndard,* sep 18 & 19, 1987, 05.

135. VENKATSWAMY, G : State govt. enterprises (Bihar): Struggling in the mire of losses. *Business Standard,* Jan 7,1988, p5.

136. VENKAT SWAMY, G : State govt.enterprises (Tamil Nadu): Poor performance and mounting losses. *Business Standard,* Dec. 19, 1987, p5.

137. VENKATACHALAM, G : Poor returns and low generation of funds in the Indian public sector. *Public Enterprise,* 9(1), Mar 1989, p45-52.

138. VENKATESWARAN RJ : Public enterprises (state govt.) : Concern over drain on exchequer. *Business standard,* Jun 27, 1989, p5.

139. VENKATESWARLU, P : Economic viability of public sector in India. *Southern Economist,* 27(1), May 1, 1988, p23-25.

140. VENKATACHALAM, TV : Public sector : A satistical profile. *National Herald,* Jan 11, 1988, p6.

141. _____: Central public sector enterprises: An overview, 1980-81 to 1985-86. *Quarterly Economic Report of the Indian Institute of Public Opinion,* 30(3), Jan-Aprl, 1987, p11-12.

142. _____: Central public sector enterprises - An overview 1980-81 to 1987-88. *Quarterly Economic Report of the Indian Institute of Public Opinion,* 31(1), Sep - Dec 1987, p40-49.

143. _____: Central public sector interprises : An overview 1980-81 - 1988-89. *Quarterly Economic Report of the Indian Institute of Public Opinion,* 31(4), Jan-Mar 1989, p35-43.

Compiled by
S.N. Vig
Documentation Officer
National Productivity Council
New Delhi 110003