PRODUCTIVITY

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राष्ट्रीय उत्पादकता परिषद पुस्तकालय नई दिल्ली

National Productivity Council

ANNOUNCES

A NATIONAL TRIPARTITE SEMINAR
ON

LINKING WAGES WITH PRODUCTIVITY

At Hotel Ashoka, New Delhi During November, 24—26, 1988

In Collaboration with

International Labour Organisation ☐ Ministry of Labour (Government of India) ☐ Bureau of Public Enterprises ☐ Standing Conference of Public Enterprises ☐ Confederation of Engineering Industry ☐ Federation of Indian Chambers of Commerce and Industry ☐ Associated Chambers of Commerce and Industry of India.

OBJECTIVE

The focus of the Seminar is on developing operational guidelines on approach to and modalities of linking at least a part of the wages with productivity, in the wider context of work environment, corporate wage policy and national prices and incomes policy.

CONTENTS AND STRUCTURE

- **Inaugural Session**—Union Minister for Industry has kindly consented to deliver the inaugural address.
- **Plenary Session-I**—International perspective by M/s S. Inouye, (Japan) and G. Starr (ILO) to address the Seminar. One expert each from USA and USSR are also expected to address.
- **Plenary Session II**—Highlights Indian experiences by M/s S. Ghosh, (IIM, Calcutta) Pramod Verma, (IIM, Ahmedabad) G.K. Suri and R.C. Monga (NPC).
- **Plenary Session-III**—Presents employers' viewpoints.
- **Plenary Session IV**—Presents employees' concerns.
- **Concurrent Sessions**—To be held to arrive at specific recommendations for linking wages with productivity in manufacturing and service sectors.
- The recommendations from various groups to be presented at the last plenary session and follow-up action plan to be evolved.

PARTICIPANTS

Senior level managers involved in policy formulation relating to wage systems and productivity improvement, Trade Union Leaders and government officials from manufacturing as well as service sector organisations.

FEE

- Rs. 1450/- for Indian delegates
- US $ 150 for delegates from abroad.
- The fee covers lunch and seminar materials only.

TIMINGS

10.00 A.M. to 5.00 P.M.

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Productivity in the Indian Economy: Some Tentative Estimates

NPC Research Section

In an earlier study, the NPC has arrived at indices of labour productivity for 15 two digit industries, electricity, gas and water supply sector and the total manufacturing sector (Productivity Vol. 28(3), 1987). In this brief Report, an attempt has been made to update this data for the total economy, total registered manufacturing sector and electricity, gas and water supply sectors for the period 1980-81 to 1988-89.

For the present purposes, the output data for the registered manufacturing sector, electricity gas and water supply and the gross domestic product are taken from the National Accounts Statistics of the Central Statistical Organisation. The output data for 1988-89 is projected based on a 9 per cent rate of growth as estimated by Reserve Bank of India. The data on labour are taken from the Directorate General Emloyment and Training for the registered manufacturing sector and also for electricity, gas and water supply. Since employment data are available only upto 1986-87, the data for the period 1987-88 and 1988-89 are estimated based on the long term trend rate of growth. The labour input data for the total economy are estimated based on the percentage share of total workers (main and marginal workers) to total population as defined in the Census of India 1981. This percentage worked out to be about 37.14 which is assumed to remain constant for the period under study.

There may be some coverage problems in both the output and labour input data since they are taken from two different sources. However, the indices of labour productivity may not show wide variations because the percentage share of employment covered by DGE&T to the total employment in the organised sector could be expected to remain stable during the period under study.

TABLE Labour Productivity Estimates for Indian Economy During 1980-81 to 1988-89

	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87	1987-88	1988-89
1. *Gross domestic product at factor Cost at 1980-81 Prices* (Rs crores)	122226 (100.0)	129776 (106.2)	133830 (109.5)	144391 (118.1)	148955 (121.9)	156083 (127.7)	164441 (134.5)	170363 (139.4)	185695 (151.9)
2. *Gross value added at 1980-81 prices* (Rs Crores)									
(a) Manufacturing (Registered)	12640 (100.0)	13683 (108.2)	15026 (118.9)	17193 (136.0)	18623 (147.3)	20518 (162.3)	21759 (172.1)	23571 (186.5)	25692 (203.2)
(b) Electricity, Gas & Water Supply	1989 (100.0)	2172 (109.2)	2313 (116.3)	2476 (124.5)	2771 (139.3)	2999 (150.8)	3468 (174.3)	3735 (187.8)	4071 (204.6)
3. *Estimated no of Workers (Million)*	252.2	257.7	263.3	268.9	274.5	280.0	285.6	291.2	297.1
4. *Employment* (Million)									
(a) Manufacturing (Organised Sector)	6.05 (100.0)	6.25 (103.4)	6.29 (104.0)	6.19 (102.4)	6.18 (102.2)	6.25 (103.4)	6.27 (103.7)	6.90 (114.0)	7.09 (117.2)
(b) Electricity, Gas & Water Supply	0.72 (100.0)	0.73 (102.2)	0.76 (105.6)	0.77 (107.5)	0.80 (111.3)	0.82 (114.8)	0.84 (116.4)	0.97 (134.7)	1.02 (141.7)
5. *Labour Productivity*									
(a) Manufacturing (1980-81=100.0)	100.0	104.6	114.3	132.8	144.1	156.9	165.9	163.6	173.3
(b) Electricity, Gas & Water Supply (1980-81=100.0)	100.0	106.8	110.1	115.8	125.2	131.4	149.7	139.4	144.4
(c) GDP Per Worker (Rs)	4846 (100.0)	5036 (103.9)	5083 (104.9)	5370 (110.8)	5426 (112.0)	5574 (115.0)	5758 (118.8)	5850 (120.7)	6252 (129.0)

Productivity
1988, XXIX, 1, 3-10

Productivity From Creativity

DAVID S. BROWN

The author in this paper puts forth some caveats for improving Productivity by managing creativity in the organisations.

David S. Brown, is professor emeritus of management at George Washington University, Washington DC.

Most people think of productivity in terms of increased effort, improved efficiency, a greater commitment to the job, and the use of more sophisticated equipment. It can be all of these, of course, but it can be other things as well. It can be new products, better services, and more innovative systems for creating and distributing them.

The case far creativity is, in fact, a simple one. It is based on the proposition that it is often easier—much easier, in fact—and much more rewarding as well to devise new products, services, systems, equipment methods and approaches than it is to try to increase the performance of existing ones.

This explains why the "work smarter" philosophy that is being increasingly urged these days has become so much more prevalent than the older "work harder" one. This is why increased emphasis is being placed on finding how to do things in new and more imaginative ways and that includes government bureaus as well as other types of organisations.

While serendipity, or chance, will produce many new ideas, this is from being enough. Those who have taken a broader look at what is happening in the United States and elsewhere are convinced that creativity must be planned and encouraged—and that it must apply to more than products or machinery. Peter Drucker, one of the senior statesmen of management, is also one of the more forceful exponents of the new trend.

As long ago as 1974, he wrote ;

> In sharp contrast to the nineteenth century... innovation from now on will have to be built into existing organizations. Large businesses—and equally large public service institutions—will have to become increasingly capable of organizing themselves for innovation as well as for administration.[1]

Some Caveats

Working smarter, however, is more easily said than done. It involves, acceptance of the idea that creativity is important to all human endeavor. While this is for the most part true, it has its problems, however. There are always short-term difficulties to be overcome and some of these are likely to be serious. No wise executive, like no thoughtful military officer, will go forward without the backing of his troops which means that in one way or another they must be involved.

There are also problems of helping a system to put theory into practice. Most large-scale organisations have spent years getting individuals to perform well the tasks they are asked to do. Now, having settled in, they are fearful for many reasons of the changes which may be required of them—and doubtful of new procedures they are asked to follow. It may be a short distance from the old to the new, but it is often a difficult one to travel.

Indeed, some of the innovations that seemed in planning so desirable will need to be changed even further. Some will work badly, having not been fully thought through. New problems not readily foreseen will be encountered. New equipment will often be inadequate to what is asked of it and also difficult to accommodate. Systems once disrupted have a habit of coming unstuck again. These are arguments that many will advance for continuing to do things the old way.

Creativity may, in fact, have been what really separates us from lower orders of animals, but it is sometimes difficult to generate and apply; and even when it seems most necessary, it creates dysfunctional results of its own which, to paraphrase Shakespeare, makes us "rather bear the ills we have than fly to others that we know not of". This is not an argument against being creative, but a recognition of some of the problems organizations are bound to face in achieving it.

It does not make the need for new systems, new procedures, new products and new services any less compelling. It merely emphasizes some of the problems that must be resolved before undertaking them. Bureaucracies, in fact, are the largest and most orderly of our institutions, and probably most in need of innovation. Those who would undertake it should probably do so incrementally if also doggedly. Societies and their institutions are often well served who make haste slowly.

Being creative holds many possibilities, for individuals as well as organizations. It means new and improved products, but also much more. It means the discovery of new uses for old products, the improvement of ways by which they are produced, the anticipation of new consumer needs, their participation in the system, the finding of new markets, the providing of better delivery systems, and new and better servicing arrangements. It seeks new organizational arrangements, as heretical as this may sound to some, new communicational patterns, better sources of information, better ways of relating to clients and customers, ways of reducing conflict, of increasing individual responsibility, of gaining cooperation, of training and learning, of auditing and inspection—in short, of managing. It seeks new ways—and they must be found—of reducing dysfunctionalism, of encouraging presenteeism (the opposite of absenteeism), or dealing with employee needs (such as those caused by alcohol and drugs) of lowering stress, and much, much more.

These are significant requirements and, based upon the record, many of them are not being achieved by conventional systems with their emphasis on authority and control. *Creating* depends on our imagination, rather than our muscles, and no nation, large or small,

1. Peter Drucker, *Management* (New York : Harper and Row, 1974), p. 785.

has a monopoly on this if it chooses to use it. It is, in fact, the key not only to man's convenience but also to his survival.

Finding New Ways of Doing Things

The encouragement of individual creativity is more important than is commonly appreciated. It is also one of the newer demands which is being made on modern managers. This is something which those in large government bureaucracies do not always do either willingly or well. In the long run, the innovative organization may be able to increase its performance, lower some of its costs (human as well as financial), improve its services, and do so in more socially/politically acceptable ways.

Creating does much for the human spirit also. Who does not have a sense of accomplishment in the discovery of useful new ways of doing things ? Who does not feel a sense of personal pride in new achievements, no matter how modest, when he or she has helped to make them possible ? There is self-development also in creating because it provides paths to new and brighter ways of thinking and of acting. There is a fulfilment which one feels when one has found an answer to questions that have perplexed us for a long time, or have contributed to the general good. What matter that the triumph is, in the context of world events, a modest or even a personal one ? It is a triumph still over what has gone before.

If creativity is interpreted only in terms of light bulbs, jet engines, CAT scans, or laser beams, most of the ideas which people have will fall far short. If, however, one applies it to the processes, methods, designs, styles, recipes, repairs, or ways of performing ordinary tasks, personal as well as organizational, there is a quite different performance record. One has only to look about oneself to realize that whatever is there that was not produced by nature was developed by human beings. We build on what has gone before, adapting it to new tasks as they require doing. Each new step added to what was already there advances life a little more.

Creating is something most people have learned to do as part of maturing. Some do a great deal of it, some much less, but all have their creative ways. The world is not meant to be left as it is. It can often be modified to suit the needs we have. Innovating is for all of us a required—and logical—way of adjusting to the conditions imposed upon us. We should not have to leave innovativeness behind us when we enter our organizations. In fact, the opportunities for doing things more intelligently, more easily, and more productively are greater there than almost anywhere else. The system requires that it be able to meet the needs it will face.

Ideas are what human beings are best able to supply. It is pointless to look either to animals or to machine for them. Individuals are the only parts of organisations that are truly developable. Managers who fail to understand this are not only failing to do what they were selected to do but they are also doomed to being held hostage so systems which in the long run cannot hope to succeed.

Times, however, are clearly changing. As national markets are invaded the world over by entrepreneurs who have found better, and less cumbersome, ways of doing things, the message becomes more apparent. We must be prepared to do more and better than we have previously been doing, and that is another way of saying we must be more innovative—and more productive.

Leaders and managers who accept such a challenge can do much to meet it. To be more creative, requires the following :

1. They must have a genuine interest in creativity as such.
2. They must understand why we have not been more creative in the past—the blocks to creativity.
3. They must understand the nature of the creative process.
4. They must know something of their own creativity.
5. They must be able to find ways of involving others.

6. They must be able to create an innovative climate.

1. *An interest in creativity.* The starting point is an interest in the creative process itself. Innovation or invention often follows curiosity. Those who are curious about things—why they are what they are and how they got that way—are more likely than others to produce improvements on what has gone before. This is why a healthy curiosity is basic to improving one's own creativity.

Such curiosity ought not to be narrowly limited. It ought to go beyond the specific interests that people have in their own lines of endeavor. If one is really to encourage the native ingenuity he or she has, there must be an interest in many things, how they work and how they came about, whether on their surface they seem to have relevance or not to the assignments at hand.

The growing literature of creativity makes it clear also that one of the more important ways of inventing is that of adapting ideas from other fields. Some of the great breakthroughs, in fact, have occurred because individuals were willing to attempt this. The fit may not have been a perfect one but with further adjustment it was made to work.

This is an assignment which goes counter to much we have been trained to do. At a time when specialization is being encouraged, managers are being urged to broaden their vision, to become interested in things that on their surface have little to do with the work in which they are already engaged. They are being asked to ask questions, to explore, to observe, and above all, to interest themselves in matters where there may be no ready answer.

2. *Understanding the blocks to creativity.* One of the reasons people are not more creative than they are is that there are so many pressures upon them to conform to, or at least to accept, existing ways of doing things. An awareness of these pressures is important to those who wish to improve not only their own innovativeness but that of others. One may not be able to fully escape them but an appreciation of the restraints they place upon people will help one to find ways of parrying and sometimes avoiding them.

Socio-cultural blocks. All societies have their mores and customs which are passed on from one generation to the next. The child at an early age learns as part of maturing what is acceptable and what is not. These are administered by parents, relatives, teachers and playmates. The good little boy or girl is the one who learns them at any early age and respects them. In later life, restraints are impressed by the members of the group, be it a social group or an organizational one. Penalties are in store for the norm-breaker in adulthood just as they were in childhood.

Organizational blocks. Organizational blocks are primarily devices for standardizing and controlling behavior. The system prescribes its own restraints: job sheets, duty requirements, managerial prerogatives, hierarchies, budgets, and much else. These serve a purpose, but they also have their by-products and these are substantial. Rewards go primarily to those who conform.

Each profession, whether intentionally or not, places restrictions on its members. We have also been taught to think of invention as related primarily to *things* and not to institutions, systems, methods, and attitudes. Our failure to see creativeness as a solution to many of our problems is to encourage other, less productive approaches.

Physical blocks. There rarely being a surplus of resources, those who would try something new and different are limited in what they can do by the fact that the wherewithal for it is simply not available. If assistance is needed, ways must be found for finding or funding it. Those with the innovative urge learn that it is easier to continue doing what they have been doing for a long time whether it really makes sense or not.

Conceptual blocks. People who have written of innovation and how it can be encouraged make much of the fact that basic learning processes are built on systems which make creativity difficult. Edward De

Bono calls this "vertical thinking." He recommends something he calls "lateral thinking" as a way of opening new vistas in conventional logic. This is probably not far off the mark.[2]

There are many reasons why people are not more innovative. They fail to identify the problem they are addressing, they have difficulty isolating it, they limit themselves to self-imposed rules, they dismiss what they regard as trivia. They say "I need a hat" when what they are seeking is protection for the head. Certain values, as this implies, are emphasized to the neglect of others. If one will observe one's own proclivities, much will be revealed that will not sustain itself.

Individual blocks. Man is a creature of habit, and what works for him is likely to be repeated, sometimes *ad infinitum*. This occurs so often and so consistently it is taken for granted. Yet habits, once formed, are not easily broken, which explains why they are continued. It is not that new ways of doing things are unwelcome, it is that they require a changing of habits, and sometimes this is a requirement we do not wish to face. Too often the game seems not worth the candle.

Thus, motivation to innovate is, in fact, seriously lacking in individuals as well as organizations. Management, it is often remarked, gets what it really wants, not what it says it wants. If we want members of the organization to be truly innovative, we must do more than talk about it. We must provide encouragement for it.

3. *Understanding the creative processes.* Creativity is often described as one part inspiration and nine parts perspiration. There is a lot of truth to this, but it is better said that some of it is pure chance (serendipity), some of it comes from inspiration, but much more from system. The great inventors have each had a system and, as their biographies reveal, they have followed it assiduously. It involves, among other things, observing, exploring, experiencing, experimenting and risking.

Many of the ideas people have burst promptly from the soil, as do weeds in spring, but many others, including most of the better ones, are a much longer time in coming. It is here that managers must learn the importance of patience. As the great French scientist, Buffon, has noted, "Genius is a long patience."

Whatever the processes in which they are acquired, they need time for incubation, maturation, and much else. Attempting to hurry them along will not suffice. Those who would learn of creativity must become aware also of the time factor. It is sometimes a long step from the intellectual to the practical. Useful ideas need marination.

Observing others, and their ways, asking questions of them, and reading of the creative processes and how they work, are the grist from which learning is derived. Managers should lose no opportunity to enlarge their knowledge. This is why field trips are so important. This is why seeing how others do things is always an enriching experience.

4. *Probing one's own Creativity.* Most people are more creative than they think. If one rates oneself only by the number of silicon chips one invents, one will get one answer. If, however, one records all of the ideas one is responsible for, whether they have to do with the office, shop or the home, one will discover that the number is considerably greater. A useful approach therefore is to record what one has done that makes life simpler or easier. The purpose is to remind oneself that in one way or another we are all inventors of ways of doing things.

Some assignments call for greater innovation than others. Writers are a particularly imaginative sort, but so are artists of all kinds. And, so, for that matter, are people who work with various kinds of equipment. They learn what keeps it going—and how to get it going again when it stops. They observe its idiosyncracies and build upon them. They also remember and use what others do, and adopt as needed. Cooks are innovative but so are teachers, particularly the

2. Edward De Bono, *Lateral Thinking: How to Use Your Ideas to Achieve Success* (New York: Taplinger), 1970.

good ones; plumbers, engineers, advertising people, those whose careers depend on their successful dealings with clients and publics, farmers, physicians, and managers. The latter may be reluctant to tell of some of the things they do but that is often because they regard what they have done as no more than one should be expected to do.

Those who have studied the innovative processes know also that some places and some times are more productive of ideas than others. This is why organizations go to great lengths to provide laboratories and research centers that are removed from day-to-day pressures. They seek a climate where individuals can think, ruminate, experiment and test. Individuals are provided the opportunity to work alone if that is their style, but also to relate to others as the need arises. The point is that we should get to know ourselves first of all.

5. *Involving others.* In one way or another, invention involves other people. Using what others have created means that we do not have to create if afresh. As individuals, we turn to them for help. We seek out those whose expertise is needed. The committee, regardless of what its critics say of it, is a way of doing this. We build on what has gone before. Management's primary task, as noted earlier, is that of producing a concert for action. It is one of solving problems where individuals cannot do it alone.

Big companies and government agencies have institutionalized the process by creating special divisions for this purpose. They are often called R & D (for Research and Development) but there are other ways also, just as there are many ways by which people work together. The formal organization is only one of them.

6. *Creating a climate for innovation.* To obtain the ideas that it needs, management must have a climate for it. This is no one-shot thing, but, rather, a continuing process.

Those in the organization must know that their contributions are wanted—and will be rewarded. Those at the top must be willing to listen to what others suggest. They must be ready, if the idea seems to be a good one, to risk it out. They must encourage the contributions of others to the common goal—and, as part of this, they must reward those whose ideas are accepted. These conventional rewards are recognition, advancement, higher salaries, special cash awards, time off, sabbaticals (where appropriate), etc. to establish the proper climate.

Much can be done by way of training. Those who are members of the organization must feel that their ideas are wanted, and if not always used, are still valued. Organizations, of course, have a number of purposes to pursue, but those who are part of them should understand that better ways of doing what they do always occupies a high place on the list of priorities,

The Formal Organization

Many large private sector organizations have their own R & D units, as previously noted, whose purpose is that of developing the products—and the ways of producing them—that their business demands. Others have created separate organizational units to explore areas which they believe offer potential. Still others turn to other companies to do what they do not have adequate in-house facilities to do themselves. U.S. government agencies require that an investment be made by contracting companies in something called value engineering to improve upon the products they are pledged to produce.

A coutinuing function of systems analysis is that processes and procedures which the organization follows be examined regularly to determine ways of improving them. Most large organizations have for years had suggestion systems. These provide management with ideas which, if they depended on the chain of command, they would otherwise not get. Some of these are quite elaborate. The point is that many people within the system have useful ideas, and it is to the organization's advantage to tap these sources.

A variety of techniques have, of course, been developed to encourage innovation. These include ways of identifying gools to be sought (analogies with

what nature can do, symbolic analogies, personal analogies, fantasizing, etc.) and then seeking to achieve them. Free association is encouraged, but so also, with the help of the computer, are cross relationships, attribute listing, and random search. What one area of technology has to offer is often applied to others.

Intraprenuring, a name that has been given a particular kind of research and development, sketches the care and feeding which these require.[3] The 'Post-it'' gummed note pads which the Minnesota Mining and Manufacturing Co. (3M) developed a few years ago is a case in point. The search for the right adhesive required a several-year commitment from the company to the man whose idea it first was. Many successful breakthroughs have been possible because the parent company was willing to provide financial backing and moral support. Also, those working on a given project must have relief from other assignments as well. Sometimes their effort has been rewarded, sometimes not.

Knowing when the trail is a positive one often requires tough decisions to be made. These often heavily commit available resources. Sometimes the organization must be prepared to write off its effort, but at other times, the fact that it has continued with it as long as it has, demonstrates to others as little else can do its willingness to support those who are creative.

This, of course, explains why those companies engaged in manufacturing invest substantial sums of money in research and development. They have learned that they cannot depend on chance alone or even the buying of ideas from others to keep them in business. No longer can they depend either, as they once have done, on the hermit genius spinning out in his hidden laboratory the ideas that they will need. R & D is an investment in a team product.

3. Gifford Pinchot III, *Intrapreneuring ; You Don't Have to Leave the Corporation to Become an Entrepreneur* (New York : Harper and Row, 1985).

Encouraging the Individual

On a lesser scale, there are other ways by which the manager can induce and encourage creativity. There is, first, the use to which staff meetings of various kinds can be put. There are also quality circles and related group effort.

Problem-solving meetings. Almost any kind of meeting can, in fact, become a problem-solving one if the chairman is willing to use it as such. The best meetings for this purpose are those in which the members have no major organizational commitments to protect. One in which a member is there to defend his own turf will ordinarily not find him enthusiastically supporting inroads upon it.

There are many ways by which the manager/chairman can launch his inquiry. He can pose a problem that has been raised. He can speak to it, or invite others to do so. He can ask that it be looked into, or even researched. He can look to, and should always be concerned with the development of a climate where it is clear that ideas are wanted and will be valued.

As the chair, he should see to it that the meeting provides an opportunity for openness. Horseback, or spur-of-the-moment, decisions are to be avoided. All they do is discourage participation, and, when made are more often a manifestation of personal power than they are of sensitivity to the contributions of others. A meeting which prides itself on its formality will hardly produce useful solutions to pressing problems.

Quality circles. The Japanese, building upon ideas suggested by Dr. E.M. Deming, an American, have had considerable success with an arrangement called Quality Circles, or QC for short. These are teams of lesser level employees, chaired by a trained supervisor or manager, which are given the opportunity to address operational problems that previously were turned over to higher level people, including engineers. Some Japanese companies have had notable success with them, so much so that the idea has been accepted by a growing number of American companies and government agencies. QCs provide an idea-producing

arrangement which has had the additional advantage of helping its participants to become a more productive part of the organization.

One should not, however, jump to the conclusion that these are by themselves responsible for the success of Japanese industry in world markets, or are even characteristics of Japanese industry as a whole. They appear in their best companies there (primarily their export industries) but vary in their effectiveness. To work well, they require time and attention from management, and also the special training of those who work with them. American experience underlines these points.

Quality circles are indicative of the resources, even at operational levels that are available to management if it would only cultivate them. Those who have worked with them speak of the ideas they have produced and the enthusiasm they engender. Management, for its part, must be willing to recognize these contributions and to see that they are suitably rewarded.

Special purpose meetings- The experience with QCs suggests the value of *ad hoc* or special purpose meetings which can be dismissed once their objectives have been achieved. There are any number of ways by which they can be formed and ways also of encouraging the creativity of their participants. A single meeting is usually not enough. People need to have a chance to think through the problems that are posed. Often they return to later sessions with new and useful ideas. Those who have set up "brainstorming" sessions first used in the advertising industry in its search for marketing ideas, have suggested the rules to be followed. They have found that individuals stimulate each other.

The approaches which most trainers and managers offer involve the finding of ways by which a problem can be seen in different dimensions than it has been traditionally viewed. Many hands make light work, and many minds focussed on the same problem increase the likelihood that solutions will be found. By "piggy-backing," participants are urged to build upon the ideas of others.

The approaches being suggested here do not, of course, exclude others. Each indeed may have his own. A starting point is often a listing of the criticisms one has of existing arrangements. This provides a useful focus on what needs to be done to make the product or service better suited to client requirements. The group can take it from there.

As this article suggests, improving productivity is more than working harder or more efficiently. It involves doing new things—and also doing old things in new ways.

It is particularly important that public sector organizations look to ways by which bureaucratic patterns can be improved. A failure to do so, a failure to make government responsive to the needs and wishes of its citizens, encourages disaffection among those it pretends to serve. More importantly, it deprives them of what they have a right to expect.

Large bureaucracies have arisen because of the demand for services. Employees traditionally have been instructed in doing what they do according to time-honoured ways. Unless efforts are made to change them, and the procedures that guide them, they will be continued.

Improving productivity is, of course, everyone's business, but it is in particular that of those in leadership positions. Making their organizations more productive requires many things, and that of making them, and their members, more creative is one of the most important of these. It is time that we gave it the attention it deserves.

Productivity
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Productivity and Inflation

L.R. OLIKER

This paper discusses the linkages between Productivity and inflation. The author suggests policy changes to overcome inflation and improve productivity growth.

L. Richard Oliker is Dean of School of Management, Syracuse Universlty, New York-13244-2130.

Productivity and Inflation

Not too many years ago, one of the major economic concerns for many countries was "stagflation;" defined as the coincidence of inflation and recession. As inflation rose in the United States, it was accompanied by a serious slow-down in national productivity. It is this latter element—productivity—which needs to be critically addressed in terms of impact on inflation and our competitive capability in the international marketplace. That proportion of wage and salary increases, which is not directly offset by higher productivity levels, must be recovered through price increases. As this occurs, the rate of inflation escalates. If we are able to take policy action which reduces this rate or, better still, increase the level of productivity, we are on the road toward dealing with the industrial restructuring process in a more effective manner.[1]

Analysts agree that productivity has declined in the past 15 years. However, there is considerable argument as to the actual importance of productivity as an inflation-reduction mechanism. When the rate of inflation rises sharply, as it did in the early 1980s, Congressional and public concern turn to a consideration of the ways to increase productivity. When the inflation rate slackens, that concern dissipates. If the rate of inflation declines as a direct results of a positive policy initiative of one variety or another, it could be one or a combination of :

1. Tightened monetary policy.

2. Reduced government spending (fiscal policy).
3. Tax policy changes to stimulate capital investment.
4. Fiscal policy improvements to increase R & D expenditures in both the public and private sectors.

However, if no articulated action is taken and, because of external factors, the rate of inflation declines, the result will be the same. Public concern disappears. But productivity in such a case remains as an unaddessed problem. Thus, in 1985 and 1986, as the rate of inflation declined, Congress appeared to breath a sigh of relief and turned its attention to more parochial fields of endeavor. The opportunity to take action that would enhance the level of productivity went unfulfilled. The basic causes for the steady decline in productivity from 1973 to the present were ignored. However, they need to be reviewed to indicate that, *if* we could improve productivity, we could over time "continue in unwinding inflation, increasing standards of living, creating jobs, and making the U.S. increasingly competitive internationally".[2]

The reasons for the prevailing slowdown of productivity are usually associated with :[3]

1. The decline in the rate of growth of capital investment on the part of the private sector. Inflation discourages this form of investment, at a time when enormous sums of capital will be required to expand the level of economic activity. This growth is necessary in order to create some 20 million more jobs for new workers entering the labor force and to reduce the present ranks of the unemployed.
2. The fact that a majority of the new jobs created since the mid-1960s have been either public sector or in the labor-intensive services areas. These two particular areas have not achieved any noticeable improvement in productivity. While smaller ventures have provided an increased source of jobs, many large manufacturing firms, whose rates of productivity have been high, are no longer able to compete in the international marketplace.
3. Vacillation in government policy. During the very period in which tight monetary policy was in place in an attempt to cool off the sources of inflation—1979-1985—fiscal policy was in the process of accruing a more than $1 trillion addition to the national debt. Thus, lack of policy orchestration produces a climate of uncertainty and heightened risks. Long-term planning and capital decision making are depressed by such an economic environment. Product and process development are slowed. As a result, productivity slumps.
4. The cartelization of oil prices in 1973 and the subsequent effects on the cost of doing business. The lack of a coherent energy policy on the part of the public sector acted to exacerbate the risk of uncertainty and inhibit private sector initiatives which would have gone a long way toward raising labor productivity.

Interrelated Elements

Inflation and productivity *are* interrelated elements. At one time the former was not considered to have a serious effect on the latter. More recently, research has revealed the opposite. As a result, "a slowdown in the productivity growth rate during one period will ignite an inflation speedup, not only in that period, but in succeeding period—even after the decline in productivity growth is halted".[4] The reverse will also be true over time if productivity starts to rise. This presents a viable opportunity for policy makers to take action to build upon this so-called "multiplier" effect. As noted above, the current economic environment is simply not conducive to productivity increases. Mainly because inflation was (in 1986) no longer considered to be a problem. However, unemployment was. Increased productivity could go a long way toward maintaining our commitment to the goals of the Full Employment Act of 1946.

This productivity-inflation multiplier has been

described in terms of the push-pull effect which is manifested between these two elements:

> "According to our estimate, the core rate of inflation has moved up from 2 per cent before 1970 to about 8 per cent today at the same time that productivity growth has moved down from 3 per cent to 1 per cent. We also estimate that even if productivity growth were to move back to 3 per cent, the equilibrium rate of inflation would go no lower than 4 per cent because of higher costs of regulation, energy, and other raw materials. This suggests that each 1 per cent increase in the productivity growth rate would lower inflation by about 2 per cent".[5]

The foregoing was taken from a 1979 report. The report and its date are significant for several reasons. First because it provides additional support for the productivity-inflation multiplier idea. Second because it refers to several factors which would inhibit the decline of inflation below a certain level. Third because, with the rate of inflation on the way down in late 1985, any positive impact on productivity had yet to be revealed.

In terms of the second point above (an inflation limit), all three of these "limiting" factors have changed radically since 1979. Government policy in the United States has moved away from a regulated private sector to a deregulated one. While the costs associated with the unchoreographed deregulation have yet to be calculated, a significant increase in privatization has been achieved. At least deregulation was one area where direct policy action produced some results. Energy and other raw material cost reductions have taken place as a result of external market forces. The former have already been described. The latter were deflated in the earlier part of this decade and, given the slow rate of economic recovery of industrial nations, rose only slightly through 1986.

Based upon this analysis, the U.S. rate of inflation has declined via a combination of tight monetary policy and falling raw material prices, rather than through any increase in the level of productivity. However, economic conditions in 1986 created a fertile environment for later increases in productivity because of the multiplier effect. Lower wage settlements, a retirement from the COLA approach, and an increasingly entrepreneurial business sector all add to that growth potential. The gains which could be derived from higher productivity are that they can :[6]

1. Lead to lower prices, or to a lower rate of price increases, directly benefiting consumers.
2. Be passed along to workers in the form of increased hourly compensation.
3. Be used to offset increases in nonlabor costs, thus forging a possible price increase.
4. Be used to increase profits as the basis for later capital investment outlays.

Whatever the results, productivity improvements can be pervasive. Every sector of the economy may benefit. This is what makes productivity such an important feature of economic operation. It provides a basic response for some of the more critical policy issues of the day. Action taken on the policy level to achieve productivity gains may return partial control over industrial restructuring to Federal decision makers. Without such control, the U.S. economy can only attempt to react to forces over which it appears to exert little or no influence.

Present and future economic competitiveness is founded on the fundamental ability to develop our resource base in an optimal fashion. This will lead to the products and services which improve the well-being of all citizens and help to guarantee improved national welfare. In the post World War II decades, new technology was responsible for nearly half of all productivity gains : for more gains than due solely to better education, better resource allocation, more capital or economies of scale. Productivity is the key to competitiveness.

Inflation is a relative term. What passes as a high rate of inflation in the U.S. may be far below normal in another country. Some Third World countries have experienced three digit inflation for extended periods. To them double-digit inflation would be a relief. And while some of those nations, via the expedience of

currency devaluation and austerity economic programs, have reduced their rates of inflation significantly, they continue to suffer from chronic inflation all the same. As a result, their capacity to increase the level of investment necessary to raise their basic standard of living is considerably retarded. Inflation is not a benign force. Given its ability to feed upon itself and the pervasive nature of its economic impact, it needs to receive increased policy attention, particularly in terms of the productivity improvements that can contain many of its negative consequences.

Implication for the Future

One thing about the foregoing explanation of inflation as a structural force is clear: productivity gains can reduce inflationary pressures. Tight monetary policy, reduction of government spending and increased taxation may act to accomplish the same end result, but they do not fuel the economic growth needed to provide for societal development. The multiplier effect of productivity increases to bring about more than proportionate reductions in inflation offers the most favourable approach to contain this particular repositioning force.

This is one rationale for the trend on the part of an increasing number of business firms to tie wage increases to increases in productivity. In this way, a wage settlement would not be inflationary, if it were accompanied by productivity gains. One way which a business firm can achieve these productivity improvements is to increase its level of capital investment. By becoming more capital-intensive, it can reduce its total wage bill, increase overall efficiency, improve product quality and, as a result become a more competitive economic unit. The introduction of the so-called "mini-mill" by the steel industry is a case in point. Small, highly automated mills were built in areas close to major customers. They required an annual put-through about 15-20 per cent of that necessary for large, "greenfield" plants in the industry. They could be operated with relatively small labor forces. They became a singularly successful feature of an industry caught between growing obsolescence and international competition.

The Federal government needs to establish some means to develop a consolidated policy approach for its various economic policies in such a manner that productivity improvement becomes accepted as a national goal. This may necessitate a re-articulation of basic governmental operations. Redundant, overlapping and conflicting policies would not be allowed. We seem to be well able to do this in time of national crisis. Under the aegis of an emergency, the government appears capable of fulfilling desired, macroeconomic goals. The same sense of urgency needs to be brought to bear on the productivity-improvement issue. It can be done—if and when Congress and the White House agree to make it a critical national objective.

There is also a necessity to change the pattern of consumption in the economy. This has been described as a move from consumerism to consumption. Rationing does this job during wartime. Wage and price controls can do the same thing. This time, it's different. The composition of consumption needs to be influenced for two basic reasons. One is that this will supress inflation. The other is that it will channel more money into savings, which in turn can be converted to capital investments for productivity improvement purposes. Tax policy can be designed toward that end.[7]

The policy changes which would be required to insure general productivity improvements would be extensive and quite complex. The interrelatedness of the economic factors involved—wages, prices inflation and productivity—makes this goal all the more difficult. However, the U.S. is already paying a staggering social cost because it has not taken any positive steps toward this end.

"Productivity growth and inflation are linked in a complex interactive relationship. A change in the rate of productivity growth produces a multiplied effect on the rate of change in inflation. But that is not the end of the interactive. A rise in the rate of inflation, in itself, causes feedback effects on the pace of inflation. These effects are produced via interest rates and the incentive to invest. As interest rates rise in response to higher inflation, the hurdle rates to be met by new investment projects also rise. Unless the

projected profit rates of new investments rise with inflation, and unless the risk factor incorporated in new capital projects remains unchanged, capital investment will respond negatively to rising inflation. In general inflation *does* tend to depress capital formation and, in time, productivity growth."[8]

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Productivity
1988, XXIX, 1, 17-22

Labour Productivity Index—Through Sensitivity Analysis

R.S. DHALLA
P. VENKATESWARLU
P.L. JOSHI

In this paper the authors present a case of the textile industry in which they arrived at labour productivity index through sensitivity analysis, They observe that LPI can be influenced by factors such as product mix, manpower employment and random variability in production quantity.

R.S. Dhalla, P. Venkateswarlu & P.L. Joshi are with National Institute for Training in Industrial Engineering, Vihar Lake, Bombay-400 087.

The textile research associations have conceptualized a standard mill and developed technical standards/ norms for labour employment and machine parameters. These standards are basis of inter-mill comparisons for annual productivity surveys conducted by the textile research associations. Modi and Joseph (1982) defined both, overall as well as sectional, labour productivity indices. Overall indices are for thc entire process (spinning), while sectional indices relate to subprocesses like ring spinning. In this context, Modi and Joseph (1982) have evaluated LPI by comparing the actual man hours employed with the standard man hours required for the production of all products manufactured in the section per unit time. The LPI is mathematically represented as :

$$LPI = \frac{\sum_{i=1}^{k} P_i S_i}{A} \times 100$$

where P_i = Productivity quantity in kilograms per unit time (shift or day) of ith product

S_i = Standard man hours required per kilogram of ith product

A = Actual man hours employed in the section or process per unit time (shift or day)

k = Number of products manufactured in the section.

The Present Work

The present work aims to analyse the sensitivity of the LPI for various product mix, manpower employment and variability in production quantity produced per unit time for each product of a given product mix. This work is based on the ring spinning section of a textile mill where different counts of yarns (products) are spun on ring spinning frames (machines).

The Ring Spinning Section of the Textile Mill

The ring spinning section of the textile mill under study consists of the following :

1. There are 50 identical ring spinning frames, each frame consisting of 440 spindles (machine units).
2. The section works on a three shift basis, where the first and second shifts are of 8 hours duration, while the third shift is of 6.5 hours duration.
3. The basic product mix consists of 10s, 20s', 36s, and 50s yarn counts. (10s and 20s are carded counts while 36s and 50s are combed counts).
4. Count-wise standard machine parameters and labour employment are used as per Bombay Textile Research Association standards; these are summarized along with arbitary machine allocations for the basic product mix and are shown in Tables 1 and 2 respectively.

Sensitivity of LPI with Respect to Product M ix

Using the standard parameters and data in Tables 1 and 2, the LPI is calculated as 83.85% for the basic product mix (Appendix-A).

It is possible for a mill to change its product mix either by allocating more machines to one counts or to spin only finer or coarser counts. Such a decision will have effect on the LPI because the production quantities will change as per the change in the products or counts. However, the labour employed will be the same, since for a short term, changes in labour rationalization or deviations in labour employment cannot be resorted to. It is further assumed that the workers are permanent employees protected by their trade union.

TABLE 1

Countwise standard machine parameters (BTRA), arbitary machine allocations and production figures

Count	Frames Allocated	Spindles allocated	Spindle Speed (RPM)	Twist Multiplier (TM)	Twist/Inch $=TM\sqrt{Count}$	Efficiency (%)	**Production (kgs/22.5 hours)	
							Production per frame	Total Prodn.
10s	10	4400	9000	4.8	15.17	82	433.2	4332.0
20s	15	6600	12000	4.6	20.57	84.5	219.6	3294.0
36s*	20	8800	13750	4.3	25.80	87	114.7	2295.0
50s*	5	2200	14250	4.2	29.69	87	74.3	372.0

*Combed

**Production/frame (kgs/22.5 hours) of a particular count. $= \frac{\text{Spindle speed}}{\text{Twist/inch}} \times \frac{60 \times 22.5 \times \%\ \text{Efficiency}}{36 \times 840 \times 2.2 \times \text{count}} \times 440$ spindles

**Production (kgs/22.5 = Production/frame × No. of frames alloted for that count hours) of a particular count.

TABLE 2

Countwise daily standard labour employment**

Count	Different labour categories employed daily in the ring spinning section						Standard Man hours per kg. of count produced
	Siders	Doffer boys	Jobbers	Material handlers	General labour complement	Total	
10s	10	8	1	4	6	29	0.150
20s	8	6	1	3	9	27	0.150
36s*	7	7	0	2	13	30	0.220
50s*	1	2	1	1	3	7	0.285
Total	26	23	3	10	31	93	

*Combed

**BTRA Standards (1985).

A sensitivity analysis was conducted for six different product mix and constant labour employment to study the effects on the LPI; values for which were calculated for the six different product mix (Table 3)

TABLE 3

Sensitivity analysis of LPI with product mix*

Mix	Count	Frames allocated	Production of count in kg/22.5 hours	LPI (%)
Basic	10s	10	4332.0	83.85
	20s	15	3294.0	
	36s	20	2295.0	
	50s	5	372.0	
1	10s	50	21660.0	155.26
2	10s	40	17328.0	134.34
	50s	10	744.0	
3	20s	35	7685.0	73.18
	36s	15	1721.0	
4	20s	15	3294.0	65.82
	36s	35	4014.5	
5	10s	10	4332.0	71.57
	50s	40	2976.0	
6	50s	50	3720.0	50.60

*Constant labour employment (93) for all product mix.

keeping the labonr employed constant at 93.

It can be seen from Table 3 that for the same labour employment, the LPI varies proportionally with the quantity produced. Hence, the LPI increases if the mill spins a larger proportion of coarser counts (10s, 20s) which weigh more. The reverse occurs, when a larger proportion of finer counts (36s, 50s) is spun. However, if the LPI of each of the above mix is computed according to the standard labour employment and not for a constant labour employment, the values of LPI differ significantly from those shown in Table 3, since standard assignment are a function of end breaks, doff weight, number of doffs/unit time, etc. The LPI computed for the six different product mix with standard labour employment are shown in Table 4 and indicate :

(a) For the same time production quantity, there exists a difference in the LPI values calculated by considering standard labour complement for a particular mix and constant labour employment (i.e. 93). This difference is minimum when the labour employment (standard and constant) are almost equal as in mix# 5.

(b) The LPI computed with standard labour

TABLE 4

Sensitivity of LPI with product mix using standard labour complement

Mix	Standard labour employed*	LPI (%)	LPI for the same mix with constant labour of 93
Basic	93	83.85	83.85
1	140	103.13	155.26
2	125	99.87	134.24
3	84	81.02	73.18
4	78	78.47	65.82
5	90	73.96	71.57
6	60	78.43	50.60

*BTRA Standards (1985).

complement and standard machine parameters must be around 100% as in the case of mix #1 and 2. However, for the others mix, (mix #3, 4, 5, 6) there always exists a possibility to reduce the standard labour complement and increase the LPI.

Effect of Variability in Labour Employment for a given Product Mix

In this case, it is observed that there has been a variability in daily man power employment. This has been attributed to the shortage of permanent workers around festival, marriage and harvest seasons. Hence, the mill employs labour on a temporary basis. The men employed may be less as per the usual employment or more on a particular day as per the prevailing situation. Usually a variability of 5—8% of the normal employment is expected on the lesser side. There is always a pressure of surplus labour in the mills and hence the case of a mill employing labour on the higher side of the normal employment is not considered.

A simulation has been carried out with respect to the variability in daily labour employment for the basic product mix and the corresponding LPI values are calculated in Table 5 and the following points may be noted :

1. For the same production quantity of counts produced for any given product mix, the LPI increases if there is a reduction in labour employment. However, the labour assignments and work loads increase; it may not be possible to get the same production quantity; or the mill may have to bear up with additional wage allowances.
2. If the mill employs temporary labour, they may not be skilled enough to deliver the target production.
3. As there is always an excess/surplus labour employment, there exists a possibility of increasing the work loads and labour rationalization.
4. The LPI is vulnerable to product mix. Thus the LPI does not show identical changes for the same change in employment for different product mix.

TABLE 5

LPI and variability in daily labour employment with a basic mix

Daily labour employment	LPI (%)
93	83.85
91	85.69
89	87.61
87	89.63
85	91.74

Effect of Variability in Production Quantity of a count product on the LPI for a given Product mix

Random variability in the production quantity of a count produced is inherent as per the process capability. The expected random variability may be more for a particular count, whereas less for a particular count.

An attempt has been made to simulate the vari-

ability in production quantity and its effects on LPI. The variability measure is derived from actual data of a ring spinning section of a textile mill (Table 6 and 7).

TABLE 6

Variability in production quantity per frame (kg/22.5 (hours) for a given basic product mix

Count	Standard Deviation kgs/22.5 hours per frame	Mean production
10s	10	433.2
20s	2	219.6
36s*	3	114.7
50s*	1	74.4

*Combed.

variability in production quantity, each in isolation. The LPI increases for a coarser product mix and decreases for a finer product mix for the same labour employment. The LPI is expected to be around 100% when standard labour employment and parameters are used. This tendency is exhibited by the coarser mix, and establishes possibility of increasing the LPI by reducing the labour complement for a finer mix. The LPI is directly vulnerable to random variability in quantity produced for the same labour employment and is normally expected to vary 0.25% about the mean value.

In real situations, the factors affecting LPI if viewed collectively, can have a considerable and significant effect on LPI. This phenomena is not particular to textile industry but is applicable in general to all automatic and semiautomatic industries.

TABLE 7

Random variability in production quantity (kg/22,5 hours) of a count and LPI for the basic product mix

Count	Frames allocated	Spindles allocated	Total Production	Labour employed	LPI (%)
10s	10	4400	4332.0±30		
20s	15	6600	3294.0±6	93	83.85%
36s*	20	8800	2295.0±9		±0.24%
50s*	5	2200	372.0±3		

*Combed

The LPI varies in direct proportion with the production quantity produced for the same labour employment. The LPI values may differ from day to day (83.85% ±0.24%) for the same product mix and same labour employment only due to random variability in the process. The expected value and variance of LPI is shown in Appendix-B.

Conclusion

A sensitivity analysis was conducted for the LPI by taking product mix, labour employment and random

The abnormal high or low values of LPI in these automatic and semiautomatic industries are to be interpreted rather carefully keeping in view of the possible effect of the factors discussed in this paper.

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APPENDIX—A

Evaluation of LPI

Using data in Table 1 and 2

$$LPI = \frac{\sum_{i=1}^{k} P_i S_i}{A} \times 100$$

$$LPI = \frac{(4332.0 \times 0.150) + (3294.0 \times 0.150) + (2294.0 \times 0.220) + (372.0 \times 0.285)}{93 \times 22.5} \times 100$$

$$LPI = 83.85\%$$

APPENDIX—B

Expected Value aud Variance of LPI

A = Actual man hours employed per section per day

P_i = Production quantity of count produced in kgs/22.5 hours

S_i = Standard man hours required per kg of count produced

$V(P_i)$ = Variance of production quantity of a count produced

$E(LPI)$ = Expected value of LPI

$V(LPI)$ = Variance of LPI

$S(LPI)$ = Standard deviation of LPI

$$E(LPI) = \frac{\sum_{i=1}^{k} P_i S_i}{A} \times 100$$

$$E(LPI) = 83.85\%$$

$$V(LPI) = \frac{\sum_{i=1}^{k} S^2_i V(P_i)}{A^2} \times 100^2$$

$$V(LPI) = \frac{(0.150 \times 10)^2 + (0.150 \times x2)^2 + (0.220 \times 3)^2 + (0.285 \times 1)^2}{(93 \times 22.5)^2} \times 100^2$$

$$= 0.0065$$

$$S(LPI) = 0.08\%$$

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Personality and Politics in Organizations

PRAMOD KUMAR
REHANA GHADIALLY

This article is based on the study of organizational Politics as a process of influence in relation to personality variables such as Machiavellianism, attitude towards employees and discrepancy in control.

Pramod Kumar is with Indian Institute of Management, Ahmedabad-380015.
Rehana Ghadially is with Indian Institute of Technology, Powai Lake, Bombay-400076.

Organizational politics is basic to organizational functioning. Politics, as a method of managing worker/management relationship and interpersonal skill is observed in highly productive organizations, such as General Motors, IBM, and Johnson and Johnson. (Schilit, 1983). National Science Foundation (NSF) study showed that about 20% of the price advantage of Japanese auto-makers over their American competitors was due to advanced use of industrial robotics, while 80% of their advantage was attributed to their collaborative management/worker relationship (Macher, 1986). Nevertheless, political behavioural skills are inadequately explored area of research in India.

A political perspective developed after a long term observation of human behaviour in organizations. This view holds that there is a political process going on within organizations. Politics involves skills and strategies aimed at exercising influence, control, power, and change. Here, organizational politics is defined as a process of influence aimed at producing organizationally relevant outcomes and pay offs for self-fulfilment.

Researchers concerned with the study of politics have identified a large number of political behaviours, viz., structure change, cooptation, ingratiation, threat (Kumar, 1983; Pandey, 1981; Gamson, 1968), impressing your boss, and career advancement strategies

(Durbin, 1978), making strategic replacement, building personal stature, alliance formation (Schilit, 1984), sanctions, persuasion, and threat (Ansari et al, 1984).

Recognizing the importance of political behaviours researchers have examined the relationship between actor's personality and political behaviours (Pandey, 1981; Deluga, 1986). Some of these personality variables include n-achievement, dominance, authoritarianism, and Machiavellianism.

Machiavellians are highly manipulative in their functioning and show lack of conventional morality, emotional involvement in interpersonal relationship, and ideological commitment (Christie and Geis, 1970). With the except of ingratiation, there is lack of evidence as to how Machiavellianism is related to other types of political behaviours such as structure change, cooptation, and threat.

Political perspective subscribes to a purely functional view of man and sees him as basically a self-seeking, and utilitarian creature engaging in activities that serve his self-interest or own group interest. He looks at others as objects and believes in exploiting their weaknesses to his advantage (Bacharach and Lawler, 1980). However, there is complete lack of literature to show a direct relationship between attitude of actors towards others and their use of political behaviours.

Another individual difference variable is actor's perception of control. Power, politics and control are intimately related (Pfeffer, 1978; Bacharach and Lawler, 1980), and, political actors attempt to gain more and more control over affairs of the organization. Swingle (1976) points out higher need of control of political actors. It can be argued that actor's perception of his own and other's actual control and need for more control may be crucial to his political functioning.

Purpose of the present study is to investigate the role of personality variables, e.g. Machiavellianism, attitude towards other employees, and perceived discrepancy in actual and desired control in use of political behaviours. This study is limited to four types of political behaviours, viz; ingratiation, structure change, cooptation, and threat.

Based on above arguments, the following hypotheses are proposed—

1. Machiavellianism will be positively related to use of political behaviours.
2. Negative attitude, such as men are disloyal, weak, unfair, unstable, etc; will be positively related to use of political behaviours.
3. Discrepancy in actual and desired control of the actor will be positively related to use of political behaviours.

METHOD AND PROCEDURE

Sample

Subjects were 278 junior, middle and top level male managers of production and non-production departments of a public and a private sector industrial organizations.

Measuring Instruments

Machiavellianism : Christie and Geis (1970) scale was used to measure Machiavellianism. The scale consists of 20 items. Split half reliability coefficient of the scale is 0.73.

Attitude Towards Employees : A 10 item Reiman's semantic differential scale (Osbosm et al, 1980) was used to measure attitude towards employees. Split half reliability coefficient of the scale is 0.94.

Discrepancy in Control : Tannenbaum's (1968) scale measuring actual and desired control was used to measure discrepancy in control. Discrepancy in actual and desired control was generated by subtracting actual control score from desired control score. A constant value of 5 was added to avoid negative sign.

Political Behaviours : Kumar's (1983) scale was used to measure four forms of political behaviours, viz., ingratiation, structure change, cooptation, and threat. Split half reliability coefficient for ingratiation is 0.71 structure change 0.50 cooptation 0.61, and threat 0.72.

Procedure

Survey was conducted in a private sector organization followed by a public sector organization. Each respondent was contacted individually and was requested to complete the questionnaire according to instruction given with every scale. Covering instruction was given as follows :

> "We are conducting a study about certain work related behaviours and attitudes. Such behaviours are commonly seen in organizations. This information will be used only for academic and will be kept confidential. You are not required to write your name anywhere. Thank you for your cooperation".

Results and Discussion

Data were analysed using multiple regression analysis with Machiavellianism, attitudes towards employees, and discrepancy in control as independent variables. Political behaviours, viz , ingratiation, structure change, cooptation, and threat were considered dependent variables. Some correlations among independent and dependent variables were also computed.

Multiple regression analysis shows that with the exception of threat, Machiavellian persons are significantly high on political behaviours (Tables 1, 2, 3 and 4).

Relationship between Machiavellianism and ingratiation is positive and significant. Similar findings were reported by Pandey (1981). Machiavellians, who are power oriented and deceptive persons, find no problem in accepting legitimacy and justification of manipulative, tactical behaviour. However, the percentage of variation it explains is low (Table 1). This suggests that Machiavellians consider situational factors before initiating ingratiation (Deluga, 1986). For example, in the professor-student relationship, as Deluga argues, ingratiation by a student is scorned by other students, and this perceived peer pressure may inhibit ingratiating tendency of a Machiavellian.

Machiavellianism is positively related to structure change and cooptation (Tables 2 and 3). Christie and Geis (1970) observed that Machiavellians do not conform to given social structure and tend to initiate new structures. Besides, they do not subscribe to given standards of conventional morality. Given their

TABLE 1

Correlation and Regression Analysis for the Relationship between Ingratiation and Machiavellianism, Attitude Towards Employees, and Discrepancy in Control

Independent Variables	Ingratiation				
	r	Standard B	Standard error of B	B	Unique variance
Machiavellianism	—.30**	.275	.028	.124**	.091
Attitude towards employee	—.16**	.076	.402	.464	.001
Discrepancy in control of top management	—0.00	—.081	.366	—.478	.001
Discrepancy in control of middle management	.06	.048	.336	.272	—
Discrepancy in control of junior management	.14*	—.037	.037	—.022	.001

*P <.05, **P <.01, N = 278 Multiple R^2 = .1008, Multiple R = .3287

Percentage of variation explained = 10.08

TABLE 2

Correlation and Regression Analysis for the Relationship between Structure Change and Machiavellianism, Attitude Towards Employees, and Discrepancy in Control

Independent variables	Structure Change				
	r	Standard B	Standard Error of B	B	Unique variance
Machiavellianism	.24**	.169	.017	.046**	.068
Attitude towards employees	—.22**	.103	.253	.387	.012
Discrepancy in control of top management	.03	—.101	.023	—.036	.000
Discrepancy in control of middle management	.16**	.083	.282	.356	.004
Discrepancy in control of junior management	.18**	—.075	.220	—.267	.019

*P <.05. **P <.01, N = 278 Multiple R^2 = .1005

Multiple R = .3170

Percentage of variation explained = 10.05

TABLE 3

Correlation and Multiple Regression Analysis for the Relationship between Cooptation and Machiavellianism, Attitude Towards Employees, and Discrepancy in Control

Independent variables	Cooptation				
	r	Srandard B	Standard Error of B	B	Unique Variance
Machiavellianism	,25**	.179	.017	.049**	.094
Attitude towards employees	—.17**	—.123	.221	—.442	.001
Discrepancy in control of top management	—.07	.103	.258	.420*	.036
Discrepancy in control of middle management	.16**	.081	.250	.307	.009
Discrepancy in control of junior management	.22**	—.107	.264	—.480	.008

*P <.05, **P <.01, N = 278 Multiple R^2 = .1504

Multiple R = .3878

Percentage of variation explained = 15.04

typical disposition, it is reasonable to find that high Machiavellians engage more in structure change and cooptation. Low propertion of relationship may again be due to situational factors.

Analysis shows that Machiavellians do not use threat (Table 4). Threat is a direct, strong, and non-rational type of strategy (Falbo, 1977). Moreover, it is a low preferred influence strategy (Schilit and Locke, 1982). Hence, a clever manipulator like a Machiavellian avoids use of threat.

TABLE 4

Correlation and Multiple Regression Analysis for the Relationship between Threat and Machiavellianism, Attitude Towards Employees, and Discrepancy in Control

Independent variables	Threat				
	r	Standard B	Standard Error of B	B	Unique Variation
Machiavellianism	.081	.171	.203	.528	.003
Attitude towards employees	—.18**	.137	.149	.337**	.028
Discrepancy in control of top management	.04	—.147	.017	—.037	.001
Discrepancy in control of middle management	.19**	—.122	.189	—.353**	.057
Discrepancy in control of junior management	.10	.078	.162	.198	.004

*P <.05, **P <.01, N = 278 Multiple R^2 = .0972

Multiple R = .3117

Percentage of variation explained = 9.72

Contrary to expectations, with the exception of threat, relationship between attitude towards employees and political behaviours is insignificant. It is interesting to note that positive attitude towards employees leads to more use of threat (Table 4). This finding is inconsistent with earlier research related to threat which shows that prior to use of threat there is depersonalization (Milgram, 1963; Kipnis, 1976), devaluation of personality, ability and character of the target person (Dollard et al, 1939).

This deviation can be explained in two ways. One, prior to use of threat for elititing certain outcomes, the actor begins with the assumption that the target is capable of yielding desired pay offs, which would constitute positive attitude. Secondly, in a power oriented authoritarian Indian society with high show off tendencies (Sinha, 1980), the power holder tends to protect his ego by acting as one who is capable of harming. The actor derives his self-esteem by acting threatening despite feeling positively about the target person.

Significant relationship between perceived discrepancy in control and cooptation and threat was observed (Tables 3 and 4). Discrepancy in control of top management leads to cooptation (Table 3). This finding is consistent with Pfeffer's (1974) observations. In cooptation, the actor operates with higher authority base and coopts dissident group leader by offering inducement. Cooptation weakens common interest of subordinates and in turn, increases power and control of the actor. Managers use cooptation under adverse conditions.

Significant negative relationship has been found between discrepancy in control of middle managers

and threat (Table 4). Probably, middle managers depend more on positive interpersonal skills to generate more control, power and influence. Different groups of individuals use different kinds of political behaviours, e.g. top managers use cooptation, and middle managers use positive social skills, to bridge the gap between their actual control and desired control. Moreover different political behaviours may be effective in different situations which this analysis itself does not tap.

In addition, correlations between independent factors show significant positive relationship between Machiavellianism and discrepancy in control. Such a relationship may be due to a Machiavellian's longing for greater power and control over others (Christie and Geis, 1970; Dubey, 1986). According to Dubey (1986), "A Machiavellian . . . . . takes up any action, virtuous or otherwise, that is required to achieve his goals; and all his goals are aimed at achievement and power over others."

Moreover, Machiavellians possess negative attitude towards others (Table 5), as they are concerned about weaknesses of others and look at others as objects, and not trustworthy. They believe in manipulation of others for personal gains (Christie and Geis, 1970; Tripathi, 1981). Despite differences in culture, Machiavelli's (1940) outlook in 'The Prince' is very close to Kautilya's view of administrator as described in Arthashstra.

Positive attitude towards employees is related to discrepancy in control. By being positive one develops a better interpersonal relationship and referent power, which in turn, bridges gap between actual and desired control. Relationship between discrepancy in control of top, middle and junior managements shows that there is inappropriate distribution of authority and hence inadequate amount of actual control (Table 5). In a bureaucratic structure, according to Weber (1947), authority serves as a principal mechanism of control. Discrepancy is highest among junior managers (M=5.92) followed by middle (M=5.79) and top managers (M=4.95).

In general, low correlations among political behaviours suggests that they are independent of each other (Table 6). As different types of political behaviours are used under different conditions or reasons for influence, there may not be correspondence

TABLE 5

Correlation Matrix

Variables	1	2	3	4	5
Machiavellianism	1.00				
Attitude towards employees	—.39**	1.00			
Discrepancy in control of top management	.06	—.17**	1.00		
Discrepancy in control of middle management	.15**	—.31**	.28**	1.00	
Discrepancy in control of junior management	.16**	—.24**	.02	.32**	1.00

*P < .05, **P < .01, N = 278

TABLE 6

Correlation Matrix

Variables	1	2	3	4
Ingratiation	1.00			
Structure change	.28**	1.00		
Cooptation	.17**	.44**	1.00	
Threat	.07	.05	.11	1.00

N = 278, *P < .05, **P < .01

between these types of behaviours. However, moderate relationship between structure change and cooptation may be due to the fact that both have some reference to organizational structure.

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Role Efficacy and Organizational Identification Among Professional Groups

POONAM GUPTA
PREETAM KHANDELWAL

The present study was conducted to investigate role efficacy and organisational identification among professional groups. The professional groups differ significantly in the extent to which they identify with their respective organisations and there is no significant difference in role efficacy, that is, all groups are equally efficient in their roles, according to the authors.

Poonam Gupta and Preetam Khandelwal are with Deptt. of Psychology, Delhi University.

Introduction

The contemporary person-environment dilemma has prompted search to reach a conceptual meeting point for social structural forces and individual personalistic forces. Linton (1936) gave the notion of role a central place in social sciences. Introduced to social psychology by Newcomb (1950), this concept has been explicated and advanced by such writers as Merton (1957), shibutani (1961), Banton (1965), and Sarbin and Allen (1968). Earlier concept of role tended to focus solely upon structural influences on personality, however, the advent of systems approaches gave a new life by balancing it with the personalistic forces. Katz and Kahn (1966) proposed the concept of role as the major means for linking the individual and the organization. Distinguishing between structure and person while integrating the two, Hunt (1965) pointed out that a social system may be viewed conceptually as an interlocking complex of positions which are populated by people who are expected to fulfil certain behavioural requirements and possess certain personal attributes associated with each position. Since a social system is a system of interdependent activities, positions within a social structure exist in relationship with certain other positions. Thus, the "rights and duties" of a particular focal position

exist with respect to a counterposition. Emphasizing on the expectations from the individual who comes to occupy a position, Pareek (1977) has defined role as a position a person occupies in a social system (organization) as defined by the expectations various significant persons (including himself) have from that position.

Performance of a person in a role depends, amongst other factors, on the balance between conformity (role taking) and creativity (role making) on the part of the role occupant. Since role in the interacting and linking mechanism between the individual and the organization, role effectiveness is the product of an effective interaction between these two. As far as the individual is concerned, two important dimensions of role effectiveness are his role efficacy and the style and strategy of coping with role stress. Conflict is a natural variable in role performance. Conflicts and stress are not necessarily negative in their effects on the individual and the organization, it is the way in which this stress is managed which is crucial factor for individual and organization effectiveness. There are two kinds of coping strategies—avoidance or dysfunctional, where defensive behaviour is exhibited and tension reduction is without resolving the problems, the individual believes that he is not capable of influencing the situation. Confrontation or functional strategy helps the individual and the organization face the problem and work out a solution for it. The individual believes that he along with others can influence the situation. Role efficacy on the other hand is the potential effectiveness of an individual occupying a particular role in an organization. The presence of dimensions which increase the efficacy of that role are the following : –

(i) Centrality : Feeling of the person that his role is central and not peripheral to the organization;

(ii) Integration : provision of the maximum use of the strength, that is, his experience, his technical training, special skills he possesses, of the occupant in his role;

(iii) Productivity : Opportunities and available sources for the implementation of the self initiated activities;

(iv) Creativity : Oprortunity to try new and unconventional ways of solving problem;

(v) Interrole linkage : Linkage of one's role with other roles in the organization, that is, a joint effort is understand problems, find solutions etc;

(vi) Helping Relationship : The opportunity for people to give and receive help;

(vii) Superordination : Feelings of the person that the role he or she carries out is likely to be of value to a larger group and this cannot be achieved without collaborative efforts;

(viii) Influence : The influence a person is able to exercise in his or her organizational role;

(ix) Personal growth : Perception that the role provides the individual with an opportunity to grow and develop;

(x) Confrontation : Confronting problems to find relevant solutions (Pareek, 1980).

Research Literature on role efficacy is scanty. Hitherto only a few studies have been done on role efficacy and its relationship with personal and organizational variables. A significant positive relationship of role efficacy with general satisfaction and job satisfaction (Pareek, 1987) and a significantly negative correlation with a measure of alienation (Sen, 1983) have been reported. Perception of a participative climate in one's organization has a significant and positive relationship with role efficacy, (Sen, 1983; Surti, 1983). A climate promoting concern for excellence, use of expertise and concern for the larger issues also contributes to role efficacy, on the other hand, a climate charaterized by control and affiliation seems to lower employee role efficacy (Pareek, 1987).

Identification is an attitude which is more or less stable. The stability of identification attitude has its roots in the norms and values that are acquired in the socialization process. Work values and values of loyalty and dedication to organization make people predispose to identify. "Socialization" is not restricted to early childhood experiences alone but covers the entire life span. Popular among organizational attitudes are organizational commitment,

involvement, identification and company satisfaction. These concepts show a large overlapping. More than one concept has been used to devote the same or very similar attitudes.

Identification has been considered as depending on satisfaction and anticipated goal achievement derived from activities which are membership bound, ego involving and intrinsically motivating" (Brown, 1969). A person can be considered identified with the organization if he feels that he is important for his organization and derives satisfaction from his membership in the organization (Porter et. al, 1974), his organization occupies a central place in his self identity (Lee, 1971), he feels that his organization has the potential to fulfil his important needs and does not perceive a conflict between his personal goals and goals of the organization, and is prepared to make personal sacrifices for his organization in terms of efforts and investment (Steers, 1977).

Identification with an organization depends on— (1) the individual's value system and the symbolic meaning the organization has to him, (2) the efforts he has spent on joining the organization or the occupation, (3) the organization's control over the action of its members and the range of actions that are controlled, (4) the organization's surveillance of actions of individual members and its power to reward conformity and punish non-conformity, (5) latitude in the conformity norms of the organization, (6) clarity of the organization's objectives, and (7) the vividness of its identity (Shrivastava & Dolke, 1978).

The individual not only compares his job with his 'ideal job' but he also compares the conditions existing on the job and the outcomes that he receives from it with job in other organizations. He feels satisfied or dissatisfied depending on his perception of the totality of the conditions under which he carried out his work. He evaluates such factors as the security that his job provides, the salary he earns, the supervision, the nature of work he does, the people around him, the company policies etc. If his evaluation is favourable he feels satisfied and his liking for the job increases.

Person wants to earn respect and esteem not only of people with whom he works but also of those who are significant to him outside his work place—his friends, his neighbours, his professional colleagues, and his family members. He has ideas on what he would like to achieve in his life.

Commitment has also been explained in terms of exchange or reward-cost notions. This notion emphasizes the bargaining or exchange relationship between the individual and the organization. Individuals join organization with certain expectations. They have certain needs, desires, skills, values and so on. If the work and the organization provides opportunities for satisfaction of important needs and of the organizational situations are congruent with the values of the individuals, they will identify with their work and organization (Steers, 1977).

Literature survey shows evidence that facilitatory supervisory practices (Cornrey, Pfiffner and Bears, 1952, katz & Maccoby, 1950); the greater vertical mobility (Stone, 1952); member's higher order need satisfaction (Hall, Schneider, and Trygren 1970); Hall, & Schneider (1972); reputation of a mill (Dave, 1976); tenure and age (Mannherm, 1975) are highly related to organizational identification.

Role efficacy is a fairly new concept, therefore there is a paucity of literature pertaining to this area. Although work has been done to investigate the relationship of organizational identification with other variables, but no study to date has examined how the two concepts role efficacy and organizational identification are related. Hence, to fill this gap in the literature the present research was taken up.

The aim of the research was to study :

(a) Whether a relationship exists between role efficacy and organizational identification?

(b) how do professionals differ in terms of role efficacy and organizational identification?

The sample consisted of 5 professional groups— Bank employees, Doctors, Engineers, Nurses and Teachers— with 34 individuals in each and making a total of 170. The study was conducted in large

organisations in Delhi, like hospitals, schools, banks and other public assistance organizations.

To meet the aim of the study, the following scales were used.

Role Efficacy Scale—To study the extent of role efficacy in professional groups, Pareek's (1981) Role Efficacy Scale was used. It is a structured instrument consisting of 20 triad of statements. A respondent checks in each triad one statement which describes his role most accurately. Role Efficacy Scale has ten dimensions, viz. centrality, integration, productivity, creativity, interrole, linkages, helping relationship, superordination, influence, personal growth and confrontation. The more these dimensions are present in a role, the higher the efficacy of that role is likely to be. Test—retest reliability of the scale is .68 and has high internal homogenity.

Organizational Identification Scale—To study the extent of identification with the organization in which the professional worked, scale developed by Shrivastava and Dolke (1978) was used. It is a 20 item Likert type Scale. The subject has to tick mark on a 5 point scale ranging from strongly agree to strongly disagree. Test-retest reliability coefficient of the scale is .89 and has high convergent and discriminant values.

Results and Analysis

Pearson's Product Moment correlation was computed to study the relationship between role efficacy and organizational identification. An obtained value of .602, significant at .01 level, shows that a high positive and significant intercorrelation exists between role efficacy and organizational identification. So there is an evidence of a direct linear relationship between the two variables.

Role is the overlapping region between the individual and the organization. When the individual joins an organization, his needs and the goals of the organization converge. The degree of convergence between individual needs and goals, or the integration of the individual with the organization determines his identification with the organization. A high positive correlation indicates that professionals feel they occupy a central role in their organization, and they identify with the organization and therefore are effective in the role. The fact that they are able to influence others and have power in their positions plays a key role in their identification with their respective organizations. A feeling of the presence of ample opportunity for personal growth in organization is also present. whenever there is a need for help, they feel that the source is present in the organization. Besides the above mentioned characteristics, the organization's power to reward or appreciate good work might have led to greater creativity and role enrichment, and hence an increase in organizational identification with a concomitant increase in role efficacy. Fulfilment of needs, desires, skills and values also provides satisfaction, and identification with work and the organization. There exists a positive relationship between job satisfaction and role efficacy (Pareek, 1987). The degree of congruency or disparity between organizational goals and the needs and goals of the members is a determined of organizational identification, goal interrolization may occur when the employee identifies with the job itself and is, therefore conducive to high quality and high quality role performance or it can occur through interrolization or organizational goals rather than through the job itself (Katz and Kahn, 1966).

To study the differences among the professional groups means, standard deviations and one way analysis of variances were computed.

TABLE 1

Means and Standard Deviations of 5 Professional Groups on Role Efficacy

Groups	Mean	S.D.
Teachers	77.15	7.64
Doctors	76.81	6.49
Bank employees	75.94	10.27
Nurses	75.47	8.20
Engineers	74.59	9.02

As revealed from Table 2, there is a statistically non-significant difference in the variance of scores of the five groups on role efficacy. F-value of .48 is statistically non-significant at .01 level of significance. This shows that all the professional groups are equally effective in their respective roles.

TABLE 2

Outcome of the one way analysis of variance showing difference among the professional groups on role efficacy scores

Source of Variance	df	SS	MS	F
Between	4	136	34	.48 NS
Within	165	11590	70.24	
Total	169	11726		

Note : F-critical at .01 level of significance = 3.44 NS—Non-significant at .01 level.

From the mean scores (Table 1) of the professionals, it is evident that all of the five groups have scored high on this variable. Teachers with 77.15 average score have shown highest efficacy in their role, followed by Doctors, Bank Employees, Nurses, and Engineers. But all the mean scores are high and do not differ significantly. This shows that all the employees perceive their respective role to be central, providing opportunities to influence, and feel that they can use their talents and skills to grow. It also shows that performance in the role depends mainly on the conformity and creativity on the part of the occupant. Conformity is the role taking in the organization which establishes identification of the individual with the organization. Responding to the expectations of other roles, which is role taking, is important for team development and may help in getting the collaboration and reciprocal response from their roles. Creativity, that is role making, is the feasibility to make unique and original contribution. A high score obtained by all the groups also signifies that they are able to take initiative in their role and can try new and unconventional ways of solving problems.

Pareek (1987) contends that a climate which promotes concern for excellence, makes full use of expertise of employees and has concern for larger issues contributes to role efficacy, but a climate with strong control of employees and too much of affiliation seem to lower employee role efficacy. Another factor positively related to role efficacy is participative climate. (Sen, 1983; Surti. 1983)

Since persons occupy multiple positions in life and are only partly involved in any single position they occupy, they have multiple identities that combine in various ways to effect their views and the enactments of their singular role, the modes of a man's participation in structured social intercourse will be reflected in his concept of himself and in the fabric of his personality. Role not only serves a linking function but also exemplifies and operationalizes the merging of social and individuals phenomena.

Table 4 shows a statistically significant difference, F-value of 16.27 at .01 level. This indicates that the

TABLE 3

Means and Standard Deviation of 3 professional groups on organizational identification scores

Groups	Mean	S.D.
Doctors	80.85	9.47
Nurses	79.10	10.90
Bank employees	78.41	10.38
Teachers	73 41	7.42
Engineers	69.44	9.85

TABLE 4

Outcome of the one way analysis of variance showing difference among professional groups on organizational identification scores

Source of Variance	df	SS	MS	F
Between	4	625	1564	16.37*
Within	165	15864	96.15	
Total	169	22120		

Note : F-critical at .01 level of significance = 3.44.
* Significant at .01 level.

variance among the groups, and their contribution to the total variance on organizational identification scale is statistically significant.

Humans evaluate their own position in relation to the value of others and come to accept others' goals as their own. An organization and job is evaluated by the individual against his more deep rooted needs and convictions. He wants to be accepted and considered important. If the membership in the organization is perceived as instrumental in his goal attainment and need satisfaction he develops identification. The extent of returns that one receives from the organization, is an important feature in determining identification with the organization.

Doctors, as can be seen from Table 3, identify most with their organization, followed by Nurses (79.10), Bank employees, Teachers and Engineers.

Identification of an indtvidual with the organization in which he is working depends largely on the quality of work life and the prestige that the organization holds. If a person has an understanding and helping supervisor, a challenging job, if the organization provides good amenities and perks, and the person is able to exercise infiuence on others, he is more likely to be identified with the organization in which he works than the employees of the organizations who don't have these facilities. The more the supervisors facilitate the satisfaction of personal goals by individual members of the organization, the stronger the latter's identification with the organization (Comrey, Pfiffner and Beem, 1952; Katz and Maccoby, 1950).

The Doctors working in large public hospitals perceive that all their needs on the job and work place are fulfilled by their organization and that is why they identify most with their organization. The feeling that the organization has the potential to fulfil the person's needs, increases identification with the organization (Steers, 1977). They are followed by nurses from the same hospital. Bank employees and Teachers have also shown high mean values on identification. These two professions are very reputed in our country. These are the white collar jobs which common man aspires to get into. Engineers among the five groups taken here have shown minimum identification with their organization. Although the Engineers for the research were taken from India's top most engineering organization, they did not score as high as compared to other groups. The reason could be that they aspire for more than what they get from the organization at present.

Payne (1954) found that the larger the organization, the stronger the identification of individual participants with it. A very high correlation exists between various job and organization related factors that contribute to the reputation of an organization (Dave, 1976). Shrivastava and Dolke (1978) have identified some important antecedent of work and organizational identification such as age, tenure, locus of control need strength and need satisfaction, values, participation in decision making and supervisory support, job challenge and job autonomy

Identification with an organization is the degree of personal relevance of the organization to an individual, its attractiveness for him, the importance he attaches and the feeling of pride he derives from his membership in the organization, and the efforts he is prepared to expend for the sake of his organization.

From the present study it can be concluded that even though individuals of different professional groups are equally effective in their respective roles, they differ significantly to the extent to which they identify with their organization. The differences in the identification scores could be because of the fact that different organization have different work climate. They may vary in the facilities they provide to their employees and the benefits that accrue to the individual.

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Utilisation of Rice Bran for Edible Oil Production

B.K. ARORA

This article focusses on the utilization of rice bran for edible oil production in India. The author discusses some policy issues and makes recommendations for proper rice bran utilization.

B.K. Arora is Director with National Productivity Council, Chandigarh.

Rice bran is the by-product of rice milling industry. The material is obtained during the process called 'polishing' wherein the surface layer of brown rice is scoured to convert it into white rice. The rice bran is, therefore, also called rice polish. The amount of bran removed usually varies from 6-10 per cent of the weight of brown rice or 4-7 per cent of the weight of paddy depending upon the variety and extent of whiteness desired. The quality of rice bran depends upon the equipment used for polishing. The popular equipments used are hullers, disc polishers, vertical cone polishers and horizontal abrasive polishers.

Production of Rice Bran Oil

Rice bran contains oil to the extent of 15-25 per cent which is a high quality edible oil. The oil content is higher (20-25 per cent) for bran obtained from parboiled paddy as compared to the bran from the raw paddy (Table 1). The annual potential of rice bran oil in the country is estimated to be 0.85 million tonnes which is expected to increase to 1.38 million tonnes by the end of the century. Against this the production of the rice bran oil in the country was estimated to be 255,000 tonnes during the year 1986-87 (Table 2). This means a utilisation of 30.0 per cent of the potential available in the country. Even this quantity of oil is not all edible grade oil. The quantity of edible oil produced was 32,850 tonnes during the year

TABLE 1

Oil Content of Different Types of Rice Bran

Method of Mllling	Bran obtained from	Oil Content
Huller	Raw Paddy	4-6%
	Parboiled Paddy	4-6%
Sheller	Raw Paddy	12-15%
	Parboiled Paddy	15-20%
Modern	Raw Paddy	15-20%
	Parboiled Paddy	25-30%

TABLE 2

Production of Rice Bran (RB) Oil in India

Year	Rice Bran Processed (Tonnes)	Rice Bran Oil Produced (Tonnes)	Edible grade RB Oil Produced (Tonnes)
1969-70	85,000	10,000	—
1970-71	2,05,000	28,000	—
1971-72	2,20,000	30,000	—
1972-73	1,65,000	25,000	—
1973-74	1,80,000	24,500	—
1974-75	2,60,000	33,000	—
1975-76	2,65,000	36,000	—
1976-77	5,40,000	70,000	—
1977-78	6,00,000	80,000	—
1978-79	6,30,000	1,01,000	2,500
1979-80	6,30,000	1,12,850	2,450
1980-81	7,86,500	1,20,000	4,000
1981-82	10,50,000	1,50,000	10,000
1982-83	10,90,000	1,52,500	26,500
1983-84	13,00,000	1,83,000	23,000
1984-85	14,10,000	2,00,200	19,200
1985-86	14,72,700	2,17,900	32,850
1986-87	17,00,000	2,55,000	1,00,000

1985-86 and its production is expected to reach one lakh tonnes during the year 1986-87.

We have got an acute scarcity of edible oils in our country. The annual shortfall is around 1.20 million tonnes (Table 3). The additional requirements are met through imports which is costing to our exchequer an annual amount of Rs. 1000 crores approx. In spite of this, our edible oil consumption is one of the lowest in the world. The supplies and consumption can surely be augmented by production of more edible grade oil from the rice bran. The deficit can be partially met from the increased supply of the rice bran oil.

TABLE 3

Trends in Demand and Supply of Edible Oils

Oil Year (Nov. to Oct.)	Production of Edible Oils (Lakh tonnes)	Quantity of Edible Oils Imported (Lakh tonnes)	Value of Imported Oil (Rs. Crores)
1978-79	25.57	8.21	479.83
1979-80	24.08	11.49	617.18
1980-81	25.50	10.74	516.00
1981-82	32.20	9.98	449.69
1982-83	28.50	11.50	504.46
1983-84	33.00	16.34	1319.00
1984-85	34.87	13.68	1122.10
1985-86	30.38	11.30	1006.00

Problems of Rice Oil Production

However, there are technological as well as economic problems associated with the production of edible rice bran oil. The rice bran contains enzyme called 'lipase' which is inactive when the bran is intact with the grain. As soon as, the bran is removed from the grain, the enzyme becomes active and breaks the oil to produce from fatty acids (Table 4). As a result of lipolytic activity, the bran becomes unsuitable and uneconomical for edible oil production. The oil extracted from such bran can be used only for industrial purposes such as soap manufacture.

The rate of lipolysis in bran is dependent upon the moisture content and the storage temperature. Drying the bran to a moisture less than 4 per cent or

TABLE 4

Rates of Rise of Free Fatty Acids in Rice Bran

Type of bran	Time after milling (Hrs.)	Free Fatty Acids (Per cent)
Raw rice bran	4	1.4
	28	4.2
	40	14
	60	21
Parboiled rice bran	4	0.5
	28	2.5
	40	3.7
	60	6.2

storage at low temperature will retard the activity, or the enzyme. The best method so far known of containing lipolysis from the view point of oil extraction is to inactivate the lipases by heat treatment. The process is called 'Stabilization'. It has been shown that steaming at temperatures slightly in excess of 100°C inactivates the lipases within 10-15 minutes (Table 5). Dry heating at 100°C for a period of about 20 minutes also inhibits lipolysis effectively both by inactivating the lipase and reducing the moisture content. However, if oil could be extracted from the fresh rice bran without giving an opportunity from enzyme to act, heat treatment is not necessary. In fact, Japan has been very successful in producing edible grade rice bran oil through proper management collection of fresh rice bran for ready extraction of oil.

TABLE 5

Heat Inactivation of Rice Bran Lipase

Temperature of Heating (°C)	Time of Heating (Minutes)	Residual Enzyme (Activity) (Units/ml)
100	0	1.04 (Fresh bran)
	10	0.90
	15	0.34
	20	0.14
110	10	0.69
	15	0.20
	20	0.00
120	10	0.41
	15	0.00
	20	0.00

Technological Solutions

Considerable work has been done in the country for developing process and machinery for stabilisation of rice bran. Central Food Technological Research Institute, Mysore, initially developed a batch stablizer consisting of revolving drum with electrical heating and air-tight lid. About 50 Kg. bran could be stabiiized in 30 minutes. Similar types of batch stabilizers may also use steam for stabilisation. The cost of treatment is reported to be Rs. 35 to Rs. 40 per tonne of bran.

Scientists at Oil Technological Research Institute, Anantpur, have developed a bran stabilizer using husk and agro-waste as source of heat. Subsequently another version of hot air stabilizer has been developed at Paddy Processing Research Centre, Tiruvarur. This stabilizer consists of a rotating jacketed vessel with a duct for passing heat. Hot air is passed through the jacket and inner duct. Even a pneumatic conveying dryer has been used for stabilizing bran. The process achieves drying as well as stabilization of bran simultaneously. Continuous stabilizers have also been developed at Jadavpur University, Central Food Technological Research Institute, Mysore and Indian Institute of Technology, Kharagpur. Most of these make use of wet heat. The equipments are provided with arrangement for stirring, continuous conveying and supply of steam. A few rice mills in the country are already stabilising rice bran commercially by these methods.

Alternate approaches for bringing down the free fatty acids (FFA) of rice bran oil have been adopted by researchers. One of the process adopted involves distillation to remove the FFA. Another process aims at extracting the FFA from the bran oil by a simpler process. Lowering of FFA from 10-60% to 3-4% has been affected with the help of chemicals like sodium chloride, sodium meta-sillicate, sodium sillicate,

dextrose, boric acid, etc., The FFA in the hydrogenated samples were lower than 1.0%. Very small quantities of the edible retarders like sodium benzote and sodium metabisulphate helped in maintaining the product for more than 6 months. The cost of treatment was Rs. 1.50 to 2.00 per Kg of raw rice bran oil depending upon initial FFA, solid impurities and other chemical constituents of the oil.

Supply of Rice Bran

Although work is in progress to seek solutions to the above technological problems, there are constraints in the supply of rice bran itself. These constraints have arisen because of the nature of the rice milling industry, quality of rice bran produced and existing utilisation pattern of rice bran. Because of these constraints, the total supply of rice bran to the extraction plants have limited itself to 15,90,000 tonnes against a potential of 51,00,000 tonnes. Furthermore, the present supply of bran does not ensure good quantity of oil because of poor quality of rice bran. The average oil content of rice bran is found to be 14 per cent against the potential of 18 per cent.

The rice milling industry in India comprises of large number of hullers. Their number is estimated around 79,000 mostly concentrated in the States of Kerala, Andhra Pradesh, Tamil Nadu, Karnataka, Uttar Pradesh, Bihar, Madhya Pradesh and Orissa. In addition, there are about 4,500 sheller mills mostly in Assam, Karnataka, Andhra Pradesh, Uttar Pradesh and Madhya Pradesh. The bran obtained from huller mills is a mixture of husk and bran is unsuitable for oil extraction. The average oil content of mixture is 4.5 per cent which makes it uneconomic for oil extraction. Even the bran obtained from sheller mills contains fractions of other materials. Only the bran from modern mills and sheller mills can be used for oil extraction. The present availability of bran from these two types of mills is 0.32 million tonnes. To increase the availability to a significant level, it is essential that the mills should be modernised. The Rice Milling Industry (Regulation) Act and Rules of 1958 and 1959 amended in 1968 and 1970 already envisage modernisation of huller and sheller mills in the country. The availability of bran for oil extraction will significantly improve if the mills in the country are modernised.

Another factor which has affected the availability of bran is a logistic one. The rice mills are located in the rural areas and are all scattered. The collection of fresh bran from these rice mills presents a big problem. The daily production of bran from these mills is small. Thus there is no alternative except to store the bran and transport it to the extraction plants only when a full load is accumulated. The location of mills are in the interior areas and far off from the extraction plants, This, sometimes makes the transportation costs prohibitive. There is a need to set up rice mill estates/complexes in rice producing areas for easy and economical collection of bran.

The quality of bran is another factor posing problems for the extraction units. Improper cleaning of paddy, drying on mud floor, storage of bran for long time and even deliberate mixing of dust with bran to increase its weight have serious effect on the quality of rice bran oil and the extraction cost per tonne of oil produced. There is need to fix standards for rice bran and payment to the rice millers made on the basis of the quality of the bran supplied. Rice Millers should be educated regarding the production and storage of rice bran so that good quality oil can be extracted.

Some Policy Issues

In some of the states, levy has been imposed on the rice millers for compulsory supply of a part of rice bran produced by them to the poultry industry. The remaining quantity can be supplied to the extraction plants after obtaining permit from the state governments. This results in accumulation of rice bran at the mill and consequently rise of FFA. Even otherwise, large quantities of bran particularly from the huller and sheller mills is diverted for poultry and cattle feeding. Scientific studies have revealed that deoiled bran is a more suitable feed for cattle than raw bran. The use of unstabilised bran in poultry diets is risky. Such a bran becomes rancid and its intake causes high mortality rates in chicks and chicken. Deoiled bran is superior to raw bran from the

preservation point of view. Also it contains more protein and less starch and is highly digestible. Thus, there is a clear case of diverting the available supply of rice bran from animal feed to oil extraction and use only deoiled bran for animal feed. However, this needs development of alternate feed materials and their supply to the rural areas.

The other factors which can increase the availability of rice bran oil in the country include encouraging the production and consumption of parboiled rice, encouraging installation of stabilisers at rice mills, maintaining a remunerative price difference between edible and non-edible rice bran oil through governmental policy. Research may be carried out to develop suitable process for reducing the FFA contents of oil with high fatty acids. Use of higher quantities of rice bran oil in vanaspati and AGMARK for refined rice bran oil has been suggested for improving its utilisation and marketing.

In April 1982 and April 1987, the National Productivity Council organised seminars on "Utilisation of Rice Bran for Edible Oil Production." A number of recommendations have been made for improving the availability of rice bran, stabilisation and pallestisation, oil extraction and refining, government policy and incentives, research and training. These recommendations, if properly implemented, can go a long way in improving the production of edible grade rice bran oil in the country. As rice is a major agricultural crop and rice milling the largest agro-based industry, the appropriate utilisation of rice bran will go a long way in improving the economy of the country.

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Rationing and Dual Pricing in A Planned Economy

L.A. REDE

In this paper an attempt is made to explain the behaviour of consumers under the system of rationing and dual pricing with the application of indifference curve technique.

Dr. (Mrs.) L.A, Rede is with the Faculty of Arts, M.S. University, Baroda.

I. Introduction

Economic planning has been accepted now as a sound technique of making major economic decisions all over the world irrespective of the form of economic system under which the countries may be operating. However, the type of economic planning adopted depends upon the nature of economic system.

India, with the adoption of 'mixed' economy, has resorted to planned economic development since 1950-51. There is a co-existence of public and private sectors. Hence, public policy is directed to correct, guide, supplement and regulate the private sector. Plan priorities, strategies and tools are therefore to be framed and implemented by considering the desires of millions of people operating in private sector and motivating them to follow the plan requirements. Indian planning over last $3\frac{1}{2}$ decades aimed at fulfilment of objectives of speedy growth, self-reliance, removal of poverty and unemployment, modernization and social justice through equality of distribution of income and regional balances. Majority of the objectives require state's intervention in market, and hence, call for regulatory policy. Thus, various types of physical (direct controls) and general controls are used as policy instruments. Physical Control aim at influencing producer's and consumer's choice and are typified by rationing, dual pricing, licensing, monopoly controls, import controls, exchange controls,

quotas tariffs etc. The indirect, or, general controls influence the prices, incomes and transactions within the economy, and include fiscal and monetary measures.

Prices of goods and services are determined in different ways in different types of economic systems. In socialist economics, prices are determined by central planning authorities and are fully controlled. Prices in capitalist economies are determined through the forces of demand and supply, i.e., through market mechanism. Obviously, tool of price control is fully exercised in former case and there is no scope for it in the latter case. Capitalist economies have resorted to the policy of price cootrol and rationing, temporarily, only in periods of war led shortages and emergencies. The co-existence of public and private sectors in mixed economy make a room for both types of prices controlled and uncontrolled, to prevail simultaneously. Goods produced under public sector monopolies are sold at fully controlled prices (e.g. postal and railway services), while prices of commodities produced purely under private sector are determined through market mechanism (e.g. fine cloth, radio etc.). However, to fulfill the objectives of planned economic development, with equity, stability and social justice, goods and raw materials with scare supplies are brought under physical controls. The prices and quantities of these are regulated, so that, equitable distribution is ensured. At the same time, excess over controlled quota of these are allowed to be sold in open market, at market clearing prices. This leads to the simultaneous existence of controlled and uncontrolled prices for the same commodities. India initiated such a policy of dual pricing after resorting to planning. Being recently developed, dual pricing system lacks theoretical explanation. Very few attempts have been made to explain, theoretically, the effects of dual pricing on the supply and demand aspects of market. Hence, an attempt is made here to examine the effect on demand aspect of the market. Theoretical works explaining consumer's behaviour under rationing during two World Wars were developed. However, these were related to rationing system followed by Western countries. Today, inspite of prevalence of relative peace in the World, price control and rationing are popular economic weapons adopted by developing countries like India. This has aroused curiosity in our minds regarding various aspects of its theoretical and policy implications. The paper therefore aims at raising following issues.

What factors cause continuation of the policy of price control and rationing during peace time ? Is there may change in the form of this policy ? If the form has changed, how does it influence consumers and sellers ? The paper attempts to answer these querries with special reference to Indian conditions. Assuming that sellers' responses are given, the paper aims at focusing on the behaviour of consumer and his welfare under rationing and dual pricing.

II. Objectives

The major objective behind price control and rationing is to influence the market demand and supply in order to protect the interests of either the producers or consumers as a group. Such type of situation is referred to as "Fix-Price Market" by J.R. Hicks. The "floor"or "minimum" prices are fixed above the equilibrium level and are intended to protect interests of the producers (e.g., Agricultural procurement prices in India). "Ceiling", or, "maximum" prices are fixed below the epuilibrium level and are meant to protect the interests of the consumers (e.g., sugar, cement, steel prices in India). It may however be noted, that, this leads to dis-equilibrium in market demand and supply. Floor prices cause excess supply, leading to situation of gluts. This calls for arrangements for procurement facilities. Ceiling prices cause excess demand, or shortages, leading to the problems of black marketing, necessitating proper distribution system.

The situation of shortages, or, excess demand, if left to market forces gets reflected through high prices and inequitable distribution and consumption of scarce commodities. In the presence of price control, however, these get reflected through incidence of queues, empty shops, etc, Since it is the money that dicates the market, the rich enjoy the consumption of such commodities while poor are deprived of them. Hence, the need of government interference in otherwise efficient market mechanism through an effective

policy measure of rationing and price control.

Shortages can be overcome by either reducing the demand for the scarce good, or, by increasing its supply. Since adjustment in supply is difficult to be achieved in short period, efforts are generally made to influence the market demand. Rationing, by allocating fixed quota at control price, succeeds in reducing the pressure on demand for the scarce good. However, rationing imposes an additional constraint (over and above the budget constraint) on the consumer in the form of fixed quantity at fixed price.

Since the nature and cause of price control in India differ from what prevailed in Western countries, there is a need to provide separate theory for such situations. An attempt has therefore been made here, to develop a theory of consumer's behaviour under Indian system of rationing and price control.

III. Causes of Rationing and Price Control

Apart from war led emergency there may be following four major causes leading to rationing.

(a) Situation of "Shortages" of necessary commodities and resources, due to excess demand;

(b) Difficulty in adjusting supply to increased demand, resulting in inflation, and threatening price stability;

(c) Expansion of the outputs of certain goods and services which are generally produced by monopolistic type of firms, e.g., public utilities like electricity, so that consumer is protected against exploitation via high prices; and,

(d) Increasing paternal attitude of the present day welfare States towards their subjects, on grounds of equity and minimum needs of consuming certain essential commodities like food, shelter, health, sanitation etc.

IV. Types of Rationing and Price Control

Broadly speaking, there existed four types of rationing and price controls, viz., (a) Commodity rationing which is applied to homogeneous commodity like sugar or cement, and good is sold at uniform price in fixed quantity to all its consumer; (b) Group rationing is applied to a group of heterogeneous commodities like meat or paper. Fixed quantity of these are then made available to all the consumers at control prices; (c) Value, or, point rationing is expressed in value terms and can be applied to all the types of commodities. It is also termed as "overall rationing", and is preferred to first two types of rationing on the grounds of convenience and freedom of choice to the consumers; (d) Rationing and dual pricing system wherein not all, but, some commodities are covered. Fixed quantities of these rationed goods are made available through fair price shops to ration card holders only (i.e , to a group of people only), at fix or control prices. Ration cards are issued on the basis of the level of income of the people, mainly the low income people. Hence, only low income people (poor) can avail of this system. The rich, or, higher income people can consume these commodities by purchasing these in the open market. Since the quuntities to be sold at control prices are fixed by the government, any excess supply of these can be sold by sellers in open market at market clearing prices, which are generally higher than control prices. This gives rlse to dual pricing and dual markets.

It needs to be emphasized here, that, the first three types of rationing and price control systems existed all over the world till World War II. Hence, Western economists like Worshick G.D.N; Rothschild, K.W.; Makower, Helen; Samuelson P.A.; Graff; Scitovasky, T; Tobin, etc. concentrated on theories which suited these system.[1] Since rationing and price control were considered as temporary policy measures to meet war led emergency and shortages the strong believers of efficient market mechanism, gave it up after World War II. However, some of the developing countries of the world, after acquiring their political freedom, resorted to the policy of "controls" for speedy economic development and growth. This gave rise to the fourth type (d) of system, wherein exist dual prices and dual markets.

It is this type of rationing and dual pricing system

1. For details see the references.

that has received neglegible attention of economists. A few economists[2] like Gonensay, E.; Khusro, A.M.; Mukherji—Prasanta—Pattnaik and Sundaram (Jointly) have made attempts to analyse some issues of this system. All these studies are, however, concentrated on the supply side of the system, and hence, analyse this problem through partial equilibrium model. The main thrust of these studies is on the problems of sellers and black marketing. However, the demand aspect of the model is neglected. This study, therefore, makes an attempt to throw light on the demand side of the model by examining the behaviour of consumer under the condition of rationing and dual pricing.

V. Consumer's Choice under Rationing and Dual Pricing

The model developed to explain consumer's behaviour under dual pricing and rationing is based on Indifference Curve Technique, and, is based on following assumptions. There is a perfect competition in market for rationed good, hence, its price is taken as given and constant. Consumer's preferences, taste and incomes are also given and constant, and they behave rationally. Rationing and price control put additional constraint on consumer. It is further assumed, that, sellers, by law, are forced to submit certain amount of rationed good to the government at control price, and, are free to sell the surplus in open market at uncontrolled (open market) prices which would be higher than pre-rationed equilibrium price.[3] Ration cards are issued on the basis of the level of income, hence, only poor can avail of them. The total quantities is cleared up through sales in both markets. [See Figure I and II.]

Hence, blackmarketing does not take place in this situation. The poor consumer under these assumptions consumes OW quantity of X while the rich consumes ON quantity at the equilibrium market price, $\frac{OA}{OB} = \frac{OK}{OL}$ and both attain equilibrium. If government introduces price control and rationing of commodity X, the price at which X will be available to the poor will be lower than equilibrium price; while, it will be higher for the rich.

A lower price of X offered to the poor, with his money income constant, rotates the price line anticlock wise at the same intercept on Y axis, i.e., at A. The new price line will be flatter than AB (Figure-I) indicating that price of X is lower, and hence, more of X is purchased with same money income. Thus, the poor faces new price line AF. It may, however, be remembered that the quantity of X offered to the poor at lower (control price) price is fixed at OC. This puts an additional constraint on the choice of the consumer. It is to be examined therefore, how will a rational consumer behave under this condition ?

The opportunity locus open to the poor, under rationing and price control, lies within the area OAPC and is greater than earlier one, i.e., OAB in pre-rationing situation (Figure 1). Had there been no rationing, but only price control, opportunity locus would have been within the area OAF. Thus, fixation of quota, i.e., rationing, along with price control leaves smallar opportunity locus, than mere introduction of price control, though, it expands it in comparison with pre-rationed price situation. Rationing and price control imply that the poor can purchase fixed quantity, or less than it, at control

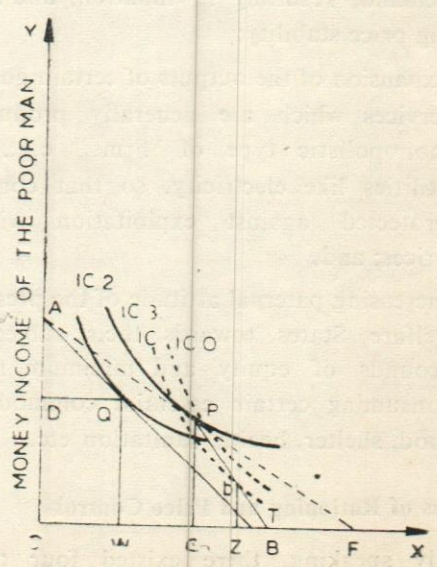


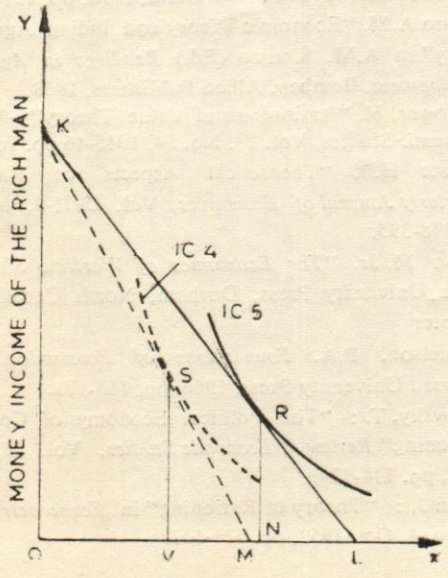
Fig. 1

2. For details see the references.
3. This assumption is based on the model of Dual Pricing unner partial equilibrium setting as developed by Khusro .A. etc.

price. He can, if his preferences are very strong, purchase larger than rationed quota, but, additional quantity has to be purchased at open market price, which will be more than equilibrium price.

Given the indifference map, the poor will be able to maximize his satisfaction under new conditions, if price line AF is tangential to a higher indifference curve, as shown at point 'P' in Figure I. Suppose his preferences are given by ICo indifference curve, he will not be in position to maximize satisfaction, because, ICo cuts the price line at point 'P'. Inspite of this the poor will choose point 'P' under these conditions, because, he would be shifted on to a higher indifference curve. Moreover, it also reflects a fact that his marginal rate of substitution between X and money would be greater than the control price of X, hence, he would prefer to consume more than rationed quota of X, though, he will have to purchase it at open market price. Under both these situations, consumer becomes better off, and his welfare is increased.

Figure-II depicts the behaviour of the rich man. He is in equilibrium at point R, purchasing on quantity of X in pre-rationed situation. Introduction of price control and rationing causes open market price of X to rise above equilibrium level. Hence, he confronts with a steeper price line KM. The opportunity locus open to the rich now shrinks to OKM compared to OKL in earlier situation. He would be in equilibrium at point S, consuming OV quantity at the higher price OK/OM. He is moved on to a lower indifference curve and becomes worse off.



Quantity of x

Fig. 2

As explained earlier, if the preferences for commodity X are very strong, the poor may wish to consume more than rationed quantity, at higher market prices. How will he determine his purchases under this condition is explained below.

Rationed quota at control price is fixed at OC. If his (Poor Man's) preferences are given by ICo, he would wish to consume larger quantity of X. He can purchase additional quantity from open market, at open market price, which is greater than pre-rationed equilibrium price. Hence, we have to incorporate open market price in Figure I, This can be done by drawing a price line steeper than AB, and parallel to price line KM in Figure-II. It may however be noted here, that, the new price line (market price) will now be anchored at point 'P' and not at A. This is so, because, the consumer would have already spent AD amount of money on the purchase of OC rationed quantity at control price. He is therefore left with OD amount of money, to be spent on additional quantity of X from open market (at market price) alongwith other commodities. Hence, he will be located somewhere on the PT range of price line, say, at point 'P,' where, his IC curve intersects this price line, and, he consumes CZ additional quantity of X at open market price. However, he is not able to achieve equilibrium under this condition, given his preferences, income, and, open market price.

In short, the introduction of rationing and price control, results in improving the welfare of the poor and reducing that of the rich person.

VI. Policy Implications of Rationing and Price Control

Rationing and price control are used as policy measures by many of the developing countries of the world. They are adopted to fulfill the objectives of

equity and welfare uplifting of the poor. Since such countries are facing the problem of inequality in distribution of income and consumption, allocation and distribution of scare goods and resources need to be taken extra care. The welfare and paternal attitude of the State induce it to see that bare necessities of life are made available to those who can not compete the rich in open market. Hence, a certain minimum quantity of such scarce necessities is determined on the basis of expert advice, and then, provided at control prices to the poor people. Obviously, the Pareto criterion of "Someone gains but no one looses," no more is allowed to operate. A purposeful intervention is made by the government in market mechanism, so that its equity and welfare objectives are attained. This type of policy is likely to give rise to following problems.

VII. Limitations of the Policy of Rationing and Price Control

1. The policy results into black marketing of the rationed good by sellers, who, either bypass the controls, or sell less than legally required quota in rationed market, thus, selling some amount in black markets at higher prices.
2. Producers may be induced to increase their self-consumption of controlled commodity (e.g., consumption of rice or wheat by farmers) causing a fall in marketable surplus, aggravating the shortage, and, raising the open market price of the good still higher. This may induce increased activities in black marketing.
3. Even if sellers honestly submit to controls, there is a possibility that production of the controlled product will be adversely affected, as, resources would obviously be diverted to the production of more profitable, uncontrolled products. Such a distortion in optimum allocation of resources may cause reduction in the total welfare of the economy. Hence, such a policy needs to be backed by provision of incentives to the producers of rationed goods.

To sum up, the policy of rationing and price control, which aims at raising the welfare of lower income group people, may fail to increase the total welfare of the economy, if, proper care is not taken to induce the producers to continue the production of rationed goods.

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Analysis of Performance Through Value Added Ratio in Iron and Steel Industry in India

S.C.R. MATHUR

In this article, the author analyses the performance of two organisations in Iron and Steel Industry through Value added Ratio.

S.C.R. Mathur is with the Post Graduate Accountancy and Business Statistics Department, Shri Jain P.G. College, Bikaner (Rajasthan).

Financial analysis regard profit as the most important measure of business performance. Profit may be expressed in money value, e.g. Rs. 30,000 per annum, or it may be measured as a sales margin percentage, e.g. net profit 10 per cent on sales, or it may be calculated as a return on investment e.g. R.O.I. 15 per cent. The Term "profit,' whether used in one form or the other, is used as a basis for the measurement of business performance. In recent years, there has been considerable interest shown in the use of 'Value added' as an alternative or additional approach to measure the operational efficiency of a business.

The concept of value added is not a new one, but interest in it has been increased since the publication of '*The Corporate Report*' by the Accounting Standard Steering Committee, London, 1975 and '*The Future of Company Reports*,' a consultative document of British Government, published by H.M.S.O., London in July, 1977.

Meaning and Concept of Value Added

Value added is the positive difference between total sales revenue and cost of bought-in goods and services obtained from outside the business. It therefore, equals to the addition in the utility of raw materials by a business. This utility is added through

the production process of the concern. It may be pointed out here that the manufacturing operations are simply conversion processes which yield an addition in utility of the material used. Value added may be known as the wealth created by the company from its operations. Value added has been defined as "the wealth, the reporting activity has been able to create by its own and its employees efforts."[1] In accounting terms Brown and Howard have pointed out that "value added is sales value *Less* the cost of bought in goods and services used in producing those sales."[2] John Sizer defined that, "Value added is the wealth the company has been able to create by its own and its employees efforts during a period."[3] Richard Lewis et al identify an organisation as a team which includes employees, providers of capital and the Government but it excludes other firms who supply goods and services. According to Richard Lewis et al, value added may be calculated as the difference between the value of the goods or services produced by the team, i,e., sales revenue, less the value of the goods and services purchased from outsiders i.e., the cost of bought-in-materials and services."[4]

Importance of Value Added

Value Added is an important tool in the hands of the analyst appraising the performance of a business. Profit is a test for shareholders to measure the performance of an enterprise while value added is a measure useful to all those who have contributed in the process of generating 'value,' such as, employees, investors of capital and the Government. Every one of them contributes to the value added and gets a proportionate share therein. This value generated by the business is included in the Gross Nation Product (GNP).

It is commonly believed that a concern not generating profit is sick while a concern not generating value is an evil to the society. From society's point of view, a sick unit may be considered useful so long as it generates value sufficient to pay wages to its employees because its closure will create unemployment which may result in a social crisis. At the same time it is also true that an enterprise may exist without making profit but cannot survive without generating value.

While preparing plans and fixing targets of the company financial managers usually set a profit target. But, as suggested by Brown and Howard, "Value Added could be a more appropriate criterion."[5] Writers such as Gilchrist and Wood have proposed that to optimise added value is more meaningful than to optimise profit because added value determines the reward for employees as well as for providers of capital. Therefore, in addition to being used as a measure of performance this index can be used as a basis for incentive schemes. It will be appreciated that the largest single distribution of value added will inevitably be in the shape of payment to employees. By definition value added excludes the cost of raw materials, so wages and salaries will normally take the largest share of value added. Therefore, incentive schemes can be designed in the light of value added.

Advantages of Value Added

A number of advantages may arise from using the value added techinque. Some of them have been given below.

1. Value added can be a moral booster which may be used to develop a feeling of team-spirit among the employees. Thus, value added may create a valuable human asset for the company.
2. The value added index can be used as a basis for incentive schemes, particularly in times of inflation, this may provide a firm base for wage settlement.
3. Value added may also be used as a measure of labour productivity. In a wage-settlement agreement labour productivity may play a vital role.
4. A value added statement shows clearly the rewards which have been assigned to each interested party, whether it may be the employees, the Government, the providers of capital or the business itself. Where data are provided over a period of years, trend can be set of index numbers or by applying the least-square method.

5. The value added statement combined with final accounts and funds flow statement provides a better communication link between the company and other interested parties.

A number of ratios can be developed by relating value added to capital employed, sales, components of cost, operating assets, profits and number of workers and with the help of these ratios inter-company and inter-industry comparisons can be made. Some of the important ratios are discussed here in the following paragraphs :

1. Value Added to Capital Employed Ratio

This ratio has been calculated by dividing the amount of value added by the amount of capital employed.

$$\text{Value Added to Capital Employed Ratio} = \frac{\text{Value Added}}{\text{Capital Employed}} \times 100$$

This ratio shows the value generation power of each rupee of capital employed on which the decision of management regarding further investment and criteria for investment depends. To arrive at the figure of capital employed, net worth and long-term borrowings have been added.

Table 1 shows the ratio of value added to capital employed in the Iron and Steel Industry in India and its units viz., SAIL and TISCO.

TABLE 1

Ratio of Value Added to Capital Employed (1978-79 to 1984-85)

(Per Cent)

Year	SAIL	TISCO	Industry
1978-79	21.22	83.75	25.51
1979-80	19.07	88.70	23.39
1980-81	17.47	92.58	22.06
1981-82	17.88	72.80	22.25
1982-83	16.67	59.05	20.39
1983-84	12.16	57.34	16.42
1984-85	17.53	69.77	22.84

Source : Annual Report and Accounts of SAIL and TISCO from 1978-79 to 1984-85.

In the industry, the ratio of value added to capital employed varied in a range of 9.09 per cent from 16.42 per cent in 1983-84 to 25.51 per cent in 1978-79. The overall tendency was towards declining. Sharp decrease in 1983-84 was due io decrease in value added combined with increase in capital employed in the year.

The ratio of value added to capital employed fluctuated in SAIL from 12.16 per cent in 1983-84 to 21.22 per cent in 1978-79 during the period of the study from 1978-79 to 1984-85. In 1983-84, the ratio decreased considerably due to decrease in value added and increase in the capital employed in the company the overall trend was towards declining in this concern.

In TISCO, the ratio of value added to capital employed varied from 57.34 per cent in 1983-84 to 92.58 per cent in 1980-81. During the first three years of the period of the study the ratio was increasing but in the later three years it decreased sharply. The ratio improved in 1984-85 when it was 69.77 per cent as compared to 57.34 per cent in 1983-84. The sharp decrease in this ratio during the later period of the study was on account of greater increase in long-term borrowings, taken to finance the capital schemes of the company.

A comparative analysis of the ratio of value added to capital employed revealed that the ratio was the lowest in SAIL as compared to TISCO and the Industry. This indicated that the company was not generating a sufficient amount of value which could give a satisfactory ratio to capital employed. TISCO's performance was far better than that of SAIL and the Industry but in the later period of the study TISCO also failed to generate enough value to match the ratio depicted during the earlier period of the study

It may be suggested that SAIL should take steps to increase the ratio of value added to capital employed by increasing the amount of value added. An effective control on bought-in-costs, both cost of goods as well as services bought, will increase the amount of value

added. On the other hand, the company should also check its cost of capital-works-in-progress so as to have an effective control over excessive capital employed. These steps will enhance the ratio of value added to capital employed as well as the profitability of the company.

2. Ratio of Value Added to Sales Revenue

This ratio has been calculated by dividing the amount of value added by the amount of sales revenue.

$$\text{Value Added to Sales Revenue Ratio} = \frac{\text{Value Added}}{\text{Sales Revenue}} \times 100$$

The ratio of value added to sales revenue shows the amount of value added by each rupee of sales revenue. Here the figure of sales revenue includes net sales and net income from services. As the figure of value added includes the amount of net income from services, the sales revenue has also been taken on the same pattern so as to have a comparable figure. Table 2 shows the ratio of value added to sales revenue of the Iron and Steel Industry in India, SAIL and TISCO for the period of the study from 1978-79 to 1984-85.

In the Iron and Steel Industry in India the ratio of value added to sales revenue decreased during the period of the study from 42.43 per cent in 1978-79 to 26.13 per cent in 1983-84 except in the years 1981-82 and 1984-85 when the ratio increased marginally to 35.95 per cent and 31.70 per cent respectively as compared to the respective previous years. During the period of the study the ratio was also declining in SAIL. In SAIL, the highest ratio was 41.09 per cent in 1978-79 and the lowest was 22.44 per cent in 1983-84. The steep decline in the ratio in 1983-84 was on account of decrease in the amount of value added in this year. In TISCO, the ratio fluctuated from 39.30 per cent in 1983-84 to 48.61 per cent in 1980-81. The ratio of value added to sales revenue was 47.80 per cent in 1978-79 which decreased to 44.84 per cent in 1979-80. The ratio rose to 48.61 per cent in 1980-81 but, thereafter it decreased continuously for the next three years i.e. 1981-82, 1982-83 and 1983-84 when it was 45.00, 41.08 and 39.30 per cent respectively. However, the ratio increased to 44.00 per cent in 1984-85 as compared to the previous year.

TABLE 2

Ratio of Value Added to Sales Revenue (1978-79 to 1984-85)

(per cent)

Year	SAIL	TISCO	Industry
1978-79	41.09	47.80	42.43
1979-80	33.58	44.84	35.68
1980-81	32.61	48.61	35.61
1981-82	33.58	45.00	35.95
1982-83	30.66	41.18	32.79
1983-84	22.44	39.30	26.13
1984-85	28.16	44.00	31.70

Source: Annual Report and Accounts from 1978-79 to 1984-85.

The ratio of value added to sales revenue was higher in TISCO than in SAIL. This shows that TISCO's performance was better than that of the SAIL.

3. Ratio of Value Belonged to the Employees to Value Added

The ratio between value belonged to the employees and the amount of value added by the concern can be calculated by the formula.

$$\text{Value belonged to the Employees to Value Added Ratio} = \frac{\text{Value Belonged to Employees}}{\text{Value Added}} \times 100$$

This ratio shows the share of employees in the value added by the concern. The terms 'value belonged to employees' and 'value added' have already been explained in detail. Table 3 shows the ratio of value belonged to the employees to value added in the Iron and Steel Industry in India and its units, viz., SAIL and TISCO.

It is evident from the Table 3 that the ratio of value belonged to employees to value added marked an

TABLE 3

Ratio of Value Belonged to Employees to Value Added (1978-79 to 1984-85)

(Per Cent)

Year	SAIL	TISCO	Industry
1978-79	35.07	40.82	36.36
1979-80	40-07	43-19	40-81
1980-81	41.88	39.64	41.31
1981-82	39.23	37.35	38.78
1982-83	44.47	41.11	43.61
1983-84	62.39	46.06	57.01
1984-85	45.18	35.93	42.31

Source : Annual Report and Accounts of SAIL and TISCO from 1978-79 to 1984-85.

increasing trend during the period of the study from 1978-79 to 1984-85 except in the years 1981-82 and 1984-85 when it decreased to 38.78 per cent and 42.31 per cent respectively as compared to the respective previous years. In SAIL, the ratio increased from 35.07 per cent in 1978-79 to 62.39 per cent in 1983-84. There was an overall increasing trend in the ratio in SAIL also except in the years 1981-82 and 1984-85 when it decreased to 39.23 per cent and 45.18 per cent as compared to the respective previous years. The sharp increase in the ratio in 1983-84 was due to the fact that the amount of value added decreased considerably and on the other hand the value belonged to employees increased. In TISCO, the proportion fluctuated from 35.93 per cent in 1984-85 to 46.06 per cent in 1983-84, In 1984-85 the amount of retained profit increased to Rs. 69.63 crores as compared to Rs. 7.77 crores in 1983-84 while the amount of the value belonged to employees increased to Rs. 175.67 crores as compared Rs. 161.93 crores in 1983-84, which indicated that the decrease in employees share was on account of the increased in the amount of profit retained.

A comparative analysis of the ratio of value belonged to employees to value added show that the ratio was higher in TISCO than in SAIL in 1978-79 and 1979-80. But in the remaining years of the period of the study the proportion in SAIL was higher than in TISCO, which indicated that TISCO had managed to check its labour costs whereas SAIL failed to do so. It is, therefore, suggested that SAIL should try to control its labour costs.

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PRODUCTIVITY IS NOT

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Productivity
1988, XXIX. 1, 57-68

Prospects of Post Harvest Equipment in Increasing Productivity and Employment Potential

R.P. KACHRU, P.K. SRIVASTAVA,
B.S. BISHT, T.P. OJHA

The paper describes the prospects, in terms of possible gains, net profits and employment potential of application of some selected post harvest equipments developed in India for dryland agriculture.

R.P. Kachru, P.K. Srivastava, B.S. Bisht & T.P. Ojha are with Post Harvest Engineering Division, Central Institute of Agricultural Engineering, Nabi Bagh, Berasia Road, Bhopal-462 018.

Introduction

The arable land in India is approximately 143 million ha out of which only 38.6 million ha is irrigated. The remaining land, amounting to about 73% is rainfed, i.e; virtually dependent upon rain which is not only scanty but also unassured, erratic and at times torrential. As far as land productivity is concerned, this rainfed area contributes 42% of the total food grain production. Almost all the irrigated crops are grown under dryland conditions also. Except wheat and barley, the dryland area under the crops is more than that under irrigation. In fact, the minor millets excluding finger millet, are nearly 100% unirrigated. The extent of drylands under different crops are : sorghum (95.5%), pearl-millet (94.6%) groundnut (94%), pulses (92.4%), chickpea (84.7%), maize (82.3%), cotton (78.2%), rapeseed/ mustard (65.8%), rice (61.7%) barley (44.0%) and wheat (35%). The country depends upon rainfed agriculture for 75% of pulses and oilseeds, 80% of the sorghum and pearl-millet, 65% of maize, finger millet and cotton, 35% of rice and wheat, thereby producing about 63 million tonnes of food grains annually. However, the dryland area is marked with low surplus in production of crops and low capital formation. This, coupled with high risk factor of crop failures results in inadequate application of

vital agricultural inputs like HYV seeds, fertilizers, plant protection chemicals and improved implements. Researches have, however, revealed that drylands can contribute at least a minimum of another 60 million tonnes to the national food basket on application of modern technologies and management practices. To this effect, there is a need for development of package of practices for increasing per hectare yields in these rainfed areas. However, farmers who have to invest on costly inputs like seeds, fertilizers, water, pesticides etc. besides, labour to raise the crops, need to be provided with appropriate means for timely harvesting and its subsequent processing for conservation and making it more suitable for use. Thus, for an overall increase, production of agricultural commodities should be matched by equally effective and extensive efforts towards the conservation of their quality and quantity during post harvest handling, processing, storage, distribution and utilisation phases.

Various post harvest equipments have been developed by different R & D organisations in our country. An attempt has been made in this paper to identify the suitable post harvest equipments which can help in increasing the productivity of dryland agriculture. The salient features of equipment, their power and labour requirement have also been described alongwith the economic analysis to determine their bankability. Further the paper also shows the projected requirements of various suitable post harvest equipments towards increasing the productivity of dryland crops in respect on its qualitative and quantitative improvement through value addition. Total investment required on equipment has also been calculated and compared with the likely gains on account of the use of such improved post harvest equipments.

Role of Post-Harvest Equipments in Dryland Agriculture

Post-harvest technology is a multi-disciplinary science which has the capability to increase the productivity of already produced crops by their scientific conservation, eliminating avoidable losses and making available more nutritive food and high value products from low grade raw materials by processing, fortification, packaging, transport and marketing. It also enables the creation of agro-processing industries to produce value-added products assuring greater financial returns and generating more employment opportunities ushering in a greater potential in reviving the rural economy.

With specific reference to dryland crops, the proper processing of all food grains produced in such low productivity areas assumes prime importance. Food grains produced at a great risk by the poor farmers should not be allowed to be lost or spoiled during various post-harvest operations by conventional, uneconomical methods or during transportation to the urban areas for marketing and/or storage. The concept of 'on the farm' processing is to be utilised in such areas by using small scale equipment owned by farmers or a group of farmers.

Realising the importance of post-harvest technology, in the overall agricultural scene of our country, more than 150 improved post-harvest equipments have been developed in India by various R & D organisations. This is, besides a large variety of equipments used in the country in its 360 roller mills, 6,000 dhal mills, 78,400 rice hullers, 14,000 shellers and 13,400 modern rice mills, 40,000 jaggery and 350 white sugar mills, 2,30,000 ghanis, 15,000 power driven expellers, 200 solvent extraction units, 84 vanaspati units, 1,500 units for processing of fruits and vegetables etc.

Suitable Equipments for Processing of Dryland Crops

In conformity with the type of crops grown in dryland areas of the country, 66 matching post harvest equipments have been developed in India which include :

(i) cleaners and graders (hand/power operated cleaners, graders, winnowers, separators, pre-cleaners etc., capacity 100-1,500kg/h, manual or 1-5 hp power operated, suitable for wheat, paddy, gram, soybean, pea, maize, sorghum, millets, pulses, groundnut, sunflower etc.—9 in Nos.

(ii) driers (batch, bin, continuous, cup and cone type with capacity between 6-10 q/h or 5-12.5 q/batch, power requirement 1-12.5 hp, 9 Nos., suitable for wheat, pad y/rice, maize, sorghum/millets, pulses, soybean, groundnut etc.)

(iii) stabilizers and heat treaters (5 in nos; with 20-60 kg/h or 200-250 kg/charge capacity operated by steam, solar energy or 0.05 hp/3.75-5 kwh electric motors, suitable for rice bran, soybean dhal, cereals/pulses etc.)

(iv) storage structures (12 in nos; 2.5-60 q capacity suitable for cereals. Pulses, oilseed etc.)

(v) milling, decortication or dehusking equipments (grain/dhal mills, grinders, pearler, dehuller or shellers, 16 in nos., capacity 10-650 kg/h, manual/0.5-7.5 hp electric motor operated and suitable for crops like wheat, gram, sorghum, soybean, pigeon pea, rice, maize, castor, sunflower, groundnut etc.)

(vi) extracting units (oil ghani, fibre extractor, scutching machines etc. 3 in Nos. with 5-10 kg/h or 15-18 kg/batch capacity operated by 0.5 kw/2hp electric motor and suitable for rapeseed/mustard, groundnut, mesta, sunhemp, jute, flax, etc.)

(vii) strippers and seed treaters (5 in nos. 20-1,000 kg/h capacity, manual/1-3 hp power operated suitable for cotton, soybean, groundnut pods etc.) and

(viii) miscellaneous equipments (paddy parboiling equipment, puffing machine, mixer, seed collector etc., 7 in nos.).

The economic analysis of representative examples of these equipments have been presented in Table 1 which shows the cost of equipment, cost of operation and break-even-point. These economic parameters for each equipment, wherever possible, have been determined for three different operational conditions, namely; purely custom based, 50% custom based and 50% sale and 100% sale based. This table also presents the profitablility by using these equipments as determined by computation of annual net profits, return-on-investment and employment generation (mandays/y/unit of capital investment). Any equipment for a particular operation condition, giving a return on investment more than 15% has been tentatively considered to be economically viable.

On Selection of the equipment, efforts have been made to calculate the number of units required for processing certain assumed fraction of the entire dryland crops. Calculations have also been made to know the total amount to be invested in making available the desired number of equipment. Likely incremental returns to farmers on account of value-addition or loss-prevention have also been calculated based on the 1984-85 trends in market prices. In order to show the profitability of sueh investment, likely returns have been compared with the amount of investment on equipment.

For determining potential of earnings additional income through the application of selected post harvest equipments, figures have been arrived at through multiplying the production figures of a crop with the market rates, potential for additional income and the percentage of crop processed. The gains have been on account of either loss prevention as in the case of storages structures or by value addition or a combination of both. In case of storage structures, the rise in prices of produce during 6 months of storage period (from harvesting season to off-season) have also been considered as gain. In case of groundnut strippers, saving of time has been considered as gain and its monetary value is calculated based on wages of unskilled labourers. The potential of additional income and possible gains by processing various dryland crops are shown in Table 2.

Requirement of Post Harvest Equipments

The details worked out for calculation of projected requipment of post harvest equipments towards processing feasible proportions of the dryland crops (as shown in Table 2) reveal that a large number of selected equipments are required. These requirements (in thousand units) may be summarised as cleaners and graders : 373 (estimated cost Rs. 2,820 million), driers : 232 (estimated cost Rs 6,370 million), storage structures : 7,631 (Rs 27,818 million), pearlers : 45 (Rs 315 million), power operated groundnut strippers : 253 (Rs. 1,517 million), groundnut decorticators : 18

TABLE 1

Economics of Selected Improved Post-harvested Equipments Suitable for Dryland Crops—Representative Case Studies (1986 prices)

Sl. No.	Economic parameter	Pedal operated cleaner	IGSI Grain drier	Blancher	Multipurpose grain mill	Power operated groundnut decorticator
1.	Cost, Rs.	2,500	5,000	15,900	2,700	4,700
2.	Suitable for	Wheat, soybean. Bengal gram	Paddy	Soybean	Wheat, gram coriander	Groundnut pods
3.	Working capital (weighted), Rs					
	100% CH*	212	341	1,703	209	314
	50% CH + 50% sale	23,532	1,739	18,353	1,672	27,194
	100% sale**	46,852	3,136	35,633	3,135	54,075
4.	Cost of operation, Rs/q					
	100% CH	1.40-2.60	14.70	10.35	7.25-36.35	3.95
	50% CH + 50% sale	1.70-2.65	14.90	10.70	7.45-37.30	4.40
	100% sale	1.95-3.00	15.05	11.10	7.65-38.25	4.90
5.	Break-even-point, q/y					
	100% CH	487	916	1,201	133	304
	50% CH + 50% sale	343	584	1,216	121	165
	100% Sale	302	445	1,225	113	125
	Self use	161	356	343	82	82
6.	Annual net profits, Rs					
	100% CH	3,414	243	14,016	1,862	2,731
	50% CH + 50% sale	8,357	1,514	17,972	2,514	7,708
	100% sale	13,300	2,785	21,928	3,167	12,668
7.	Return-on-investment, %					
	100% CH	133	5***	91	67	57
	50% CH + 50% sale	87	27	88	78	60
	100% sale	80	47	85	87	61
8.	Employment generated, mandays/y/Rs 10,000 investment					
	100% CH	468	490	261	905	125
	50% CH + 50% sale	125	453	195	781	47
	100% sale	72	421	156	687	29

*CH : Custom hiring/processing operation.
**Sale : Procurement of raw material, processing followed by sale of processed items.
*** : Not viable under the assumed operational conditions.
Source : Kachru, RP et al. Hundred Bankable Post Harvest Equipment Developed in India. CIAE, Bhopal, 1986.

TABLE 2

Potential Additional Income on Using Selected Post Harvest Equipments in Dryland Agriculture (1984-85)

Sl. No.	Crop	Production* MT	Market rate Rs/t	Post-harvest equipment used	% of production processed	Potential of additional income, %	Possible gains by processing** (Rs. million)
1.	Sorghum	9.00	1,600	Cleaner/grader	100	7.5	1,080
				Drier	50	10.0	720
				Storage	50	16.5	1,188
				Pearling	50	10.0	720
2.	Pearl-millet	4.93	1,600	Cleaner-grader	100	7.5	591.6
				Drier	50	10.0	394.4
				Storage	50	16.5	650.8
				Pearling	50	10.0	394.4
3.	Groundnut	6.07	4,000 (pods)	Cleaner-garder	100	7.5	1,821
				Stripper	100	12.0	2,913.4
				Drier	50	10.0	1,214
				Decorticator	25	12.5	758.7
				Oil Extraction	12.5	22.0	667.7
4.	Pulses	10.99	3,500 (weighted)	Cleaner/grader	100	7.5	2,884.9
				Drier	25	10.0	962.0
				Storage	25	15.5	1,491.1
				Dhal milling	50	12.5	2.404.9
5.	Maize	5.43	1,750 (grain)	Husking-shelling	75	12.5	890.9
				Cleaning-grading	75	7.5	534.5
				Storage	50	15.5	736.4
6.	Rapeseed-mustard	2.73	3,500	Cleaner/garder	100	7.5	716.6
				Storage	25	16.0	382.2
				Oil extraction	25	45.3	1,082.1
7.	Paddy	20.52	1,700	Cleaner-grader	100	7.5	2,616.3
				Drier	50	10.0	1,744.2
				Storage	25	15.0	1,308.2
				Parboiling	25	22.0	1,918.6
				Stabilization***	25	40.0	174.4
8.	Wheat	15.48	1,800	Cleaner/grader	100	7.5	2,089.8
				Storage	25	15.5	1,079.7
				Pearling	5	10.9	139.3
9.	Soybean	0.80	2,700	Cleaner/grader	100	7.5	162.0
				Storage	40	16.7	138.2
10.	Castor	0.47	3,500	Sheller-winnower	75	6.0	74.0

* Estimated at 1980-81 production basis (Mt: million tonnes).
** Cost of processing has not been subtracted here.
*** 5% of paddy.

Note : Gains on account of storage are through :
(i) reduction in avoidable losses, and
(ii) average increase in value.

5.	Castor	75	Shelling and winnowing	50	234	68.00	24.6
6.	Pulses	100	Pedal operated cleaner	60	5,497	21.50	263.3
		25	Recirculating batch drier	50	1,308	49.00	134.6
		25	Storage structure	—	—	250.75	688.9
		50	Dhal mill	200	13,742	93.50	513.8
						Total :	1,573.6

(*Contd.*)

(Rs. 85 million), castor shelter-cum-winnower : 2 (Rs. 19 million), KVIC power oil ghani : 231 (Rs. 3,470 million), CIAE dhal mil l : 34 (Rs. 240 million), maize husker-cum-sheller : 26 (Rs. 420 million), mini paddy parboiling equipment : 15 (Rs. 122 million), rice bran stabilisers : 4 (Rs. 31 million), etc. The total estimated cost of these equipments works out to be Rs. 43,227 million.

reveals that for cleaning and grading of sorghum crop alone, for 30 days of operation per year, the employment potential could be of the order of 662 thousand man-days per year. Similarly, employment potential has also been worked out for all the 10 major crops and selected operations, namely: drying, pearling strippering, decortications, expelling etc. Thus for the the selected crops and operations, the total employ-

TABLE 3 (*Contd.*)

1	2	3	4	5	6	7	8
7.	Maize	75	Seed cleaner-cum-grader	30	300	15.00	61.1
		50	Storage structure	—	—	205.00	556.6
		75	Husker-cum-sheller	30	5,483	36.00	146.6
						Total :	764.3
8.	Rapeseed/mustard	100	Pedal operated cleaner	30	1,364	30.00	81.9
		25	Storage structure	—	—	223.00	152.2
		25	Oil ghani	200	9,684	802.50	547.7
						Total :	781.8
9.	Wheat	100	Pedal operated cleaner	25	11,057	30.00	464.4
		25	Storage structure	—	—	250.75	970.4
		5	Pearler	50	968	77.50	60.0
						Total :	1,494.8
10.	Soybean	100	Pedal operated cleaner	25	364	20.50	16.4
		40	Storage structure	—	—	223.00	71.4
						Total :	87.8
				Grand Total :	125 million md/y		13,882.2 Rs million

md : mad-days
y : year

the total cost of processing. Analysis presented in Table 2 regarding the use of selected post harvest equipments for 10 major crops of the dryland agriculture reveals that possible gains to the tune of Rs. 36,644.3 million could be obtained. This was equivalent to producing another 20.35 million tonnes of wheat or 22.90 million tonnes of sorghum or 21.55 million tonnes of paddy under dryland conditions. Benefits on account of processing of the products have been worked out by deducting the cost of processing from possible gains on account of processing. It is revealed that the net benefits could be to the tune of Rs. 22,762.18 million per year. The basic assumptions in working out this figure have been that all the equipments are used for processing reasonable proportion of the produce. The benefit to cost ratio reveals encouraging figures ranging from 0.19 to 9.20 for different crops. The monetary gains on application of the selected post harvest equipments for dryland agriculture as well as the employment potential have been depicted in Figures 1 (a) and 1 (b). It reveals the significance of additional benefits on account of processing and also potential for employment on using the selected equipment. The exercise has been done for the selected 10 major crops and 13 unit operations.

Processing and Production Pathways for Additional Gains

In order to find out whether it is beneficial for the farmers to gain through processinng or through

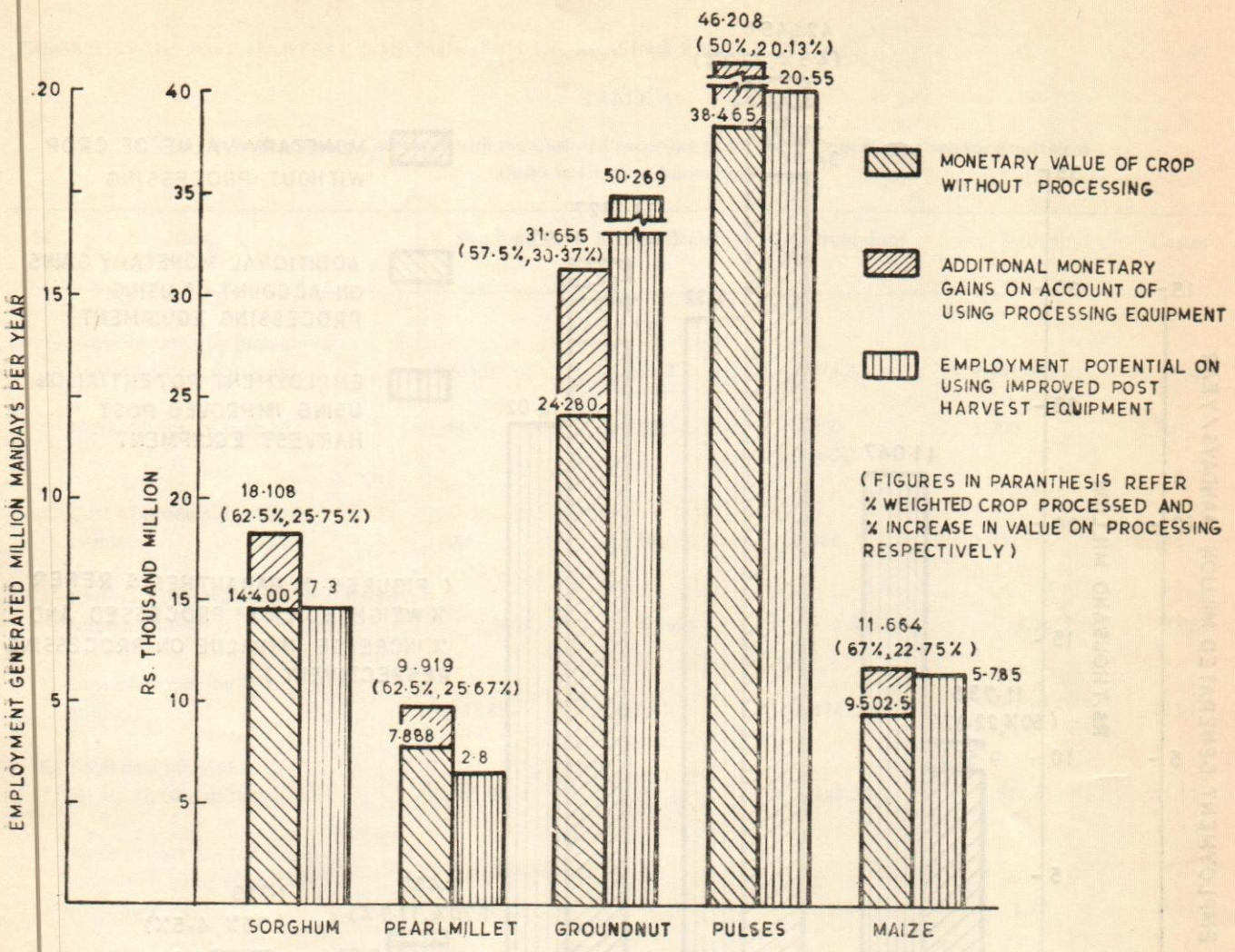

Fig. 1(a) Monetary Gains and Employment Potential on Application of Selected Post Harvest Equipment

additional production, analysis have been done as shown in Table 4. For this purpose, the cost of production for 5 crops, namely; sorghum, pearl-millet, groundnut, paddy, and castor have been obtained from literature (Rastogi, et al; 1982). Possible gains through post-harvest operations on account of value addition are as mentioned earlier (Table 2). The market price of different crops and cost of production have been same as applicable for the year 1984-85. Processing gains have been equated with additional farm production by dividing the gains by market price prevailing for individual crops. In case of sorghum, it is revealed that the gains on account of processing were equivalent to 2.318 million tonnes of additional sorghum production. An amount of Rs. 3,441.49 million are required as cost of production of this quantity. This is with the assumption that the incremental production and incremental cost of operation follow a linear relationship. Though, in practice the cost of production should be higher for incremental production based on the basic laws of economics. The ratio of the cost of production (of processing gains) to the cost of processing reveals that the values are always more than unity which in other words mean that it is advantageous to process the crops as compared to having to invest for increasing the production. The values obtained have been in the range of 1.44 for groundnut, to 2.13 for castor. For sorghum, the ratio was 1.95 which reveals that for certain additional gains, a farmer could have afforded

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Productivity
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Cheap Labour Explanation of Agricultural Productivity

SIAMAK MOZAFFARI
A.J. SINGH

The authors attempted to test the hypotheses of cheap labour explanation in the context of latest technological advances in Punjab based on the disaggregated farm level data for the year 1980-81.

Siamak Mozaffari was formerly a student in the Punjab Agricultural University, Ludhiana.
A.J. Singh is Senior Economist in the Punjab Agricultural University, Ludhiana.

In recent years, many agricultural economists Bhattacharya (1), Rudra (2), Deolalikar (3) and Mazumdar (4,5) have conducted numerous studies on the efficiency of the small farmers. Of particular interest is the one conducted by Rudra (7) on the myth of the small farm efficiency. Rudra (7) gives a brief review of the explanations offered in support of the small farm effiiciency (alleged inverse relationship) particularly the cheap labour based explanation of Sen (9). Sen (9) noticed that by and large productivity per acre decreases with the size of holding. This phenomenon, he explains, is due to the small farmers using more input per acre, and therefore, getting more output as well. Sen (10) later presents his cheap-labour explanation, that under situation of wide-spread unemployment, the opportunity cost of labour to a family based farm is very low. As a consequence, the farmer who did not have to hire labour, applied labour more liberally with less restraint than the farmer who had to hire. This naturally leads to higher productivity per acre on the small farms. Rudra (7) has empirically tested the validity of Sen's cheap labour explanation for the years, 1969-70 based on disaggregated farm level data for a number of states in India and particularly Punjab (Ferozepur). Rudra (7) has divided the cheap labour explanation into a number of hypotheses, which are :

Hypotheses

H_1 Small farms employing exclusively family labour, use labour more intensively than large farms based exclusively on hired labour.

H_2 Higher input per acre of human labour on the small farms based exclusively on family labour, results in higher output per hectare on such farms.

H_3 Higher proportion of farms that have a large farm size are based exclusively on hired labour.

H_4 Higher the farm size (F-H)*, higher the proportion of hired labour to family labour.

H_5 Higher the proportion of family labour to hired labour, higher the intensity of application of human labour.

H_6 Higher the input of human labour (whetever its composition in terms of hired labour and family labour), higher the output per acre.

H_7 Higher the proportion of family labour to hired labour, higher the productivity of land.

H_8 Higher the proportion of family labour to hired labour, lower the average productivity of labour.

H_9 Higher the farm size, higher the average productivity of labour.

The objective of this study is to test these hypotheses in the context of latest technological advances in Punjab that are based on the latest disaggregated farm level data (all zones of Punjab) for the year 1980-81. As it was difficult to locate farms using exclusively family labour or hired labour this study compares farms employing mainly family labour (small farms) with farms using mainly hired labour (large farms). Hereafter, we shall refer to these farms as small and large farms.

Results and Discussions

Hypotheses H_1 and H_2 are both confirmed for Punjab State giving ample support to the cheap labour based explanation. H_1 indicated that labour intensity is relatively higher on small farms than on large farms (Table 1). This also signifies that farms with mainly family labour work more intensively than the large hired labour farms. H_2 is also confirmed; indicating that gross value product/hectare is relatively higher on smaller farms, than on large farms, supporting the inverse relationship between farms size and productivity. H_3 is confirmed, implying that labour input per hectare decreased as farm size goes up. Hypotheses H_4, H_5, H_6, H_7, H_8, and H_9 were tested through regression analysis. The results are presented in Table 2. The regression coefficients and their significance indicate that H_4 is confirmed, implying labour farms of F-H type apply a higher proportion of hired labour than family labour. Coming to mixed farms of (F-H)-it is seen that total labour input per

TABLE 1

Testing the Hypotheses H_1, H_2 and H_3

Hypotheses 1 :	Labour intensity* on small farms	= 1173
	Labour intensity on large farms	= 763
Hypotheses 2 :	Gross value product/hectare on small farms	= 7185
	Gross value product/hectare on large farms	= 6632
Hypotheses 3 :	By simply observing the 200 farm holdings for the year 1980-81, one can observe that as farm size increases higher is the proportion of hired labour to total labour input.	

Size	Per cent of hired labour Total Labour input
Small (0—5.45 hectares)	6.6
Medium (5.46—10.25 hectares)	32.4
Large (10.26 hectares and above)	61.0

*Labour intensity is worked out as under :

$$\text{Labour intensity (Manhours)} = \frac{\text{Family labour + hired labour}}{\text{Operated area}}$$

*F-H indicates farms with family and hired labour.

TABLE 2

Regression Analysis for Testing Various Hypothesis

Hypothesis	Regression coefficients	Standard errors	't' values
H_4	.9446*	(.1530)	6.173
H_5	.0024 (NS)	(.0014)	1.639
H_6	.0424*	(.0059)	7.579
H_7	(—).00387*	(.0029)	2.997
H_8	(—).0056*	(.0013)	4.182
H_9	.0141*	(.0031)	4.525

*Significant at one per cent probability level.

hectare does indeed go up as the proportion of family to hired labour goes up though not significantly. As such, H_5 is not confirmed but this does not result in output per hectare going up at the same time. Thus, H_7 stands refuted. This is because productivity of labour goes down as the proportion of family labour to hired labour goes up confirming H_8. H_9 is also confirmed, indicating that as farm size increased, labour productivity will also go up. Table 3 summarizes the results.

TABLE 3

Confirmation Refutation of Hypotheses

State—Punjab	Year 1980-81
1	2
Hypothesis 1	
Labour intensity is higher on small farms	Confirmed
Hypoihesis 2	
Gross value product per hectare is higher on small farms	Confirmed
Hypothesis 3	
Proportion of hired labour to the total labour used is higher for large farms	Confirmed
Hypothesis 4	
Higher the farm size of F-H type higher the proportion of hired labour to family labour	Confirmed
Hypothesis 5	
Higher the proportion of family labour to hired labour, higher the intensity of application of human labour as a whole	Refuted
Hypothesis 6	
Higher the input of human labour, whatever its combination, higher the output per hectare	Confirmed
Hypothesis 7	
Higher the proportion of family labour to hired labour, higher the productivity of land	Refuted
Hypothesis 8	
Higher the proportion of family labour to hired labour, lower the productivity of labour	Confirmed
Hypothesis 9	
Higher the farm size, higher the productivity labour	Confirmed

From the foregoing discussion of the empirical verification of the different hypotheses advanced by Rudra (7), it follows that our results are consistent with the results reported by him for 1967-70 except for Hypotheses 1 ahd 2. Our study confirms these two hypotheses, whereas Rudra's study rejects them. It seems that with the wider diffusion of new seed-water-fertilizer technology which is divisible in nature, the small farms are obtaining relatively higher output per hectare by using haman labour more intensively as compared to large farms. We can therefore, conclude with Sen that cheap labour is one of the important factors lending support to the inverse relationship between farm size and p-oductivity in the Punjab State on the basis of the latest set of Farm Management Survey data for the eightees.

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Converting dreams into deeds is the credo of productivity!

Productivity
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Measuring Effectiveness of R & D Groups

V.S.R. KRISHNAIAH
PRITHPAL SINGH

The authors seek to assess the potential of Goal attainment approach to measure the effectiveness of R & D Groups.

V.S.R. Krishnaiah is System Analyst in the National Informatics Centre, New Delhi and Prithpal Singh is Professor in the Indian Institute of Technology, New Delhi.

From the early days of industrialisation through the era of scientific management, organisational effectiveness was measured by productivity/and/or profits. As more humanistic approaches to management emerged, so did apparently "new" goals of the organization, resulting in an expansion of organisational effectiveness to include individual satisfaction and need fulfillment. More recently, others have argued that organisational effectiveness must be assessed with respect to its impact on the family, on the society, on the community and, even, on the environment. This accelerating movement towards multiple causal determinants (independant variables) of effectiveness and multiple measures (dependant variables) of effectiveness has obfuscated a clear definition of organisational effectiveness (Goodman et al, 1983). Eventhough, several attempts have been made by organisational scientists to develop a general model for consistently and systematically defining and measuring effectiveness, little agreement exists regarding what organisational effectiveness means or how to asses it. Some researchers have, even, advocated abandoning the construct altogether in scholarly activity (Hannan & Freeman, 1977). Goodman (1979) for example, has asserted that "there should be a moratorium on all studies of organisational effectiveness, and chapters on organizational effectiveness." However, organisational effectiveness holds an important place in organisation theory,

research and practice that the concept should not, indeed cannot, be abandoned (Cameron & Whetton, 1983). It deserve even more systematic and fine-grained analysis that it has received, heretofore.

This article seeks to assess the potential of one of the major perspectives on organisational effectiveness viz. goal-attainment approach to measure effectiveness of research and experimental development (R & D) groups. The second part of the article focusses its attention on the review of evaluation studies in R & D settings, which then logically leads to the examination of relevance and applicability of goal-attainment approach to study the effectiveness of R & D groups in the Indian context. In this article, the terms 'R & D.' 'R & D Unit,' and 'research unit' have been used interchangeably.

Major Perspective of Organizational Effectiveness

The most widely used models are the goal-attainment model (Bluedorn, 1980; Price, 1972), the system resource model (Yuchtman & Seashore, 1967), the Strategic constituencies model (Miles, 1980; Pfeffer & Salancik, 1978) and the Competing-values model (Quinn and Roharrbaugh, 1983).

The goal-attainment model states that an organization's effectiveness must be appraised in terms of the accomplishment of ends rather than means. Since effectiveness is defined with respect to the degree of goal achievement, the definition of 'goal' is crucial. Etzioni's (1964) definition is widely cited : "An organizational goal is a desired state of affairs which the organization attempts to realize . . ." Those who define effectiveness in terms of the degree of goal achivement typically equate "goal," "objective," "purpose," "mission," "aim," and "task" (Price, 1972).

The Systems approach to organizational effectiveness has developed more as a counterpoint to goal attainment than as an extension. It has been argued that organization should be judged on its ability to acquire inputs, process these inputs, channel the outputs, and maintain stability and balance (Yuchtman and seashore, 1967). Thus the systems approach has focussed not so much on specific ends as on the means needed for the achievement for those ends. Its time frame is longer since it is oriented towards assessing the organization's ability to survive and considering all those factors that can and do impact on survival. A systems approach to organizational effectiveness implies that organizations are made up of interrelated subparts. If any one of these subparts performs poorly, it will impact on the performance of the whole system. Effectiveness requires awareness and successful interactions with environmental constituencies.

The Strategic—constituencies, approach assumes that an organization is faced with frequent and competing demands from a variety of interest groups. Not all these interest groups are of equal importance, so effectiveness is determined by the organization's ability to identify its critical or strategic constituencies and to satisfy the demands they place upon the organization (Pfeffer & Salancik, 1978). Further, this approach assumes that managers pursue a number of goals and that the goals selected represent a response to those interest groups who control the resources necessary for the organization to survive.

Proposing the competing—values approach, Quinn and Roharbaugh (1983) explained that "organizational researchers share an implicit theoretical framework" about organizational effectiveness consisting of "three axes or value dimensions" (p 369). These axes are orthogonal to each other, and represent organizations' structural properties (centralized/decentralized), attention orientations) internal/external focus), and the relationship between means and ends to achieve desired outcomes. These three value dimensions were combined to create eight cells or organizational effectiveness criteria. The result was four diverse models or definitions of organizational effectiveness, no one of which is right for assesing all organizations. They are labelled human relations, open systems, rational goal, and internal process.

The competing values approach assumes that there are competing values that create conflicting goals. There is no single goal in an organization. There is also no consensus around the goals that can be identified. It also assumes that what an evaluator

values will go a long way in determining what the evaluator chooses to assess.

It has beeome clear that with the divergence of models and criteria used in relation to organizational effectiveness, no single, unambiguous meaning of the construct of organizational effectiveness is available. Organizational effectiveness is inherently subjective and it is based on the personal values and preferences of individuals (Cameron & Whetten, (1983). Writers such as Van de Ven and Ferry (1980), Bluedorn (1980) and others refer to organizational goals as being manifestations of individual preferences and values, so goals, for them, are the best criteria for measurement. Agreement on certain preferences or goals causes them to be advanced as the major criteria of effectiveness for the organization.

Concept of R & D Groups

Contemporary research and development has been taking on the structure of groups or clusters of individuals—moving away from solitary efforts. This trend is stimulated by the increasing complexity of research questions being addressed on the one hand and on the other by phenomenal advances in research technology. Significant research problems are inherently complex and cannot be solved within the bounds of a single discipline and this is reflected in the increase in the number of multi-disciplinary research groups. A rough indicator of these trends is the increase in the proportion of research articles written by three or more authors. Collaborative research is also considered to be more productive in terms of quantity and quality of output. The scientist, instead of working as an individual works as a member of a group.

Hagstrom (1967) observed that R & D groups are formed by the prestigious or otherwise powerful scientists to exploit more effectively younger scientists Weinberg (1970) and Wilson (1970) observed that research groups are formed because the development towards "big science" with emphasis on expensive heavy equipment, makes them necessary. Stankiewicz (1980) stated that research groups are formed simply because they offer competitive advantage to their members both senior and junior.

The advantages of R & D groups rest on the fact that such groups create the socio-psychological environment which is conducive for individual creativity and productivity. Scientific research is, indeed an individual based activity requiring freedom from rigid formal coordination (Pelz & Andrews. 1976). However, it is also an activity that is greatly stimulated by interactions (communication/collaboration) among the scientists. Such interactions enhance the intellectual synergy, i.e. the process by which the scientists reinforce each other's creative potential and work capacity. The specific aspects of this process include such things as the cross-fertilization of ideas, complementarity of skills, coordination of work, communication of tacit knowledge, mutual criticism, error detection, psychological support and many others (Stankiewicz, 1980). Forming research groups may be regarded as the means for achieving a high level of interaction among scientists and, thus, promoting the intellectual synergy.

A major concern of R & D management is how to improve the performance of R & D groups. In the search for optimal configuration of human and material resources and management practices, the most important question is how to evaluate the performance of scientific activity.

Review of the R & D Evaluation Studies

Until recently the evaluation of science was the exclusive domain of the scientific community and the criteria employed for evaluation were primarily those which were concerned with the internal development of scicnce. But the scenario has changed now, and this change has been brought about by the growing institutionalization of science, and the state support to scientific research. The rapid growth in the financial investments by the government and the industry and their capability to harness science for social, economic and political purposes have led to a qualitative change in the concept of research performance and its evaluation. The criteria of evaluation are no longer confined to the domain of science itself; they have extended beyond the boundaries of science (Nagpaul, 1985).

Most of the studies in the past investigated research effectiveness from a micro or individual perspective, and only a few employed R & D groups/ organisations as units of analysis. Among these later studies, most of them did not provide a conceptual definition for research unit effectiveness, and usually employed measures which were basically of the average performance of the scientists in the unit (e.g. Andrews and Farries, 1967: Hall and Lawler, 1970; Smith, 1971; Mann et. al; 1974). In this regard, the studies by Barnowe (1973) and Stahl & Steger (1977) are exceptions in which they provide conceptual approaches to research unit effectiveness. Barnowe conceptualizes the effectiveness of a research unit in terms of its scientific and applied contributions. This criterion concerns the extent to which the research unit's output contributes to scientific knowledge, both quantitatively and qualitatively; whereas the applied contribution criterion concerns the extent to which the output contributes to the solution of applied problems. Barnowe studied the performance of research units of US Forest service on these criterion in 1973. Stahl and Steger (1977) measured the performance of 35 work groups in Air Force R & D Laboratories on two subjective dimensions : Innovation and Productivity. While innovation is output that is original and useful productivity is quantity or amount of output without regard to innovativeness or any other quality. Moser (1985) conducted a study to find out how performance was actually being measured in R & D units. His respondents were 400 R & D managers representing groups in which basic and applied research in science and engineering, and design and development of prototypes. Moser asked the res pondents to rate the frequency of use of the 13 performance measures in their work settings. He found that three criteria—quality of output, degree of goal attainment, and the amount of work done on time - are the most frequently and consistently utilized performance measures in R & D environments.

ICSOPRU Measures of Research Performance

With the primary objective of developing a methodology for assessing and improving the effectiveness and efficiency of research units for the benefit of all member countries, UNESCO undertook a major study viz. 'International Comparative Study on the Organization and Performance of Research Units' (ICSOPRU) in 1971. The study has been carried out in 14 countries and is currently being replicated in four more countries (UNESCO ICSOPRU PROJECT, (1987). In this study, the effectiveness of the research unit is measured within the framework of a goal attainment model. The research unit has several goals. As a social entity of scientists, it has to contribute to the world pool of scientific knowledge and seek recognition of its work by the scientific community at large. As a part of the organisation which supports its activities and provides the necessary financial and material resources, it has to meet the goals and objectives of the organization. Also, the scientists as well as the organization have a responsibility to the society—the output of science should have a social purpose and, therefore should subserve the societal goals. Taking these aspects into account, effectiveness of research unit should be modelled as a multi-dimensional concept, incorporating both intra-scientific and extra-scientific dimensions of research. The intra-scientific dimension reflects the traditional criterion of the scientific contribution of research i.e., production of scientific knowledge, its quality and dissemination being through publication and training. The extra-scientific dimension includes application and social values of research and its management.

In this study, two types of measures are used to tap the quantitative and qualitative aspects of effectiveness. Effectiveness is measured in terms of counts of various discrete outputs, self-evaluation and peer review.

Quantitative measures

(i) Published written output, represented by :

* number of books published in the country
* number of articles publised abroad
* number of articles published within the country
* number of published reviews and bibliographies.

(ii) patents and prototypes, represented by :
- * number of patents and number of prototype devices, instruments, etc.
- * number of experimental materials.

(iii) reports and algorithms, represented by :
- * number of internal reports on original R & D work
- * number of algorithms and number of routine reports.

Qualitative Measures

1. ability of a research unit to meet the R & D objectives of the institute.
2. usefulness of the research unit in meeting the objectives of the institute with regard to training of scientists and engineers.
3. degree of success of the research unit in meeting the quality requirement associated with its work.
4. innovativeness in generating new ideas and concepts, approaches and techniques, inventions or applications.
5. productiveness in adding to the store of knowledge, methods or inventions.
6. national reputation of the research unit.
7. international reputation of the research unit.
8. demand for publications of the research unit and their citation in open literature.
9. general contribution of the unit to the advancement of science and technology.
10. social value of the application or potential utilization of the research work done by the unit.
11. usefulness of the research unit in solving current societal problems.
12. application effectiveness of the unit i.e., the extent to which the results of the units are utilized or followed up.
13. ability of the unit to meet time schedule.
14. effectiveness of the unit in terms of its ability to stay within the operating budget.

The foregoing review of literature brings out that effectiveness of R & D groups encompass many aspects, which cannot be reduced to a single dimension. Effectiveness of research groups is essentially a multi-dimensional concept. It is tempting to consider performance of scientific activity as falling somewhere along a simple good-bad or effective-ineffective dimension; but this is a much too simplistic assumption. It would, therefore, be unrealistic to evaluate the performance of R & D activities by a single universal criteria.

Patterns of Relationships among Effectiveness Variables

To study the relationships among various qualitative measures of effectiveness of R & D Groups a correlation analysis was performed. The empirical data upon which the study is based has been collected from 220 research groups, carried out in India for the third round of the ICSOPRU. The data was collected through standardized questionnaires, which was administered to the supervisors of R & D groups, scientists and engineers of the R & D groups and external evaluators. The selection of the R & D groups were made by sampling from groups belonging to a major national research organization, which has a network of laboratories in different fields of agricultural science (UNESCO/ICSOPRU/87/1). Indices for the effectiveness measures were constructed on the basis of the ratings of supervisors and scientists/ engineers of research groups and external evaluators. The effectiveness of the research groups was measured on a 5 point scale (5 indicating a high value and 1 indicating a low value).

Table 1 presents means, standard deviations, and a correlation matrix of the variables. It can be observed from the table that there exists a strong relationships among the three variables representing extra-scientific dimensions of research effectiveness (viz. social value of research work done by the unit, usefulness of the unit in solving current societal problems and application effectiveness of the Unit.) Also the relationships among the variables representing intra-scientific dimension of effectiveness are very strong. But what is interesting is that some of these effectiveness measures are strongly related to the extra-scientific measures of effectiveness.

TABLE 1

Correlation Matrix of Effectiveness Measures

	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Meeting R & D Objectives	4.17	.49													
2. Training	3.68	.64	.50**												
3. Quality	3.83	.55	.68**	.46**											
4. Innovativeness	3.86	.57	.66**	.37**	.65**										
5. Productiveness	3.94	.50	.60**	.41**	.62**	.72**									
6. National reputation	3.88	.62	.58**	.51**	.58**	.52**	.61**								
7. International reputation	3.19	.77	.53**	.37**	.51**	.54**	.55**	73**							
8. Demand for publications	3.50	.62	.48**	.35**	.48**	.55**	.50**	.65**	.68**						
9. General contribution	3.63	.59	.60**	.38**	.67**	.64**	.65**	.65**	.67**	.70**					
10. Social Value	3.72	.60	.52**	.39**	.55**	.48**	.48**	.50**	.49**	.47**	.59**				
11. Usefulness	3.67	.67	.50**	.45**	.54**	.47**	.47**	.59**	.51**	.44**	.57**	.71**			
12. Use of R & D results	3.47	.64	.58**	.51**	.60**	.51**	.52**	.65**	.55**	.43**	.60**	.54**	.70**		
13. Metting schedules	3.75	.55	.50**	.35**	.55**	.57**	.53**	.43**	.48**	.41**	.55**	.42**	.49**	.57**	
14. Stay within budget	3.99	.55	.24**	.22*	.29**	.24**	.26**	.19*	.27**	.25**	.30**	.22*	.20*	.16	.22*

* $P < 01$.
** $P < 001$.

It is observed that the variable, general contribution of the unit to the advancement of science and technology, is very strongly related to most of the variables. It implies that one may not loose much information by excluding this variable while measuring the effectiveness of research units. It can be observed from table 1 that the units which are rated highly on all other effectiveness measures, are not effective in staying within their operating budget.

This means that insistence on budgetary limits and judging scientific research on this criteria would be counter-productive. The variable meeting schedules' is positively and strongly related to all other effectiveness variables except 'staying within the budget.' This is understandable because the value of scientific output depends upon how timely it has been performed. It also needs to be emphasised that irrespective of goal—whether it is intra-scientific or extra-scientific, meeting time schedules is important in view of pressure from users for applied,' search and from scientific competition for basic research. In meeting these goals, the R & D group gives much less importance to the organizational requirements for staying within the budget. This view is also supported by Might and Fisher (1985).

Conclusion

The goal of the present study was to explore a series of questions concerning measurement of effectiveness of R & D groups. It should be noted that no single, unambiguous meaning of the construct of organizational effectivenees is available. Financing of research by both public and private sectors of industry has led to the promotion of "goal-oriented"

research. As R & D groups have several goals, effectiveness of R & D. groups should be modelled as a multi-dimensional concept, incorporating both intra-scientific and extra-scientific dimensions of research. This observation implicity validates a notion that R & D management should take into consideration multiple dimensions when assessing the effectiveness of research groups.

The findings of correlation analysis indicated that the boundaries between the intra-scientific and extra-scientific criteria of effectiveness are not as sharp as is normally believed. That means the intra-scientific goals and extra-scientific goals pursued by R & D groups are complimentary to each other and they do not tend away from one another.

It is true that the financial resources of R & D groups would always be felt scarce. However the performance of a R & D group can't be judged only on its ability to stay within the operating budget. The findings of this study have important implications for research management that planning and allocation of financial resources to research activities must go beyond a simple cost benefit analysis.

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Productivity
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Productivity Trends in Non-Electrical Machinery Industry in India

NPC Research Cell*

The performance of Industrial machinery sector is crucial in the context of industrialisation and economic growth for more than one reason. Firstly, the sector contributes about 8 per cent of total industrial output and secondly, it employs about 7 per cent of the total organised industrial employment in the country. Perphas, importance of the sector in the context of rapid industrialisation is derived from the fact that this industry has very high forward linkage effects. The sector produces such machinery items as are directly used to process agricultural products e.g. sugar, textiles, tea, tobacco, rubber, dairy, rice and wheat flour etc. The sector also supplies machineries which are essential for the industrial sector itself e.g. boilers, metallurgical, cement, chemical, paper, construction, mining etc. Therefore, it will not be an exaggeration if the industrial future of the conntry is linked directly with the performance of this sector. In fact, industrial machinery sector has been conventionally classified as a mother industry. The importance of the sector has been reflected in the fact that it has been extended top priority in the successive five year plans.

It has been attempted in this paper to measure and analyse the productivity of factor and total inputs of various sub-sectors under Non-electrical industrial machinery sector in recent years.[1]

Measurement of Output and Input

For purposes of productiviiy measurement, output has been measured by net value added at 1980-81 base price. The commonly used single deflation method is resorted to while converting net value added at current prices into its corresponding constant price counterparts.

The inputs considered here are only two viz. labour and capital. Labour is measured in terms of total number of persons employed.[2] Capital input is measured in terms of net fixed assets arrived at through a perpetual inventory accumulation method. The indices of Net Fixed Assets, Employment and Net Value Added are shown in Annexures I, II and III respectively.

Price & Price Indices

Index of wholesale price for the respective products (base 1970-71) are utilized in order to deflate net value added at current prices to the respective constant

* Prepared by N.K. Nair, Director (Research) and A.K. Barman, Asstt. Director (Research) of the National Productivity Council, New Delhi.

1. See Appendix I for various sub groups of Non Electrical Machinery.
2. For details, see Annual Survey of Industries, various issues.

price counterparts. It may be noted that the price indices were not available directly from the source viz. Index Number of Wholesale Prices in India for all the category of products under the study. The price indices of major products in each category have been, therefore, combined using the weightages given at the source, in order to arrive at the required price dafletors. These weightages are given in Appendix II.

In the case of capital input, however, there are no separate price deflators available for individual sub-sectors. There is only one price index at the source viz. that of transport machinery and equipment. This index is utilized in order to convert capital additions during each year into values at 1980-81 base prices

The price deflators, thus, used are given in Appendix III.

Nature and Sources of Data

The data for arriving at the partial factor productivity and total productivity are obtained from the summary results of the Annual Survey of Industries. The data relate to the period from 1973-74 to 1984-85 for the factory sector as a whole. The factory sector includes those units which use power and employ 10 or more workers on any day and those which do not use power and employ 20 or more workers on any day.

The present study covers only post 1973-74 period mainly because of the reason that the ASI followed the Ntional Industrial Classification from this year. The data relating to the total factory sector of Non electrical Industrial Machinery were grouped under one category until 1973-74. These were regrouped into ten sub categories during later period. Data for the post 1984-85 are yet to be published and therefore, could not be obtained.

Partial and Total Productivity Indices

The partial factor productivity has been attempted only for two factor inputs i.e. labour and capital. The labour productivity has been measured in terms of value added at 1980-81 base prices per person employed. Capital productivity has been measured as value added at 1980-81 base prices per rupee of capital employed at 1980-81 base prices.

The total productivity indices have been arrived at by using the following formula* :—

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

where

ITP_t = Index of Total Productivity

IKP_t = Index of Capital Productivity

ILP_t = Index of Labour Productivity

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

β = Share of Labour in value added during the base period.

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

Results

The results of computations are presented in tables 1, 2 and 3. A summary of the growth magnitudes and their pattern are given in tables 4 and 5 respectively. The following could be observed :—

1. Labour productivity has risen at a very high rate (above 10%) only in the case of one industry viz. Office computing and accounting machinery and parts (code 358). Of the remaining 9 industries, six recorded moderate growth rates (3-5 per cent) in labour productivity. These are : agricultural machinery and equipments and plants (code 350); prime movers, boilers and steam generating plants (code 352); industrial machinery for other than

* The formula used here, however, is similar to the Kendrick Index of Total Factor Productivity which is taken as

$$TFP_t = \frac{V_t}{r_o k_t + W_o L_t}$$

where V_t, L_t and K_t refer to the value added, labour and capital during the current period and r_o and W_o are the base year rate of return on capital and wage rates respectively. For details see Kendrick (1961).

TABLE 1

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

Industry Code	1973-74	74-75	75-76	76-77	77-78	78-79	79-80	80-81	81-82	82-83	83-84	84-85
350	81.3	90.0	83.5	104.2	85.0	90.5	85.3	100.0	110.6	101.4	101.5	131.1
351	45.0	80.6	47.9	58.6	71.2	75.1	69.6	100.0	53.9	65.2	64.9	77.8
352	76.2	80.1	90.4	120.2	127.1	105.5	94.2	100.0	113.8	112.8	106.9	170.5
353	92.0	95.7	91.5	108.4	112.4	123.8	102.9	100.0	94.9	92.8	99.1	106.9
354	73.1	75.5	96.5	112.4	59.9	78.7	88.5	100.0	92.4	92.1	124.9	120.0
355	78.2	76.9	57.4	75.6	123.1	106.0	90.1	100.0	109.8	139.2	129.0	118.5
356	88.6	92.1	87.3	90.8	94.7	99.4	90.3	100.0	102.5	110.6	109.6	122.1
357	98.4	120.4	106.6	110.3	97.6	101.2	110.9	100.0	135.9	135.7	154.1	139.9
358	12.6	18.1	26.1	63.3	73·6	97.1	102.1	100.0	103.4	128.9	164.5	186.9
359	110.0	93.1	87.1	98.0	119.2	109.9	74.6	100,0	89.9	105.9	110.3	126.4

TABLE 2

Indices of Capital Productivity in Non-Electrical Machinery (1980-81=100)

Industry Code	1973-74	74-75	75-76	76-77	77-78	78-79	79-80	80-81	81-82	82-83	83-84	84-85
350	105.8	92.5	92.2	112.6	100.7	106.6	99.1	100.0	99.8	76.4	71.6	82.4
351	109.2	149.0	63.8	65.9	83.9	74.3	62.0	100.0	53.9	51.8	46.1	48.2
352	157.7	164.7	134.4	160.6	169.9	129.0	110.6	100.0	101.0	86.8	61.3	93.0
353	135.7	150.3	128.7	147.8	153.2	152.1	124.4	100.0	76.8	65.7	62.9	51.2
354	96.1	102.1	121.3	137.7	93.9	114.6	114.4	100.0	120.2	120.3	141.4	124.8
355	130.2	121.3	76.8	100.5	148.9	134.7	83.3	100.0	99.8	121.8	96.8	76.3
356	126.3	118.9	108.0	108.1	115.8	120.5	105.0	100.0	80.1	80.0	63.6	67.1
357	125.6	142.2	138.1	132.2	116.0	126.6	121.8	100.0	128.9	115.1	109.5	92.5
358	19.6	21.1	30.0	65.1	82.9	104.5	100.3	100.0	94.3	108.2	124.2	69.8
359	244.0	185.8	160.1	177.3	197.1	155.0	132.5	100.0	92.4	97.8	87.9	105.5

TABLE 3

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

Industry Code	1973-74	74-75	75-76	76-77	77-78	78-79	79-80	80-81	81-82	82-83	83-84	84-85
350	95.6	91.5	88.6	109.1	94.2	99.9	93.4	100.0	104.3	86.8	84.0	102.6
351	88.8	127.3	58.8	63.6	79.9	74.6	64.4	100.0	53.9	56.0	52.1	57.6
352	119.9	125.4	114.0	141.8	150.0	118.1	103.0	100.0	106.9	98.9	82.5	128.9
353	115.2	124.7	111.3	129.4	134.1	138.8	114.3	100.0	85.3	78.4	79.8	77.3
354	83.4	87.4	107.6	123.7	75.1	94.7	100.1	100.0	104.8	104.7	132.2	122.1
355	106.2	100.8	67.8	89.0	136.9	121.4	86.4	100.0	104.4	129.8	111.7	95.8
356	110.7	107.8	99.5	100.9	107.1	111.8	98.9	100.0	89.4	92.6	82.6	89.8
357	109.5	129.3	119.4	119.2	105.1	111.5	115.3	100.0	133.0	127.3	135.9	120.6
358	15.2	19.2	27.5	63.9	77.0	99.8	101.4	100.0	100.1	121.3	149.7	144.0
359	168.8	133.8	119.1	132.8	153.4	129.7	100.0	100.0	91.0	102.3	100.5	117.2

TABLE 4

Rates of Growth of Capital Intensity, Labour Productivity, Capital Productivity, and Total Productivity in Non Electrical Industrial Machinery during 1973-74 to 1984-85

Industry Group	Capital Intensity	Capital Productivity	Labour Productivity	Total Productivity
350	+ ve — Moderate	— ve — Moderate	+ ve — Moderate	Negligible
351	+ ve — Very High	— ve — Very High	Negligible	— ve — High
352	+ ve — Very High	— ve — High	+ ve — Moderate	Negligible
353	+ ve — Very High	— ve — High	+ ve — Low	— ve — Moderate
354	+ ve — Low	+ ve — Low	+ ve — Moderate	+ ve — Mederate
355	+ ve — High	— ve — Mederate	+ ve — Moderate	— ve — Low
356	+ ve — High	— ve — High	+ ve — Moderate	— ve — Low
357	+ ve — High	— ve — Moderate	+ ve — Moderate	+ ve — Low
358	+ ve — Very High	+ ve — Very High	+ ve — Very High	+ ve — Very High
359	+ ve — High	— ve — High	+ ve — Low	— ve — Moderate

Low Growth = Less than 3 per cent but positive.
Moderate = Between 3 and 5 per cent.
High = More than 5 but less than 10 per cent.
Very High = More than 10 per cent.

TABLE 5

Compound Growth Rates of Capital Intensity, Labour Productivity, Capital Productivity and Total Productivity during 1973-74 to 1984-85 for Non Electrical Machinery

Industry Group	Capital Intensity (K/L)†	Labour Productivity	Capital Productivity	Total Productivity
350	5.4	4.4	—2.3	0.6
351*	11.5	—0.3	—11.9	—8.3
352**	13.7	3.4	—5.9	0.2
353	10.8	1.4	—9.3	—3.7
354	2.2	4.6	2.4	3.5
355	9.0	3.9	—5.0	—1.0
356	9.0	3.0	—5.9	—1.9
357	6.2	3.3	—2.8	0.9
358	13.8	27.7	12.2	22.5
359	9.3	1.2	—7.9	—3.4

* For the period 1974-75 to 1984-85.
** For the period 1973-74 to 1983-84.
† K & L are capital stock at 1980-81 base price and employment respectively.

food and textile industries (Code 354); refrigerators, flre fighting equipments, other parts, components and accessories (code 355); general items of non-electrical machinery (code 356) and machine tools and their parts (code 357). In the case of industrial machinery for food and textiles (code 353) and miscellaneous machinery industry (code 359), labour productivity growth has been rather negligible. In the case of one industry i.e. machinery used by mining and construction sector (code 351), labour productivity seemed to have declined by a negligible rate.

2. Capital productivity has increased at a very high rate only in the case of office computing and accounting machinery (Code 358). Except in the case of industrial machinery for other than food and textile industry (Code 354), capital productivity has actually declined in a number of industries, the rate of decline being as high as 12 per cent in the case of machinery used by mining and construction sector (Code 351) and 9.3 per cent in the case of industrial machiney for food and textile industries (Code 353).

3. Total productivity inereased at a very high rate in the case of office computing and accounting machines (Code 358). Total productivity increased at a moderate rate of 3.5 per cent in the case of industrial machinery for other than food and textiles (Code 354) also. In the case of three industries i.e. agricultural machinery, equipments and parts (Code 350); prime movers, boilers and steam generating plants (Code 352) and machine tools and their parts (Code 357), total productivity either remained stagnent or increased at negligible rates. In the case of all remaining industries total productivity actually declined during the period under study, the rate of decline being as high as 8.3 per cent in the case of machinery used by construction and mining sector.

It is important that labour productivity did not record any significant increases in some of the industries despite the moderate-to-high growth in technical

progress index measured by capital labour ratio or capital intensity. It is also significant that in those industries which recorded moderate to high rate of growth in labour productivity, capital intensity has been increasing at a faster rate. In fact, the capital labour ratio has a strong and negative co-relation with capital productivity. The correlation of capital intensity with labour productivity seemed to be rather weak.

Some Explanations

The mixed trends in the factor and total productivity indices and capital intensity ratio show that technical growth alone may not be a necessary and sufficient condition for productivity growth in the context of Indian industries. The industries under review did not succeed in reaping the benefits of higher techniques of production during the period under study excepting the only case of office computing and accounting machines (Code 358). The following hypotheses could be examined while looking for suitable answers to this phenomenon :—

1. The small size of the market and its sluggish growth during the period did not allow some of the industries (e.g. machinery used by the construction and mining sectors and also the machinery for the traditional food and textile industries) to expand their operations to such levels at which large scale benefits due to productivity growth could be internalised by them. Although not sufficient enough to draw any firm conclusions in this regard, there were some evidence in the Indian context in favour of this hypothesis. The Productivity Board for Industrial Machinery (undated) found that out of the 53 companies surveyed, 53 per cent felt that demand was the most seriously hindering factor in capacity utilisation. Further, this report found that only 38 per cent of the companies were able to utilize their capacities upto 65 per cent. Edquist and Jacobson's study (1985) of Hydraulic excavators in India and Korea pointed towards the small size of the domestic market as the main factor responsible for the failure of the Indian industry to raise substantially industrial productivity despite significant advancement in technology. Citing the case of Larsen & Tubro, the study concluded that the high price charged by the domestic manufacturer is mainly due to the low volume of production which, in turn, is attributed to the small size of the domestic market. Role of exports in expanding the market base was dismissed by Goldar (1988), on the ground that "Industries have come into existence and grown under heavy protection against imports. This has made export activity very difficult (because of cost disadvantage) and much less attractive than selling in the domestic market."
2. The impact of inadequate growth in the infrastructural sectors including sources of raw material might have constrained the efforts of the industry to step up operations at which the benefits of higher technology could actually be realised by the industries. Although not in the specific context of these industries, some evidences were available in favour of this hypothesis (Ahluwalia, 1985). The Productivity Board for Industrial Machinery (undated) found that about 40 per cent of the surveyed companies suffered on account of poor infrastructure. Further about 23 per cent of the companies were found to be faced by problems due to poor ancillary support, while 9 per cent of the units faced acute shortage of raw materials of required quality, as high as 67 per cent reported that they faced serious raw material availability problems. The Report also found that communication facilities were major problems for the industry particularly in the Northern Region. Power availability problems are well-known in India and, therefore, do not require any special mention.
3. The organisational capabilities of the industries might not have been augmented to levels required to ensure uniterrupted operations of these industries. The organisational factors include, among others, managerial inputs; skill, morale and motivation of the workforce;

systems and procedures adopted etc. Some former studies relating to industries elsewhere brought forward the finding that the industries requiring large capital investments appear to require correspondingly large investments in organisations (Harbison, 1956; Harbison and Myers, 1959). As a corrollary, it has been pointed out that large investments in equipment and machinery are likely to be unproductive unless there is corresponding level of investments in organisation. Development of high productivity standards in less developed countries may require a much higher investments in organisations which did not seem to have taken place in India. Further, there were studies which indicated that technological backwardness has, very often, less to do with the age of the machinery than the low level of technological training and the lack of R & D support in many enterprises in less developed countries (Carter & Williams, 1957). The Productivity Board for Industrial Machinery (undated) found that the R & D expenditure in as high as 61 per cent of the companies was below one per cent of their turnover. This Report found that despite 69 per cent of the companies were in the process of technological upgradation, around 21 per cent did not carry out any value engineering analysis. It is important that, according to this Report, only 62 per cent of the units responded positively to productivity imporvement proposals. An earlier study in the context of Indian industries, has highlighted a number of areas of organisational shortcomings (Chandy, 1980). It could normally be expected that the industries under study are no exceptions.

Conclusion

A review of the factor and total productivity indices relating to 10 industry groups of Non electrical machinery during the period 1973-74 to 1984-85 shows that while labour productivity increased in most of them at low or moderate rates, capital productivity declined at moderate or very high rates. Although the rate of technical progress was impressive in a majority of the industries, its impact on factor and total productivity has either been negligible or even negative. This highlights the fact that mere technical progress alone is not a sufficient condition for productivity growth in the Indian context. This may be explained largely by the small size of the domestic market and its sluggish growth during the period under study. A part of the explanation for the lack of productivity growth may also stem from the absence of a commensurate expansion in the infrastructural capabilities of the economy which can support higher levels of continued operation at which economies could be expected to accrue to the industry. Most importantly, the organisationl capabilities in these industries might not have been augmented to levels required to ensure uninterrupted operations. These organisational factors include, among others, managerial inputs; skill, morale and motivation of the workforce; systems and procedures adopted etc.

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ANNEXURE I

Indices of Net Fixed Capital at 1980-81 Prices in Non Electrical Machinery (1980-81=100)

Industry Code	1973-74	74-75	75-76	76-77	77-78	78-79	79-80	80-81*	81-82	82-83	83-84	84-85
350	51.6	58.3	59.9	72.4	72.4	79.2	90.5	100.0 (8797)	103.0	128.2	145.6	146.2
351	38.1	68.2	68.2	73.6	84.1	94.6	100.0	100.0 (4136)	104.0	125.4	183.0	204.4
352	47.8	51.8	61.3	66.2	66.2	73.8	85.6	100.0 (13878)	126.9	145.9	220.6	220.6
353	59.1	55.3	61.6	64.2	72.2	76.5	86.1	100.0 (10739)	110.6	141.8	168.2	190.4
354	58.5	65.3	80.7	84.1	84.1	84.1	100.0	100.0 (9113)	102.3	102.3	102.3	105.8
355	45.7	50.2	56.9	65.2	65.2	70.5	100.0	100.0 (2660)	111.1	113.6	134.2	156.8
356	50.6	52.8	61.0	70.4	76.4	78.2	87.7	100.0 (13656)	131.5	150.1	200.2	200,2
357	58.9	65.6	70.0	71.3	79.2	80.0	90.9	100.0 (11600)	108.4	127.4	146.2	146.2
358	56.6	80.9	88.0	97.6	99.3	99.3	100.0	100.0 (723)	109.5	123.6	123.6	335.8
359	32.5	32.5	44.1	44.1	48.5	54.5	66.7	100.0 (3906)	100.0	116.1	123.7	136,9

* Figures in brackets are the absolute values in lakhs rupees.

ANNEXURE II

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

Industry Code	1973-74	74-75	75-76	76-77	77-78	78-79	79-80	80-81*	81-82	82-83	83-84	84-85
1	2	3	4	5	6	7	8	9	10	11	12	13
350	67.2	59.9	66.1	78.2	85.8	93.3	105.1	100.0 (38798)	92.9	96.6	102.7	106.5
351	92.5	126.0	90.9	82.7	99.2	93.6	89.1	100.0 (22430)	104.1	99.5	129.8	126.9
352	99.0	106.5	91.1	88.4	88.5	90.2	100.5	100.0 (58871)	112.6	112.2	126.5	120.3

(*Contd.*)

ANNEXURE II—(*Contd.*)

1	2	3	4	5	6	7	8	9	10	11	12	13
353	87.2	86.8	86.7	87.5	98.4	94.0	104.1	100.1 (73498)	89.5	100.3	106.7	91.1
354	76.9	88.3	101.4	103.0	131.9	122.5	129.2	100.0 (39853)	132.4	133.7	115.8	110.2
355	76.1	79.2	76.1	86.6	78.9	89.6	92.5	100.0 (21362)	101.0	99.4	100.7	100.9
356	72.1	68.2	75.5	83.8	93.4	94.8	102.0	100.0 (59195)	102.7	108.6	116.2	110.1
357	75.2	77.5	90.7	85.5	94.2	100.1	99.8	100.0 (50186)	102.9	108.3	103.9	96.7
358	88.4	94.7	101.2	100.3	111.8	107.0	98.2	100.0 (7498)	99.9	103.8	93.3	125,5
359	72.1	64.9	81.1	79.8	80.2	76.9	118.5	100.0 (29337)	102.8	107.3	98.6	114.2

* Figures in brackets are the absolute figures of total employment.

ANNEXURE III

Indices of Net Value Added in Nonelectrical Machinery (1980-81=100)

Industry Code	1973-74	74-75	75-76	76-77	77-78	78-79	79-80	80-81*	81-82	82-83	83-84	84-45
350	54.6	53.9	55.2	81.5	72.9	84 4	89.7	100.0 (8701)	102.8	98.0	104.3	120.5
351	41.6	101.6	43.5	48.5	70.6	70.3	62.0	100.0 (7628)	56.1	64.9	84.3	98.7
352	75.4	85.3	82.4	106.3	112.5	95.2	94.7	100.0 (14379)	128.2	126.6	135.3	205.1
353	80.2	83.1	79.3	94.9	110.6	116.4	107.1	100.0 (15213)	84.9	93.1	105.8	97.4
354	56.2	66.7	97.9	115.8	79.0	96.4	114.4	100.0 (8244)	123.0	123.1	144.7	132.1
355	59.5	60.9	43.7	65.5	97.1	95.0	83.3	100.0 (4856)	110.9	138.4	129.9	119.6
356	63.9	62.8	65.9	76.1	88.5	94.2	92.1	100.0 (15926)	105.3	120.1	127.4	134.4
357	74.0	93.3	96.7	94.3	91.9	101.3	110.7	100.0 (8796)	139.8	147.0	160.1	135.3
358	11.1	17.1	26.4	63.5	82.3	103.8	100.3	100.0 (1433)	103.3	133.8	153.5	234.5
359	79.3	60.4	70.6	78.2	95.6	84.5	88.4	100.0 (3670)	92.4	113.6	108.8	144.4

* Figures in brackets are the absolute values in rupees lakhs.

APPENDIX I

Classification Details of the Industry Groups

Industry Group	Description
35	*Manufacture of Machinery, Machine Tools and Parts, except Electrical Machinery.*
350	Manufacture of agricultural machinery and equipments and parts.
351	Manufacture and repair of drills, coal cutting machines, earth moving, lifting and hoisting machinery, cranes, conveyors and road rollers and other heavy machinery and equipment used by construction and mining industries.
352	Manufacture of prime movers, boilers and steam generating plants such as diesel engines and parts.
353	Industrial machinery for food and textile industries.
354	Industrial machinery for other than food and textile industries.
355	Manufacture of refrigerators, air conditioners and fire fighting equipments, and other parts, components and accessories.
356	Manufacture, alteration and repair of general items of non-electrical machinery, components, equipments and accessories not elsewhere classified.
357	Manufacture of machine tools, their parts and accessories.
358	Manufacture of office computing and accounting machinery and parts.
359	Manufacture and repair of non-electrical machinery, equipments, components and accessories not elsewhere classified (such as sewing machines, automotive merchandising machines, washing, laundry, dry cleaning and processing machines, cooling ranges and ovens, other service industry machines, arms, and armaments etc.).

APPENDIX II

Details of Price Weightages

Industry Groups	Price Indices	Weights
350	1. Tractors	0.928
	2. Agricultural Powrah	0.036
	3. Sprayers	0.036
351	1. Road rollers	0.667
	2. Concrete Mixtures	0.278
	3. Mining machineries	0.055
352	1. Boilers	0.262
	2. Diesel Engines	0.323
	3. Internal Combustion Engines	0.415
353	1. Textile, Jute Machineries	0.962
	2. Oil Mill Machineries	0.038
354	1. Milling Machineries	0.50
	2. Tea Mill Machineries	0.50
355	1. Air Conditioners	0.692
	2. Refrigerators	0.308
356	1. Non-electrical Machinery and Machine Tool	1.000
357	1. Machine Tools	1.000
358	1. Computing, Accounting Machines	1.000
359	1. Power Driven Pumps	0.574
	2. Sewing Machines	0.277
	3. Compressors	0.149

APPENDIX III

Price Indices of Non-electrical Machinery and Transport Machinery and Equipment (Base 1970-71=100)

Sl. No.	Items	1973-74	74-75	75-76	76-77	77-78	78-79	79-80	80-81	81-82	82-83	83-84	84-85
1.	Tractors	128.5	161.5	204.6	203.0	202.4	223.0	262.5	290.3	331.0	335.7	355.8	381.7
2.	Agricultural Powrah	166.1	207.4	216.9	216.9	231.3	247.6	308.5	317.6	390.4	390.4	400.1	440.4
3.	Agricultural Sprayer	115.8	158.7	159.3	154.6	153.7	157.3	177.1	185.2	187.8	292.3	208.2	232.6
4.	Road Rollers	177.0	177.2	262.5	272.1	265.1	278.2	307.8	341.5	358.0	384.9	402.0	402.2
5.	Concrete Mixtures	123.8	147.6	184.2	184.2	186.6	209.9	247.9	275.4	333.6	347.9	363.6	388.2
6.	Boilers	134.1	153.6	181.7	190.6	211.8	250.8	286.0	340.3	382.9	425.6	494.6	532.8
7.	Diesel Engines	110.9	134.4	141.0	138.0	137.6	138.2	151.1	172.0	184.0	192.8	192.8	193.4
8.	Internal Combustion Engines	115.6	132.3	138.6	138.6	139 0	139.4	139.0	139.0	139.0	139.0	139.0	139.0
9.	Textile, Jute Machineries	143.1	185.8	201.1	205.6	215.4	234.2	284.0	328.1	373.6	385.4	409.4	424.3
10.	Milling Machineries	102.9	111.6	111.6	111.6	111.6	111.6	117.6	123.2	123.2	152.4	167.0	170.0
11.	Tea Mill Machineries	114.9	137.5	147.8	137.7	140.6	154.5	177.3	196.1	228.6	236.0	262.4	319.4
12.	Mining Machineries	125.4	170.9	230.2	218.8	181.4	194.0	198.5	241.3	359.7	416.1	500.7	506.4
13.	Oil Mill Machineries	136.2	216.7	166.0	170.4	179.4	206.0	277.6	363.0	424.4	462.1	505.6	543.8
14.	Air Conditioners	109.2	153.0	160.2	160.2	160.6	165.2	178.7	212.1	230.6	230.6	223.1	220.6
15.	Refrigerators	116.2	160.9	169.2	163.9	158.5	164.8	173.6	199.4	187.8	172.4	161.1	161.4
16.	Machine Tools	133.7	151.7	202.8	216.2	220.6	227.7	263.0	295.1	313.3	342.2	394.0	394.0
17.	Computing, Accounting Machine	107.1	107.1	72.0	32.4	26.7	24.6	25.3	25.3	25.3	25.2	25.2	25.2
18.	Power Driven Pumps	125.9	165.8	168.1	165.4	161.5	163.3	206.9	233.8	271.0	274.6	234.4	307.8
19.	Sewing Machines	115.0	145.2	156.5	147.5	152.6	165.8	204.0	220.0	260.5	269.5	282.8	301.9
20.	Compressors	111.4	199.2	205.5	205.5	207.6	221.8	248.7	273.9	293.4	341.6	353.1	362.7
21.	Non Electrical Machinery and Machine Tools (Total)	125.8	155.2	175.4	176.0	171.9	189.2	218.8	246.0	275.0	291.2	311.6	324.5
22.	Transport Machinery and Equipment	122.7	156.4	172.6	170.1	172.6	183.9	215.9	239.4	265.1	279.9	289.4	303.6

Source : Index Number of Wholesale Prices in India.

Indian Journal of Industrial Relations

A Quarterly devoted to dissemination of knowledge in the fields of Industrial Relations and Human Resources including relevant aspects of labour relations, personnel management and rural labour. Besides, communications from Managers and Union Leaders reflecting their views and Book Reviews are also incorporated.

Editor : **J.S. SODHI**

Vol. 23 *Number 4* *April 1988*

ARTICLES

Importance of Education in Youth Unemployment	Joya Sen
A Study of Individual need strength, Motivation and Job involvement in relation to job satisfaction, Productivity and Absenteeism	A.P. Singh & Patiraj Kumari
Sociological Analysis of Migration of Agricultural Labourers from Eastern to North-Western region of India	A.K. Gupta, D.R. Arora and B.K. Aggarwal
Frustration in Organisations : Relationship with Organizational Climate	Shailendra Singh
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BOOK REVIEWS

Labour Law and Labour Relations, Cases and Materials (Anand Prakash, Suresh C. Srivastava & P. Kalpakam)	C.K. Johri
Of Peasants, Migrants and Paupers (Jan Breman)	Partap C. Aggarwal
Index of Articles	

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Cheques payable to Shri Ram Centre for Industrial Relations and Human Resources, 4-E/16, Jhandewalan Extension, New Delhi-110 055.

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EXECUTIVE READINGS

New International Economic Order Inter-dependence and Southern Development
By Mangat Ram

Published by :
Sterling Publishers Pvt. Ltd.,
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pp 204.

Reviewed by :
N. Durairaj
Reader in Economics
Department of Economics
Madurai—Kamaraj University
Madurai—625 021.

This book, examines the validity of the proposals put forward by the group of 77 in order to establish a New International Economic Order. The declaration by the United Nations General Assembly made on 1st May 1974, called for the replacement of the existing International Economic Order marked by extreme inequality, dominance, dependence, narrow self-interest by a New Order based on Equity, Sovereign equality, interdependence, common interest and cooperation among all states irrespective of their different economic and social systems. The author examines the main proposals adopted by the UNCTAD and the rationale and background of the demand for the establishment of NIEO. The implications of GATT and a careful assessment of the UNCTAD's form the subject matter of the first chapter.

In the second chapter, the author examines the economic, trade and social structures of the least developed developing countries (LDDC). Quoting Brandt, the author says that most of these countries are the poverty belts of the population excluding China. Examining the GDP, it is observed that the share of developing countries as a group, increased from 14.5% to 18.6% in the total real world GDP, but the share of LDDC not only was negligible but also declined from 1% to 0.08% during 1963-1980. A critical account of the comprehensive resolutions adopted by UNCTAD—III in Santiago-de-Chile in 1972 and UNCTAD-IV in Nairobi in 1976 are given.

The third chapter, examines the contributions of trade and aid to the economic development of the LDDC. The participation ot the developing countries in the management and decision making process of the IMF, IBRD and GATT remains not only inadequate but highly disappointing. The author analyses the working of the Generalised system of preferences (GSP) supposed to benefit the LDDCs' But in reality it has helped only a small number of countries which have appropriated unduly large share of the gains. Official Development Assistance (ODA) of 0.7% of GNP of the member countries, has not been fully paid by many, including USA. Besides, the tussle between USA and Japan has threatened the IDA from giving aid to the poor countries. The USA has cut its commitments to $ 750 billion a year for three years.

In chapter IV, the author

examines the role of trade in the economic development of many countries. As the author says, "the exports of woollen manufactures and cotton textiles in Britain, timber in Sweden, dairy products in Denmark, wheat in Canada, wheat and wool in Australia, for example, not only played a pivotal role in their development programmes but also became a leading force in their efforts to achieve take-off". Based on the studies of Emery, the author says that higher rates of economic growth tend to be associated with higher rates of export growth. The Peribisch, Singer, Myrdal thesis that the terms of trade have severely moved against the developing countries vis-a-vis the advanced economies is also examined thoroughly.

Chapter V deals with International Commodity Agreements. Many developing countries, during the post 1945 era have been adversely affected by violent and sudden fluctuations in prices, quantum and total proceeds of exports which have nearly crippled their economies. Though the UNCTAD-IV passed resolution for stabilising the prices of primary commodities by the developing countries and transferring global wealth from rich to the poor, not much success has been achieved. The industrialised countries outrightly rejected the notion of the resource transfer through the Commodity Price Mechanism.

Chapter VI, examines the impact of Multinational corporations which have been described as the most viable innovation of the post war period in the economic field. The author examines the views of the neo-classical economists who concluded that foreign private direct investment has a positive significant impact on the economic development of the host countries while the Marxian school of economists viewed that the MNCs have not only failed to lead to income generating development but actually inhibited more economic development which might otherwise have taken place.

In Chapter VII the author argues the case for reforming the International Monetary system. The demise of the Breltonwoods system, the birth of floating currency system, multiple exchange rates and a new and effective role of IMF are analysed. The defects of the IMF and the criticism by the developing countries on the present working of the IMF are ably presented by the author. The origin of SDR, the link scheme formula and its rejection are also discussed. The author pleads for the control of two digit high rate of inflation through suitable monetary and fiscal actions at the national and international levels.

In the final Chapter, development strategies suited to the third world countries—"import substitution (IS) and export-led growth (EL) are analysed". The failure of the IS policies as evidenced by Hirchman, Bruton, Baer, etc. have given birth to a new strategy 'export-led growth', to achieve economic and social development. The working of the EL strategy is lucidly analysed. The policies of South-South trade, common tariff, clearing and payments arrangements are thoroughly examined. The author also calls for fundamental institutional reform i.e. changes in the structure of land ownership in the southern countries. South-South dialogue will be more useful than to depend too much on North for building a NIEO.

The author has covered all aspects of NIEO. The challenges and problems faced by the South and the rather stiff and nonhelpful attitude of the North are lucidly analysed.

The book makes an excellent reading. It is a valuable contribution to the existing literature on NIEO. This book will be of immense use to students, teachers, researchers and professionals.

Office Management
By Mrityunjoy Banerjee

Published by :
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Calcutta
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PP X 11+230

Reviewed by :
C.V. Rao
Dy. Directory (Supervisory Development)
National Productivity Council
Madras

It goes without saying that information has become the nerve-center for any activity, whether it be in

running a small business or a government. In fact, it is the right kind of information that helps any manager succeed in achieving the desired objectives.

For that matter, a group of managers can make any organisation move forward if they have relevant information properly stored in a file or is available at their fingertips. Such information is by and large, available in offices who concentrate on collecting information. But these offices too, have to be managed in a manner to facilitate decision-making.

Any office will have to have premises, proper furniture, machines and equipment, a method of recording information and above all, proper manpower trained to handle such information. For these, an office is also called upon to give service in the form of communication, handling of correspondence etc. for which they follow some systems and procedures. In other words, the success of an office—which handles information—depends upon how successfully it is managed. Hence the study of Office Management.

The book under review is an addition to the already existing literature. At the outset, it may be stated that there is nothing new that the book has to offer so that it is helpful to a supervisor or a manager to improve the efficiency of his office. A subject like Ergonomics—dealing with layout, environment, type of furniture, space required by an employee and the like—has been dealt with, but without any detailed pictures. Any reader would miss the importance of Ergonomics especially, a student if he is not given the right perspective.

With regard to office machines, the author has done well in giving photographs of various machines that are used in offices in addition to a good description followed by their merits and demerits. However, the author has not given much thought in giving due coverage on computers and their applications when computer science is being taught in schools today!

Merely dealing with records management in terms of definition, purpose, methods of filling etc. is not enough, It would have been better had the author picked up some good examples of filing and dealt with them in detail. In addition, Form Design—an important integral part of record management has been ommitted. These aspects are the very pulse of an office and the author should have devoted more time and space on the subject.

Chapters on office service, office systems and procedures are fairly good and give a broad perspective to a beginner. The author has devoted sizeable space to Personal Management. Since Personnel Management is a vast area, it would have helped a student a lot, had there been a list of references of books and articles on the subject.

Looking at the target audience for whom the book is aimed at, that is the students of B. Com., ICWA, MBA etc., the canvass could have been broadened and relevant information on other books and disciplines could be included. Nevertheless, for first reading it may serve the purpose, but for indepth reading anyone would be stranded.

Shaping the Technology Era
Edited by
O.N. Wakhlu and
G.L. Labru

Published by :
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PP 141

Reviewed by :
G.G. Rajan
Jt. Director
Centre for High Technology
707, New Delhi House
27, Barakhamba Road
New Delhi 110001.

There is an old saying which means "A genius appears once in a while". So is the case with a noble book, a book with educative and informative values written by an agglomeration of intellectuals.

'Shaping the technology Era' is one such book, comprising of thought-provoking ideas, portrayed in eleven chapters. These chapters cover areas like 'human settlements, man-made environmental hazards, higher technical education in India, human resources development, entrepreneurial management,

energy resources management and computer manpower management etc. written by top ranking intellectuals of our country.

As per hierarchial needs theory one of the basic needs of the man is a dwelling place. When once a dwelling place is made available he thinks of achieving a better living standard.

How the increasing living standards and sophistication have added to pollution hazards, and how the technical education must be revamped to achieve the challenging standards, compatible with the current technological development, is portrayed very nicely in the first part of the book.

Large scale use of computers in design, production control, and services, and modernisation of plant and processes are the key steps for improving productivity. The authors recommend continuing education programmes in the engineering field, to keep abreast of the international standards.

India is a country, bestowed with the best human resources in the world, both, in quantity and quality. Tapping these resources effectively for achieving the best 'human productivity, is dealt with in the chapter on "Human Resource Management". In the absence of this the 'Resources remain as Resources' only, as Peter Dracker puts it.

Indians excel in performance as individuals, and individuality is a 'key' characteristic of an entrepreneur. The topic on 'Entrepreneurial Management' analyses the problems and suggests information system, training, consultancy, marketing linkages, quality control, quality assurance services etc. as remedial measures for promoting entrepreneurship, and averting future failure.

While the chapter on 'computer man-power development' is highly informative for those from academics the chapter on 'Energy Resources Development' analyses the energy problem, and suggests ways and means for enhancing the productivity of the energy resources by using energy efficient machines and technologies. Proper energy management involves loss reduction, retrofitting and cogeneration techniques.

Any reader after reading the book will conclude that. 'Shaping the Technology Era' bridges the gap between 'what we are' and 'what we want to be'.

Dimensions of Rural Poverty
By P.P. Sharma

Published by :
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Reviewed by :
Jagpal Singh
Senior Scientific Officer
Indian Institute of Technology
(Centre for Rural Development and Technology)
New Delhi 110 016.

The book is an outcome of a doctoral dissertation submitted to the Andhra University. The research study was undertaken with the assumption that poverty is a multidimensional phenomenon. Besides per capita income, poverty is the cause and effect of various socio-economic aspects the dimensions of which the study designed to identify. The study is based on the primary data of one hundred families of agricultural labour of Bandar Taluk, Krishna district in Andhra Pradesh. For collecting the desired data Sample Survey Technique has been followed. The collected data have been analysed for estimating the values for arithmetic mean and for chi-square tests for association between pairs of selected socio-economic variables. Multiple regression analysis technique has also been followed for studying the impact of different socio-economic aspects on per capita income of labour households.

The study has covered a very wide range of socio-economic dimensions of poverty, such as, inequality, asset holding, size of the household, structure of the family, dependents per earner, level of education of head of the family, activity status of children, school participation of children, caste, access to land, wage rate, family planning and fertility, infant mortality, employment aspects, types of labour contracts, inter and intra-generational occupational change, indebtness, dwelling status etc For arriving at reliable conclusions, information have been analysed from different angles. The results of the analysis presented in

the book support the assumption of the study i.e. poverty is a multi-dimensional phenomenon. The study concludes that family size, dependency ratio, access to land, participation of labour force, inter and intera-occupational change, assets and indebtness etc. are some of the important determinants of the poverty. The study also reveals that infant mortality is high in case of the families living above the poverty line. Wage rate, caste, literacy and age of the head of the household are inversely related to the poverty. Microscopic review of the book gives a message that poverty problem in terms of efforts, policies and programmes is related to the workers and not to the consumers.

In this book efforts had been made to identify the socio-economic aspects which are directly related and which lie on second, third and even on fourth priphary and to high-light the interaction with each other. As such, the book may prove very useful to the persons who are directly or indirectly involved in designing and implementing the anti-poverty programmes for reshaping their efforts. The material available in the book may help them in identifying the entry point for starting the process of alleviating poverty.

Wide coverage and multi-dimensional analysis approach followed in the book has made it exhaustive and complex. The spirit of enquiry based academic input may improve the composition of the book and may help in making the book more clear and composite. Logical and systematic enquiry could have helped in identifying the backward linkages-asset poverty in terms of capital, operational, managerial and entrepreneurial skills and forward linkages—size of the family, saving habits and house management etc. On the basis of this excercise, certain hypotheises could have been formulated and with the help of data these hypotheises could have been tested.

Transport Systems
By R.R. Khan

Published by :
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Price : Rs. 50
PP. 208

Rnviewed by :
L R. Gosain
General Manager (Rtd.)
Indian Railways
D-137, Anand Vihar
New Delhi 110 092

Transport, to-day, is playing an increasingly vital role in growth and development of not only every country but also in World Trade and World Development. A book on transport, is therefore, very welcome and timely. The book by Dr. Khan is very temptingly titled "Transport Systems". It whets one's appetite and curiosity to get answers to one's querries and questions about past, present and future of Transport Systems all over the world.

The book is well planned. The Author takes one through the Principles, elements and means of transport to details of existing Rail, Road, Air, and Water transport systems in India. The book also delves, although too briefly, into, the Financial Administration and National Transport Policy of India. The author rightly emphasises that Transport is a public utility service indispensable to society and cost of services is an important consideration in a transport system. Furthermore, the cost should be reasonable enough to attract traffic. The author makes us aware of imperfect competition and tendency of monopoly in some systems but his conclusion that competition is quite unstable and leads to monopoly cannot be easily accepted. In fact, heavy investments required, relative efficiency, and economics of different systems, are making competition between different systems very essential and desirable. The author has not highlighted certain other important factors like energy consumption, pollution, environment, population growth and dispersal,which strongly influence the selection of a particular mode of transport. For example. based on first principles of friction, railways are significantly more energy efficient than roadways.

In the discussion on Elements of Transport, there are some statements which to-day, have become out-of-date. For example, it has been stated that electricity, in this country, has been rarely used due to its shortage and the installation of wide network of wires. Also that the experience of electrification of

railways has been gloomy; To-day, due to increasing foreign exchange requirement of petroleum products electric traction is considered the most efficient form of transport, not only in India, but in many other countries except the oil rich ones. In India, to-day, shortage of capital, particularly foreign exchage, is the main obstacle in the way of foster rate of electrification.

The middle chapters, roughly two thirds of the book, discussing different transport systems, like Railways, Road, Air, Inland water and shipping are interesting, well written and supported by adequate up-to-date data and statistics from authorised sources. These should form the basis of solid information and knowledge for any student or reader.

The best and most important part of the book is the chapter on National Transport Policy. There is reasonable data in this chapter. The chapter could, however, become more illuminating and educative. if out of total requirement, the share of different modes of transport. capital investment, employment generated, operating cost per passenger kilometre, and freight tonne-kilometre were also included, since First Five Year Plan, in form of some tables or graphs. These could be also utilised to project the future trend of a well integrated balanced inter-model transport system repuired and planned for the country, upto 2000 AD.

This could be achieved without increasing the size of the book, by suitably reducing the volume of information in chapters on Classification of Railway Goods. and Rates and Fares of Different systems like Railways Road and Air.

The National Transport Policy Committee's Recommendations are of vital importance to all sectors of industry and society. The very first and important recommendation of this Committee is determine an optimal inter-model, mix and that our aim should be to develop a Transport System, which provides service at the least cost to society. The author has given good, intelligent thought provoking criticism of this policy and thus encouraged thinking afresh, and a healthy lively debate amongst his readers.

The author set himself a laudable task of producing a reasonable size book of great value to students, teachers, planners and policy makers. While a broad survey like this, giving a bird's eye-view of all the Transport systems will prove admirably suitable and useful to students and teachers, the planners and policy makers will need much more detailed, comprehensive and innovative treatment.

The book has a well designed attractive cover and 208 pages only. It is reasonably priced (Rs. 50/-). A little more investment in proof reading, to eliminate minor errors, repetitions and better quality of paper (even if it means a marginal increase in price) may prove more attractive for the youthful students and readers.

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BOOKS IN BRIEF

How You Can Do More in Less Time

By Clive T. Goodworth. London, Business Books 1985, 184 pp, $13.95.

This book is for all those who want to do more in less time. For the executive who has no time on hand to read, this is a practical working tool to enable him to derive utmost benefit from each minute of the day. One will find helpful tips on managing ourself delegation, problem solving, coping with paperwork, controlling meetings, handling interruptions, working while travelling, setting priorities, compiling a work schedule etc. Each chapter is supported by self analysis tests.

Human Side of Advanced Manufacturing Technology

By Toby D. Wall, Chris W. Clegg and Nigel J. Kemp, Chichester, John Wiley, 1987, 205 pp, $44.95

This book covers a wide range of human issues including : the planning and implementation of A M T (Advanced Manufacturing Technology); work system design; selection and training; supervisory roles; organization design; industrial relation; social implications; and research and development needs for the future. This will bean important book for advanced students, researchers and professional psychologists and engineers concerned with man-machine systems.

Integrating Productivity And Quality Management

By Johnson Aimie Edosomwan. New York, Marcel Dekker, 1987. 360 pp, $59.75

The book treats productivity and quality as inseparable linked. It offers a conceptual framework, methodologies, and techniques for managing them. Productivity and quality management are defined as consisting of three phases : measurment, control and evaluation; planing and analysis; and improvement and monitoring.

Managing Projects in Organizations: How To Make The Best Use Of Tlme, Techniques And People

By J. Davidson Frame. San Francisco, Jossy-Bass, 1987, 240 pp, $21.95

The stages of project's life cycle within an organization are examined in detail in order to present strategies that can be used successfully by a project manager. Topics covered include the management of human resources, teamwork, needs and requirement analyses, and pitfalls.

Managing Quality : The Strategic And Competitive Edge

By David A. Gravin. New York, Free Press, 1988, 319 pp. $23.95

The U.S. and Japanese approaches to quality management are compared and contrasted through an examination of the history of quality in both countries and from the perspective of a single industry-room air conditioning. Categories of comparison include attitudes and philosophy; quality programs, policies, and systems; product design; and vendor selection. Findings are summerized with a discussson of

implications for researchers and managers.

New Corporate Ventures : How To Make Them Work

By Ralph Alterowltz Jon Zonderman. New York, John Wiley, 1988, 224 pp, $22.95

New corporate ventures, sometimes, donot fit the corporate mission and fail to run as smoothly as the parent company. This book shows executives, planners, and managers of new business ventures how to evaluate potential ventures and determine which ones to back. It shows how to present a business plan which addresses to financial and management question, while keeping the new venture within the corporate culture. The book provides a step-by-step nurturing process based on methods developed by venture capitalists in getting new companies off the ground.

Productivity Through People In The Age of Changing Technology

By Asian Productivity Orgn. Tokyo Asian Productivity Organisation 1987, 287 pp, $35.00

This is a collection of the papers delivered at the 1986 International Productivity Conference held at Kuala Lumpur. The unifying theme of the conference was productivity in a changing technological environment. Papers delivered fall within five major areas of interest-productivity in developing countries, technological trends and prospects, people productivity, agriculture, and the corporation of the future.

Programming Productivity

By Capers Jones. New York, McGraw-Hill, 1986, 280pp, $36.50

There is a discussion of past and future growth trends in the numbers and types of programming and end-user personal including actual examples from major corporate enterprises. This discussion also features the personal views of senior corporate executives on the role of programming within their enterprises. Later chapters explore methods of reducing program development cycles, such as program skeletons and reusable software functions. This book is intended to summarize the experience of the first 30 years of commercial and industrial programming and to point out both the progress and the latest trends.

The Innovators

By William Davis. New York, American Management Asson. 1987, 408 pp. $19.95

This is an international portrait gallery of people who have contributed significantly to the business world. Their contributions have been in the form of ideas, innovations, products, services, or simply inspirations. Portraits, in which the subjects (business-related biographical facts) are highlighted, are two or three pages in length.

The Strategic Use of Information Technology

By Stuart E. Madnick. New York, Oxford Univ. Press 1987, 206 pp, $ 18.95.

Articles on information technology are divided into three topics : how to identify strategic opportunities and mobilize the organization to make the most of them; the appropriate roles of the information systems (15) organization, focusing primarily on the role of the chief information officer; and the responsibilities of the corporation vis-a-vis information systems, particularly in the areas of computer security and employee privacy.

Technology Absorption iu Indian Industry

By Ashok V. Desai. New Delhi, Wiley Eastern, 1988, 210 pp, Rs. 125

This book brings together the views of both companies abroad that have sold technology and firms in India that have bought it. It reports on what foreign companies think of the Indian market for technology, of Indian firms, practices and of India's policies; it also reports on how Indian companies decide on the import of technology and how far they benefit from it. The author shows how Indian industry differs from those in industrial countries and how the proliferation of small firms leads to a fragmentation of the demand for technology and cuts down the benefits of technology imports.

Compiled by :
S.N. Vig
DOC. & INF. Officer
NPC, New Delhi

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1988, XXIX, 1, 101-106

A Select Bibliography on Robotics (Part II)

MANJUNATHA K

This is the Second part of the Bibliography on Robotics published in October-December Issue of Productivity

Manjunatha K. is Librarian, TA Pai Management Institute, Manipal, Karnataka-576 119

4. SOCIO-ECONOMIC IMPLICATIONS

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Distribution Structure of Corporate Information System

R.K. Arora
R.K. Sachdeva

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

R.K. Arora is head of Computer Services Centre at the Indian Institute of Technolagy, New Delhi-110016 and R.K. Sachdeva is a senior faculty Member of the Indian Institute of Public Administration, New Delhi-110002.

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

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

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

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

Centralised System

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

End-user Computing

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

Distributed System

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

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

Distribution Structure

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

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

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

Information System and Decision Making System

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

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

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

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

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

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

Existing (Cost Minimisation) Models

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

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

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

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

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

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

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

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

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

Limitations of Existing Models

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

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

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

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

Proposed Cost-Effectiveness Approach

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

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

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

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

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

$$n \leqslant u + s$$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Conclusion

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

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

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

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

S. Pathak
M.K. Pal

राष्ट्रीय उत्पादकता परिषद्
पुस्तकालय
नई दिल्ली

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

S. Pathak and M.K. Pal are scientists (Agricultural Extension) in Jute Agricultural Research Institute (ICAR), Barrackpore-743 101.

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

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

Materials and Methods

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

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

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

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

(Contd.)

TABLE 1 (*Contd.*)

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

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

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

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

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

(*c*) *Rainfed conditions*

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

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

Results And Discussion

Production potential of different crop rotations

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

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

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

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

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

(*Contd.*)

TABLE 2 (*Contd.*)

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

* Green pod for vegetable.

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

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

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

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

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

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

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

Economics of different crop rotations

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

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

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

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

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

(Contd.)

TABLE 3 (*Contd.*)

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

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

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

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

However, the crops included in each rotation varied

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

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

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

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

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

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

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

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

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

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

Conclusion

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

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

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

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

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Entrepreneurial Correlates in Three Types of Firms in Kerala

Sridhar Seetharaman

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

Sridhar Seetharaman is Research Associate, National Institute of Rural Development, Rujendranagar, Hyderabad-500030. *The author is grateful to Dr. B C. Muthayya for his valuable suggestions.*

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Introduction

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

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

Objectives

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

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

Methodology

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

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

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

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

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

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

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

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

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

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

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

[3] C indicates that these are classificatory variables.

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

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

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

Results

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

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

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

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

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

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

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

   The degrees of freedom are in parentheses.

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

Small firms :

Entrepreneurship = 0.31 — 0.35 Locus of control + 0.84 centralisation

Beta :	—0.61	—0.29
Partial F :	11.10	2.50

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

Medium firms :

Entrepreneurship = 1.40 + 0.11 explicitness of strategy + 0.19 technocratisation

Beta :	0.68	0.33
Partial F :	17.10	4.10

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

Big firms :

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

Beta=	—0.57	0.65	0.41
Partial F	13.30	19.60	6.70

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

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

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

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

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

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

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

(Contd.)

TABLE 5 (*Contd*)

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

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

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

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

Conclusions

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

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

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

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

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

Importance

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

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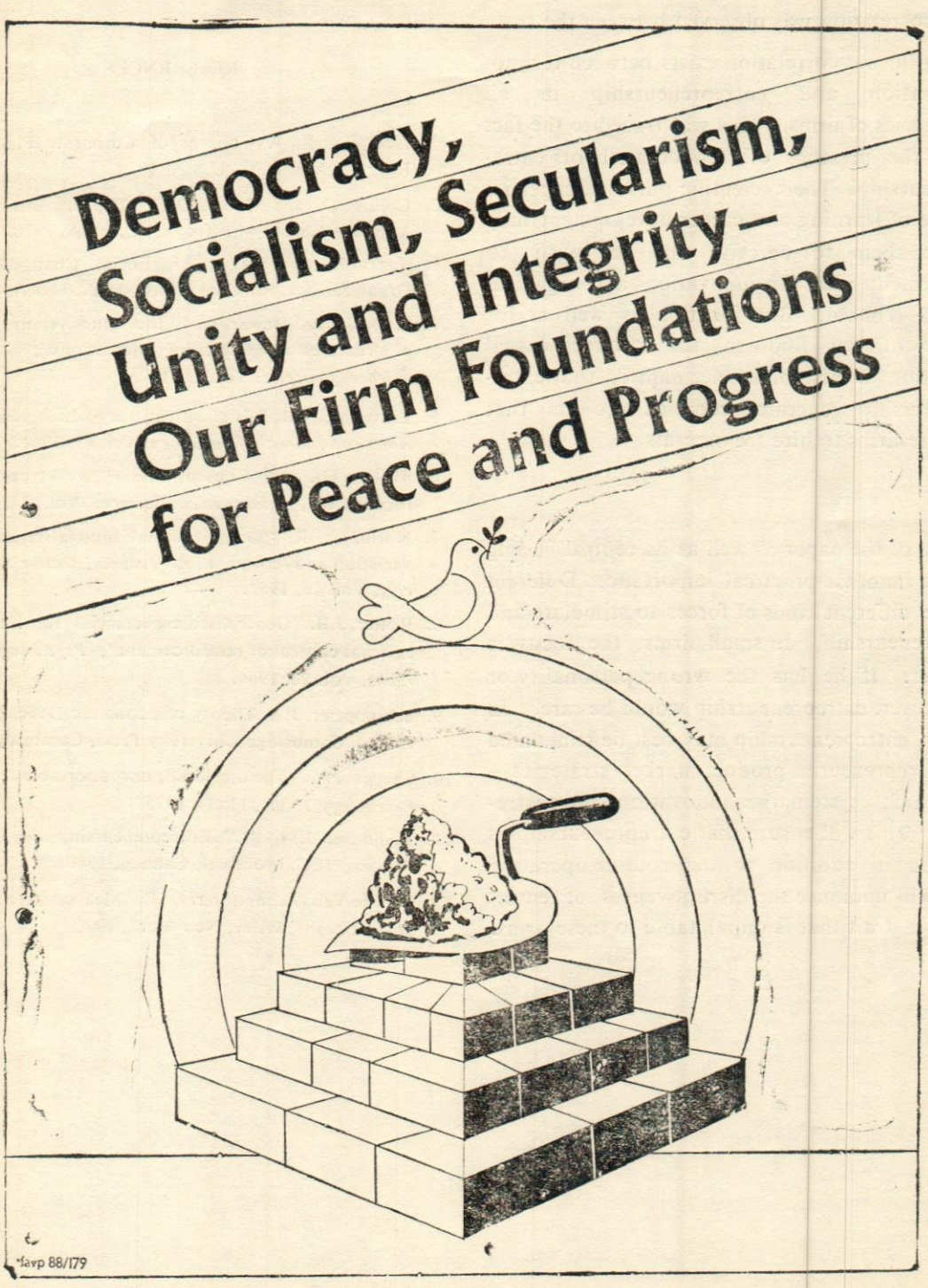
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Unity and Integrity –
Our Firm Foundations
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Navp 88/179

Economic Analysis of Paddy Shelling in Punjab

I.S. Chatha
Joginder Singh
S.K. Kapahi

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

The authors are in the Department of Economics and Sociology, Punjab Agricultural University, Ludhiana.

Productivity, Vol. 29, No. 2, July-September 1988, 137-141.

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

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

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

Methodology

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

Results and Discussion

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

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

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

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

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

Net Shelling Costs

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

Break Even Analysis

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

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

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

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

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

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

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

Where,

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

F_c = Total annual fixed cost

P = Selling price per quintal of paddy

V_c = Variable cost per quintal of paddy milled.

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

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

Profitability

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

Paddy on an average yields 67 per cent of head

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

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

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

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

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

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

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

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

Conclusion

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

□

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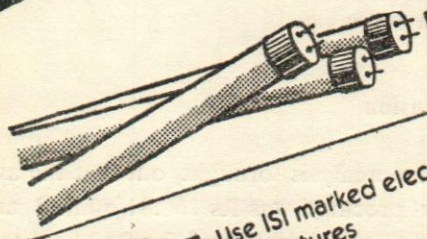
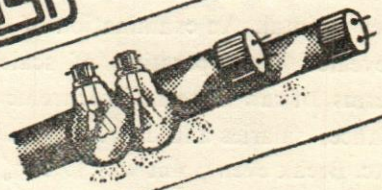
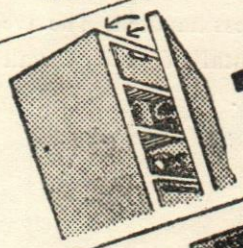


■ Use tube lights. They give more light with less power.

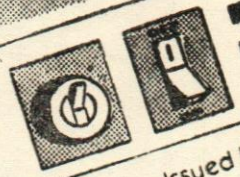
■ Use ISI marked electrical appliances and fixtures



■ Keep your tubes and lamps dust free



■ Close your refrigerator door soon after use.



■ Switch off all appliances when not required
■ Switch off lights, fans, and air-conditioners when you leave the room.

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davp 88/204

PACE—An Effective Productivity Tool for Management

Om Prakash Kajipet
Sankaraiah K.

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

Om Prakash Kajipet and Sankaraiah K. are Members of faculty of Commerce aud Management, Satavahana Institute of Post Graduate Studies, Osmania University, Karimnagar 505 002.

***Productivity**, Vol. 29, No. 2, July-September 1988, 143-149*

Introduction

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

Objectives of PACE Programme

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

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

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

Prerequisites

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

Components of PACE Programme

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

I. PACE measurement.

II. PACE programme.

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

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

where,

N = Number of workers assigned to the work/task

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

K = Number of idle workers

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

E = Group effort rating.

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

(i) Idle time Index

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

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

(ii) Out of area Index

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

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

(iii) Group effort Rating

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

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

The group effort rating computation is :

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

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

PACE Programme

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

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

(i) Personnel Index

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

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

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

(ii) Schedule Index

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

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

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

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

(*iii*) *Shortage Index*

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

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

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

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

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

(i) poor planning of the parts required,

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

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

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

Installation of PACE Programme

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

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

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

TABLE 1 PACE—Observational Chart

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

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

Evaluation of the PACE programme

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

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

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

3. Schedule index in the beginning shows that

TABLE 2 PACE—Measurement Chart

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

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

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

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

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

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

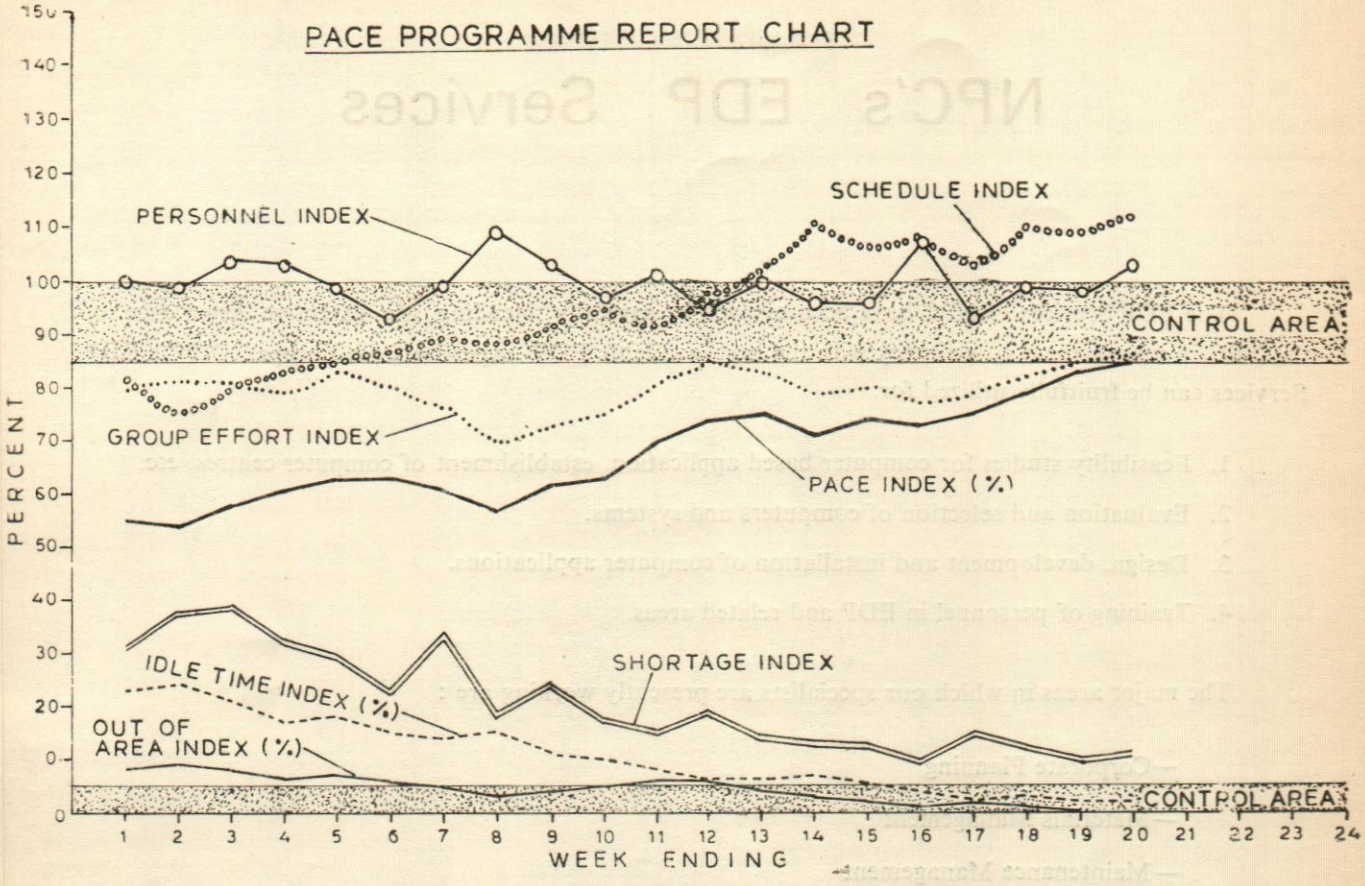

Fig. 1

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

Conclusion

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

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

R.L. Sagar
O.N. Kunzru
B. Singh

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

R.L. Sagar and B. Singh are Scientists and O.N. Kunzru is Jt. Director (Extn. Education) in the Indian Veterinary Research Institute, Izatnagar-243 122.

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

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

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

Methodology

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

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

The data were collected from January to March, 1986.

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

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

Findings

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

— nonsignificant difference
* significant difference at 5% level

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

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

Conclusion

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

Implications

On the basis of above finding the following are obvious :

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

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Optimum Utilisation of Resources for a Production Planning Problem

G.M. Shah
B.B. Jani

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

G.M. Shah is in the Statistics Department of Arts and Commerce College, Talod-383 215 and B.B. Jani is in the Economics Department of University, School of Social Sciences, Gujarat University-380 009.

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Introduction

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

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

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

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

Assumptions

Following are the assumptions for this model :

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

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

(3) Shortages are not allowed to occur.

(4) Lead time is zero.

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

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

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

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

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

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

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

Formulation of The Model

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

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

Derivation of the Model

We use production function in its linear form as given by

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

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

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

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

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

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

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

Production cost $= CQ$

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

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

Advertising cost $= \alpha_1 (pR)$

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

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

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

Which is the quantity discount cost function.

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

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

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

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

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

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

Total inventory cost (TIC)

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

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

Hence total cost

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

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

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

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

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

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

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

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

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

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

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

The necessary condition for maximization of profit is

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

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

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

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

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

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

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

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

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

Application

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

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

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

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

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

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

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

TABLE 1 : Optimum Solution

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

Sensitivity Analysis

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

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

TABLE 2 : Total Sensitivity

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

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

TABLE 3 : Partial Sensitivity

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

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

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

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

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

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Skills of Human Resources : Need for Periodical Review

B.S. Chettey
K.N. Krishnaswamy

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

B.S. Chetty is a faculty member in the Administrative Staff College of India, Bella Vista, Hyderabad-500 049 and K.N. Krishnaswamy is in the Department of Management Studies of the Indian Institute of Science, Bangalore-560 012.

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HR Review

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

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

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

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

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

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

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

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

Results of Survey*

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

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

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

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

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

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

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

TABLE 2 : Distribution of Organisations having Human Resources Planning Group

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

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

HR Review Periodicity

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

TABLE 3 : Distribution of Organisations Carrying out Systematic HR Review

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

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

Participation of Management

Another important factor in HR review is the parti-

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

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

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

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

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

Employee Turnover

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

Job Data

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

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

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

Training of Employees

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

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

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

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

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

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

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

Retraining Programmes

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

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

Conclusion

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

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

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

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

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

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

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

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

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

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

□

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Energy Consumption Trends in Indian Pulp & Paper Industry

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

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

V. Raghuraman is Director and M/s. K.C. Mahajan and P.K. Srivastava are Deputy Directors in the Fuel Efficiency Division of the National Productivity Council.

Productivity, Vol. 29, No. 2, July-September 1988, 171-180.

Introduction

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

(i) Obselete technology.

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

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

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

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

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

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

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

IMWG Study Report

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

Follow Up Energy Audit Study

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

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

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

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

Specific Energy Consumption

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

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

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

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

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

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

TABLE 4 Specific Energy Consumption in Paper Mills

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

Legend : * Figures in Million Kcal/tonne.

‡ Figures in Kwh/tonne.

† Percentage of energy cost to sales turnover.

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

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

Intra-Unit Variations in Energy Productivity

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

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

TABLE 5 Intra-Unit Energy Productivity Performance

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

* Categories :

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

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

Energy Conservation Measures

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

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

TABLE 6 Cost Benefit Analysis of Energy Conservation Measures

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

* See Appendix II.

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

Status I Measures successful and substantial savings achieved

Status II Marginal or meagre savings achieved.

Status III Savings not quantified

Status IV Measures under consideration.

Status V Measures under implementation.

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

TABLE 7 Number of Units According to Status of Implementation

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

* See Appendix II.

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

Energy Management Function

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

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

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

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

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

Energy Reporting System

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

Energy Audit Function

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

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

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

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

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

Energy Norms

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

Energy Culture

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

Effect on Energy Conservation

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

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

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

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

* Degrees :

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

Conclusion

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

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

→



Converting dreams into deeds is the credo of productivity!

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

Short Term Measures

—Combustion control in coal fired and chemical recovery boilers.

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

—Improving condensate recovery.

—Improving thermal insulation.

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

—Improving power factor.

—Optimisation of process parameters.

Medium Term Measures

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

—Casacading of steam utilisation in paper machines and evaporators.

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

—Improving digestor blow heat recovery systems.

—Optimising hot water utilisation.

—Increasing number of effects in the evaporators.

—Reduction of water consumption and hence pollution load.

Long Term Measures

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

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

—Optimisation of total plant hydraulic systems.

—Balancing of production equipment and utilities.

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

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

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

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

Family Plan Based Resource Allocation for Economic Development and Social Justice

Jagpal Singh

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

Jagpal Singh is a Senior Scientific Officer in the Centre for Rural Development and Appropriate Technology of the Indian Institute of Technology-New Delhi 110 016.

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Introduction

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

Objectives of Resources Allocation

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

resource allocation then are :

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

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

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

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

Family Plan

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

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

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

C = resources consumed by the family in a year.

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

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

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

where,

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

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

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

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

Resources for Allocation

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

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

where,

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

AC = amount of capital and land in use.

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

ES = amount of resources contributed by the

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

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

Allocation of Resources Based on a Family Plan

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

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

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

where,

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

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

Allocation of 'G' Resources in Geographical Units

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

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

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

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

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

Allocation of 'I' Resources in Activities and Areas

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

Methodology

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

TABLE 2 **Households and Sample Units**

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

Working Manhours

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

Gross-Income

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

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

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

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

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

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

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

Capital-in-Use

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

Per-Working Manhour Gross-Income

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

Capital-Gross-Output-Ratio

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

Total Resources

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

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

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

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

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

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

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

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

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

Investment-Plan

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

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

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

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

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

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

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

Impact of the Proposed Family-Plan Based Resource Allocation

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

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

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

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

Policy-Implication

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

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A Goal-Oriented Weighted Multi-Factor Productivity Index

Khalil F. Matta

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

Khalil F. Matta is Assistant Professor in the Department of Management, University of Notre Dame (College of Business Administration) Indiana-46556.

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Introduction

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

Definitions

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

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

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

The outputs can, in most cases, be easily indentified

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

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

Use of Productivity Measures

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

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

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

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

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

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

Desirable Characteristics of a Productivity Index

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

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

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

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

*Can this input be controlled and managed ?

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

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

Weighted Multi-Factor Productivity Model

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

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

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

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

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

f_i is the partial productivity factor associated with resource i.

This model has two significant features :

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

Key Input Resources

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

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

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

Q-Factor

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

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

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

where

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

and

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

A = Orders Live/Day

I = Man-Hours/Man-Day

T = Work Days/Year

E = Number of Men Per Typical Order

M = Direct Labor Hours/Year

N = Total Order/Year

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

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

The Q-Factor is defined as :

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

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

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

TABLE 1 Cost Changes From 1979-1982

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

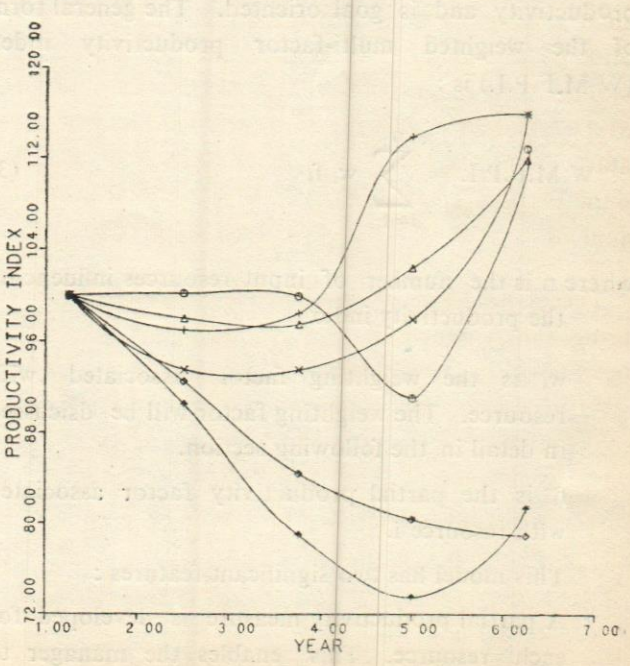

Fig. 1 Partial Productivity Index

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

Weighted Ranking Technique

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

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

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

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

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

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

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

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

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

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

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

The weighting factors can, then, be formulated as :

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

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

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

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

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

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

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

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

TABLE 2 Sample Matrix Formulation*

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

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

TABLE 3 Manager's F.I.C.

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

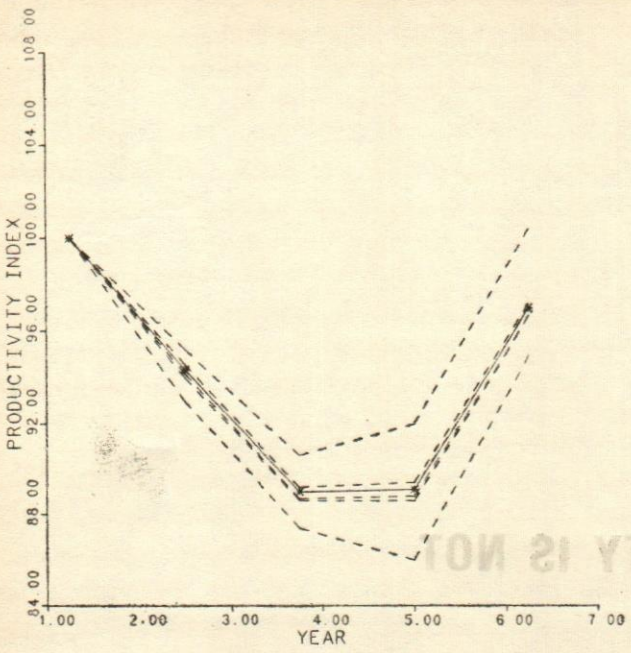

Fig. 2 Total Productivity Index

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

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

Conclusion

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

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PRODUCTIVITY IS NOT

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A WAY OF LIFE

Productivity Trends in Electrical Machinery Industry in India

N.P.C. Research Cell

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

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

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Introduction

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

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

Variables and Their Measurement

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

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

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

Prices and Price Indices

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

Nature and Sources of Data

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

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

Partial and Total Productivity Indices

The labour productivity has been measured in

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

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

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

where

ITP_t = Index of total Productivity

IKP_t = Index of capital Productivity

JLP_t = Index of Labour Productivity

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

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

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

Results

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Some Explanations

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

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

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

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

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

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

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

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

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

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

Conclusions

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

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APPENDIX I

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

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

APPENDIX II

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

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

APPENDIX III

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

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

APPENDIX IV

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

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

APPENDIX V

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

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

APPENDIX VI

Price Indices and Their Weightages

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

APPENDIX VII

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

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

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

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BOOK REVIEW

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

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

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

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

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

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

C.K. Johri,
Fellow,
Indian Institute of Advanced Studies,
Simla.

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

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

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

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

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

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

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

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

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

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

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

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

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

R.C. Monga,
Director (Finance and Electronic Data Processing)
National Productivity Council,
New Delhi.

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

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

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

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

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

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

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

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

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

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

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

N.K. Nair,
Director (Research),
National Productivity Council,
New Delhi.

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

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

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

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

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

Printing of the book is highly appreciable.

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

S.N. Laharia,
Jt. Director (Extn.),
Haryana Agricultural University,
Hissar.

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

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

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

Data Base

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

Relative Efficiency

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

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

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

Industry Studies

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

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

Factor and Product Market and Linkages

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

Government Policy

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

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

Veena Bhatnagar,
College of Vocational Studies,
Delhi University,
Delhi.

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

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

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

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

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

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

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

Anupama Kwatra,
Faculty of Management Studies,
University of Delhi,
Delhi.

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BOOKS IN BRIEF

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

Agricultural Research Systems and Management in the 21st Century

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

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

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

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

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

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

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

American Business : A Two-Minute Warning

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

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

Banks and Customers—A Behavioural Analysis

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

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

Capital Formation and Output in the Third World

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

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

Computer Based Information Systems

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

This book is an introductory study of computer

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

Essential Guide to dBase III + in Libraries

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

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

Entrepreneurship Development Under Trysem

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

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

Generating Technological Innovation

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

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

Human Resource Development : The Indian Experience

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

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

Human Resource Development and Productivity: New Perspectives

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

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

Management of Economic Development, New Horizons

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

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

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

Managing New Products

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

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

Optimal Expenditure on Social Services in India

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

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

Planning Strategies That Work

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

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

Productivity, Innovation, Management and Development

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

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

The Art of Managing Human Resources

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

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

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

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

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

The New Unionism : Employee Involvement in the Changing Corporation

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

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

The Strategic Use of Information Technology

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

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

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

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

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

Women and Information Technology

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

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

Compiled by
S.N. Vig.
Doc. & Inf. Officer
National Productivity Council

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Compiled by :

S.N. VIG
Doc. & Inf. Officer
National Productivity Council
New Delhi.

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All business correspondence to be addressed to the Business Management Section, National Productivity Council, Utpadakta Bhavan, Lodi Road, New Delhi-110 003 (INDIA)

Strategic Information Systems for Developing Countries

Prashant Palvia
Shailendra Palvia
Ronald M. Zigli

Strategic information systems (SIS) are being developed and used for competitive advantage in many organizations in the developed nations. The authors contend that such systems would have significant use for developing countries as well. In this article, two models are presented: a model for Strategic Information Systems for Competitive Advantage in developing countries, and a model for Strategic Information Systems for Economic Development (SISED). The article concludes with a discussion of desired preconditions for SIS development.

Prashant Palvia and Ronald M. Zigli are from the Memphis State University (Tennessee) and Shailendra Palvia is from the Babson College, Bostan (Massachussetts).

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Introduction

Strategic Information Systems (SIS) are conceptually much more than a technique, clone or isomorphism of Management Information Systems (MIS), Computer Information Systems (CIS), or Decision Support Systems (DSS). It represents a radical departure from other information systems concepts—a completely new way of thinking about the role of information systems in the strategic planning process. It has been adapted and applied to a myriad of models and strategic constructs including Porter's Competitive Strategies framework (Porter, 1980) and McFarlan and McKenney's Strategic Grid (McFarlan et. al., 1983), the value added chain, strategic opportunities matrices, portfolio analyses, and the life-cycle concept. Indeed, the idea that information systems are an integral part of the strategic planning process is more revolutionary than evolutionary.

Today, strategic information systems are considered vital for the long term survival of organizations. They (SISs) have been identified as one of the ten information systems megatrends (Kanter, 1985). The conventional wisdom is that SIS's are essential in supporting, shaping, and implementing organizational missions, policies and direction. This capability has been called the SIS vision (Wiseman, 1985).

In the private sector this vision has generally been directed towards the achievement of competitive advantage. To date, most strategic information systems have been developed for use in the private

sector of advanced and developed nations. The literature abounds with examples of strategic information systems for competitive advantage (SISCA). Examples include the SABRE and APOLLO reservation systems for airlines, a clinical laboratory installed in doctor's offices by Metapath Inc. (Wiseman, 1985) and SISCAs that provide pricing information used for competitive advantage (Grand Union, Red Lobster, and GE) (Beath and Ives, 1986). The value of strategic information systems, however, is more ubiquitous, and extends beyond the private sector and the developed nations.

Both SISCA and strategic information systems for economic development (SISED) can be invaluable to less developed nations. The former (SISCA) focuses primarily on profit, but its secondary objective is to make selected domestic companies in a given nation more competitive in the world market. SISED in fact is aimed at improving the economic health of a developing nation.

When a strategic information system is applied to the public sector, the focus is on the commonwealth—the provision of high quality goods, services, and utilities for the promotion of national economic development and international trade. Human and economic welfare are paramount. For example, in a deregulated airline industry, cut-throat price competition may deemphasize safety (reduced maintenance expenditures, long hours for pilots, etc.) whereas in a government regulated airline industry, safety would be the primary consideration.

Current Models for Identifying SIS Opportunities

Most of the current research and applications in strategic information systems relate to companies and organizations in a free economy. Based on the body of knowledge in strategy formulation (e.g. Glueck, 1980; Porter, 1980; Thompson and Strickland, 1986) and especially Porter's model, several authors have proposed systematic approaches for identifying SIS opportunities in an organization (Rackoff et. al., 1985; Wiseman, 1984, 1985). The following is a synthesis of the important models for SIS identification.

Typically, three major strategic dimensions (or factors) are cited: strategic target; strategic thrust and strategic mode (see figure 1). Each factor has several qualitative values. The targets identified are : supplier, customer and/or competitors; the thrusts are : differentiation, cost, focus, innovation, growth, and/or alliance; and the modes are defensive or offensive. SIS opportunities may exist for one or more factor value combinations.

In addition, Warren McFarlan (Ball, 1986) has suggested answering the following five basic questions for identifying SIS opportunities :

(1) Can information systems (IS) technology build barriers for competitors ?

(2) Can IS build high switching costs for customers ?

(3) Can IS change the basis of competition ?

(4) Can IS technology change the balance of power in supplier relations ?

(5) Can IS technology generate new products ?

Ives and Learmonth (1984) have suggested a 13-stage customer resource life cycle for identifying SIS opportunities. It has also been suggested (Palvia et. al, 1988) that critical success factors (Anthony et. al, 1972; Ohmae, 1983; Rockart, 1983) may be used for focusing on more important areas of the SIS grid of figure 1. Finally, a variety of planning processes (Applegate et. al, 1987; Cohen, 1973; Palvia, et. al, 1988: Rackoff, et. al, 1985; Steiner, 1979; Steiner, 1977), and technological forecasting technique (Applegate et. al, 1987; Bouchard, 1970; Burton, et. al, 1970; Dunnette, 1964; Palvia, et. al, 1988; PUU, 1978; Taylor, et. al, 1958; Torrance, 1957; Wheelwright, et. al, undated) have been discussed for SIS implementation.

Strategic Information Systems in Developing Countries

While most of the literature on strategic systems is written for implementation in a developed, free and competitive economy, we believe that this body of knowledge has application for developing countries and more controlled economies as well. For example, it is hard to imagine that every country in this class will answer "NO" to all of the five questions posed by Warren McFarlan (Ball, 1986).

In this section, we extrapolate the SIS model discussed earlier (Figure 1) to developing countries.

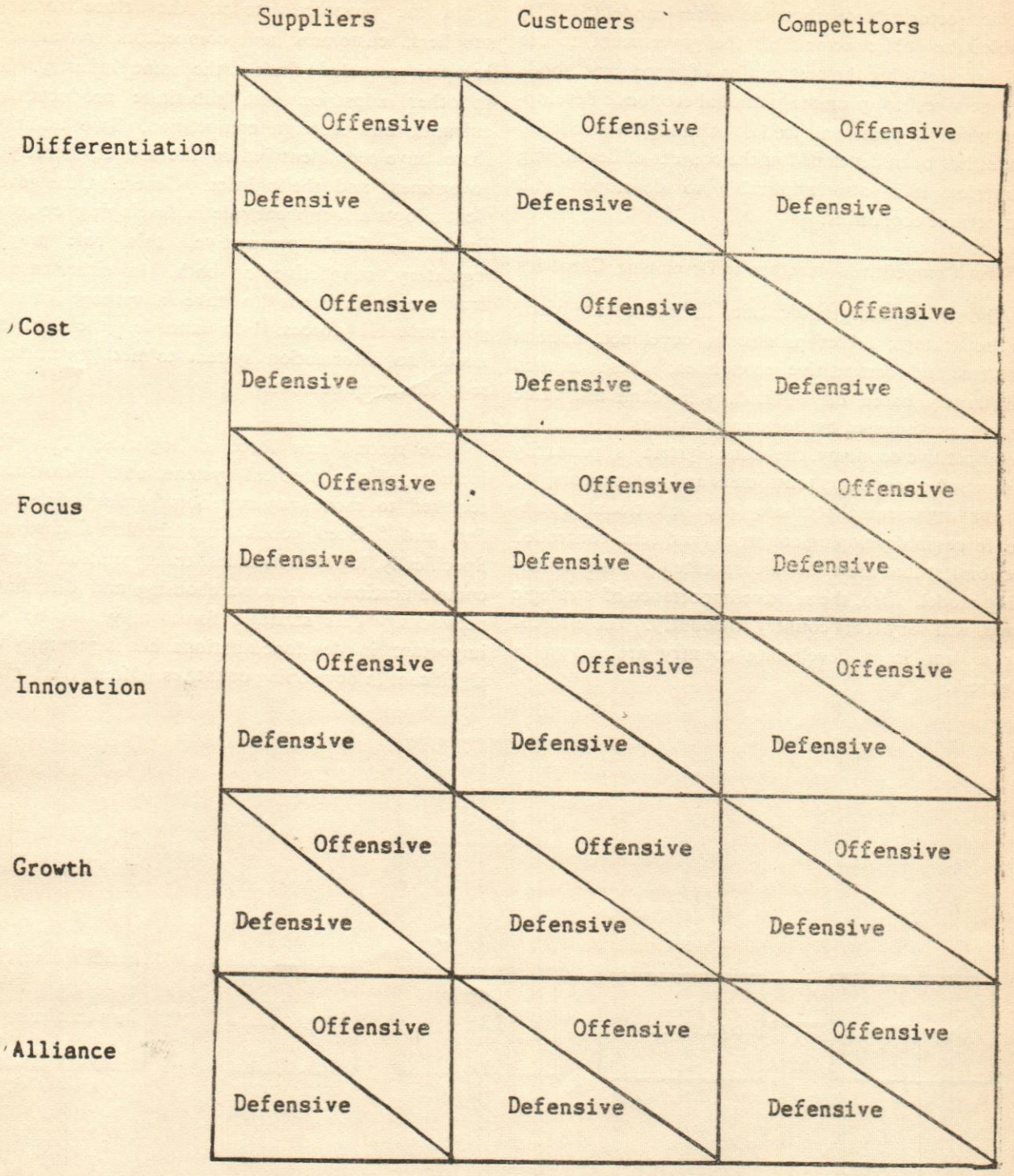

Fig. 1 The SIS Scanning Grid

We are convinced that SIS opportunities exist in developing countries both for the private sector (to gain competitive advantage) and the public sector (to promote economic development). The specific strategic forces will vary; however, the underlying model is still a valuable tool. We develop and report two conceptual SIS scanning models for developing countries; one for the private sector and one for the

public sector. Note that the latter model (SISED) enables the public sector (i.e., the government) to use SIS for providing the best quality of necessary goods and services to promote national economic development and international trade. Although the SISED model has been developed in the context of developing countries, it is also applicable to developed and competitive economies.

SIS for Competitive Advantage in Developing Countries

The strategic targets identified in Figure 1 are based on the strategic forces present in developed nations with free and competitive economies. These in turn are largely based on a firm's value chain and value system, as discussed by Porter and Millar (1985). In a competitive economy, the value system is primarily comprised of suppliers, customers and competitors. It is our argument that there are additional strategic forces in developing countries (and semi-controlled economies) that must be incorporated in the underlying model. Also, the relative importance of strategic forces will vary from country to country. These forces for a firm in a developing country are shown in Figure 2.

In the proposed model, the three forces of suppliers, customers and competitors remain. The competitors include firms in the same industry, firms in other industries with substitute products, new entrants, and foreign competition. Two additional forces have been identified in the model, namely the government and the logistics. Generally, the government adopts a significant role in developing countries. From the firm's perspective, this role may be regulatory, supportive, or both. In either case, the firm may take steps to take advantage of these governmental forces. For example, the firm may install an information system to meet governmental regulatory requirements.

The second new force is logistics. This force includes all the physical systems and infrastructure required to move raw materials from suppliers to the firm and finished goods from the firm to customers. Specifically, logistics includes transportation systems, communication systems, warehousing and distribution networks. This strategic force may not be very important in developed nations, but is generally very significant in developing countries. Often the logistics

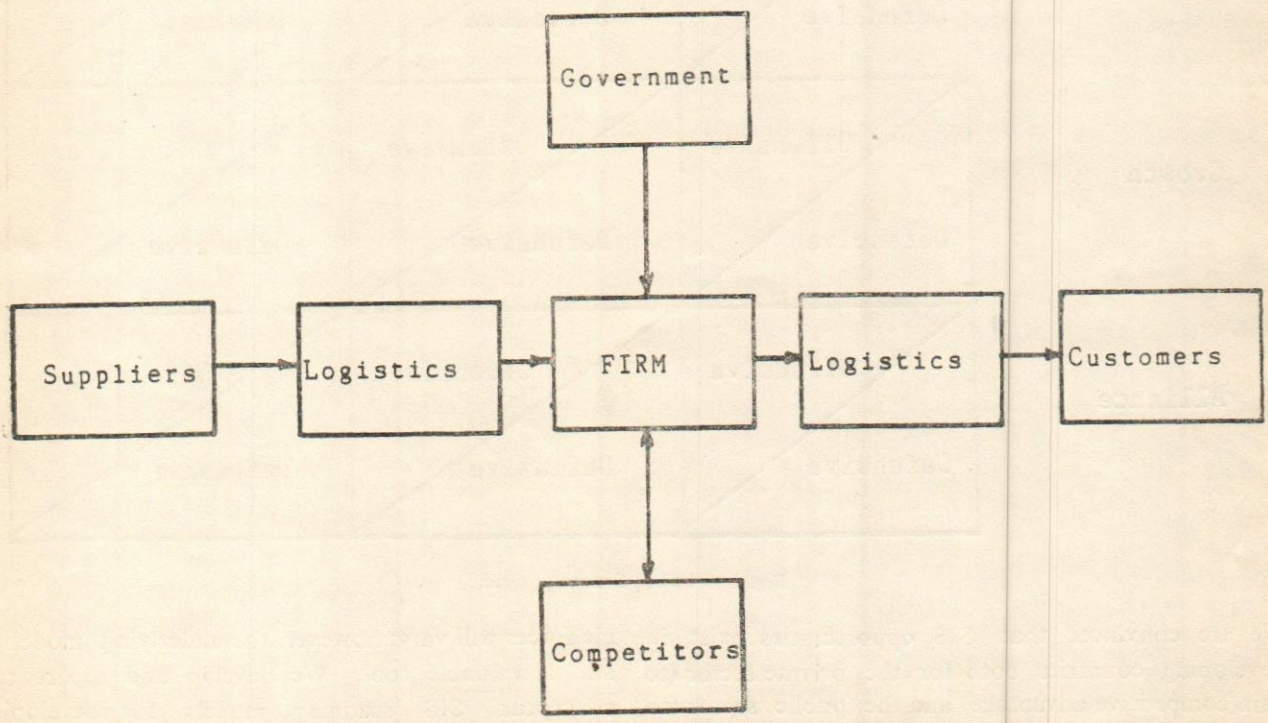

Fig. 2 Strategic Forces for a Firm in a Developing Country

systems and the infrastructure in such countries are far from adequate. A firm may be in a strategically stronger position when it uses technology to overcome some of these logistics problems. For example, a telecommunications system may be used to track and expedite deliveries to more crucial distribution points.

These, then, are the suggested strategic targets for a firm in a developing country. Again the firm may use one or more of the six strategic thrusts, identified in the previous section. The SIS scanning grid for developing countries is shown in Figure 3. The strategic mode in each cell (though not shown in Fig. 3) may again be defensive or offensive. An SIS opportunity may exist for any of the 60 combinations shown in the scanning grid. This, we believe, is a rich

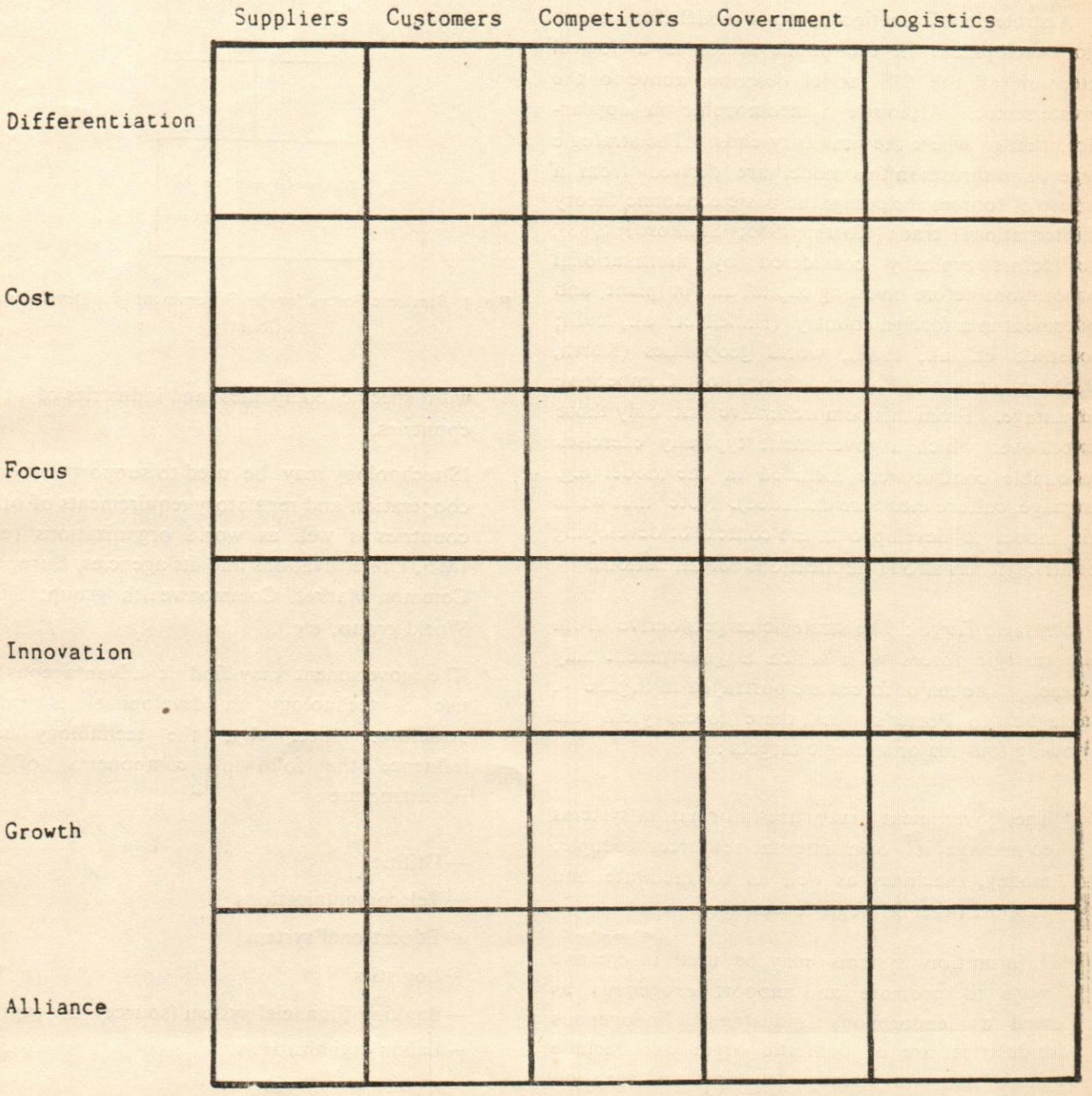

Fig. 3 Strategic Information Systems for Competitive Advantage Scanning Grid For Developing Countries

model for SIS identification. Of course, depending on the firm and the country, some combinations may be more attractive than others; while some may not be feasible or applicable. A sound planning process will have to be undertaken to generate feasible and implementable ideas.

SIS for Economic Development (SISED)

A strategic information systems model for economic development in the public sector is a logical extension of the SIS model described above for the private sector. Although homeomorphic in appearance, that is where the similarity ends. The strategic targets and thrusts in this model are derived from a variety of sources including: the basic economic theory of international trade (Korth, 1985; Stanford, 1983), the factors typically considered by multinational corporations before investing capital and/or plant and equipment in a foreign country (Hanell et. al., 1981; Ronstadt et. al., 1982), world geopolitics (Korth, 1985) as well as Porter's theory of Competitive Advantage. From this comprehensive list, only those factors over which a government typically exercises reasonable control were included in the model (e.g. language, culture etc. were excluded). Note that while this model is developed in the context of developing countries, it has strong implications for all nations.

Strategic Target: The strategic targets derive from the strategic forces with which a government may interact. The major forces are portrayed in Figure 4. Analagous to Porter's work, these forces yield the following four major strategic targets :

* The government may use information systems to manage its own internal resources (people, money, machines) as well as to facilitate and support other strategic forces.

* Information systems may be used in creative ways to promote and support exogenous as well as endogenous industries. Endogenous industries are of domestic orgin and include those that are already developed and are soon to be developed. Exogenous industries include multinational corporations and joint ventures with specific companies and industries of other countries.

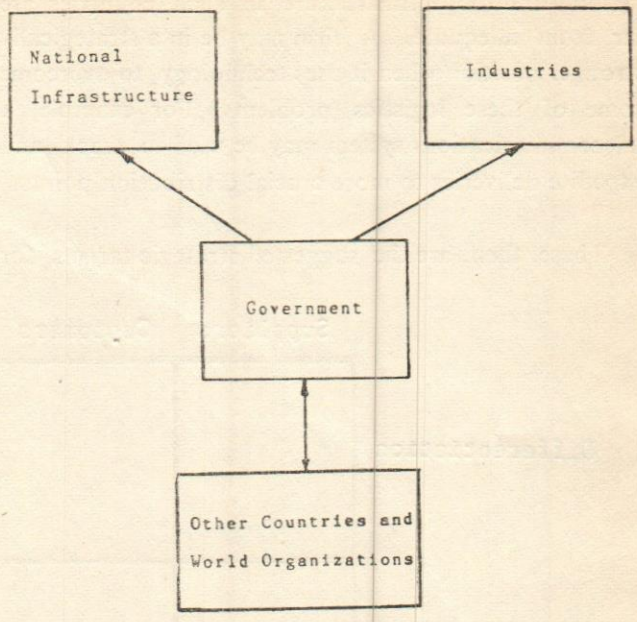

Fig. 4 Strategic Forces for the Government in a Developing Country

* IS technology may be used to support economic cooperation and regulatory requirements of other countries as well as world organizations (e.g., IMF, United Nations and its agencies, European Common Market, Commonwealth group, Third World group, etc.).

* The government may find it advantageous to use IS technology in developing its infrastructure. Specifically, the technology may influence the following components of the infrastructure :

  —Utilities
  —Telecommunications
  —Educational system
  —Logistics
  —Banking/Financial system (sources of capital)
  —Labor organizations

Strategic Thrust: As before, strategic thrusts refer to the kind of advantage gained by actions taken. In

this model, however, these actions are initiated by government and not by competitors within an industry. Six thrusts or strategies are identified for the public sector model. These thrusts are :

* *Focus* : Concentration by government on a particular industry or segment of government etc.
* *Innovation* : A fundamental and creative change in the way a segment of government or an industry operates etc.
* *Growth* : Expansion of an industry, government segment, an infrastructure etc.
* *Alliance* : Forging partnerships with specific industries, other countries etc.
* *Direct Support* : Providing direct support in one or more of the areas identified as the targets of government strategy like :

  —Financial (aid or contribution)

  —Technological

  —Experts/Consultants

  —Tax Advantages

* *Indirect Support* : Providing indirect support in one or more of the areas that follow for one or more of the targets of government like :

  —Information

  —Education/Training Programs for Industry

Strategic Mode : Once again in this model there are two strategic modes, offensive and defensive.

The targets and thrusts can be organized into a 6×4 matrix or scanning grid (Figure 5). The mode in each cell of the grid may again be defensive or offensive. Again, we believe this grid provides a rich set of SIS opportunities to explore.

Requirements for Strategic Information Systems

There are some desirable preconditions for the successful development and implementation of strategic information systems in an organization. We classify these into two categories : business/organizational requirement and technological requirements. These requirements are not absolute prerequisites; rather, they increase the likelihood of success. The absence of these preconditions pose certain barriers for SIS development; compensating strategies need to be adopted to overcome them (Morris, 1987). Thus these requirements suggest further actions needed to be taken by organizations before deployment of SIS (in both developed and developing nations).

Business/Organizational Requirements

1. The SIS must be patterned after the strategic vision (or corporate strategy) of a company (Cunningham, 1985). Before undertaking SIS development, the organization leaders should be strategically oriented and be explicitly doing strategic planning.
2. Top management must be involved. This is crucial since SISs involve significant risk, have a long-term planning horizon, involve substantial investment and have a wide scope.
3. Information must be recognized as a resource on par with other resources : men, money, materials. One measure of this requirement is that the chief information officer (CIO) reports directly to the chief executive officer of the company. In this role, the CIO becomes an interpreter, educator, advocate, and stimulator (Cunningham, 1985). Another measure is the maturity of the organization in its use of information systems, (i.e., it must have systematically passed through transaction processing and management information systems (Morris, 1987). In terms of the Nolan stage model (Nolan, 1979), the organization should be in or near the maturity stage.
4. The strategic position and nature of the firm and/or industry and environmental factors may require or facilitate the use of IS technology for gaining strategic advantage. Thompson and Strickland (1986) identify four generic types of firms and five types of generic industry environments and different competitive strategies for each one of them. Environmental factors include the size and

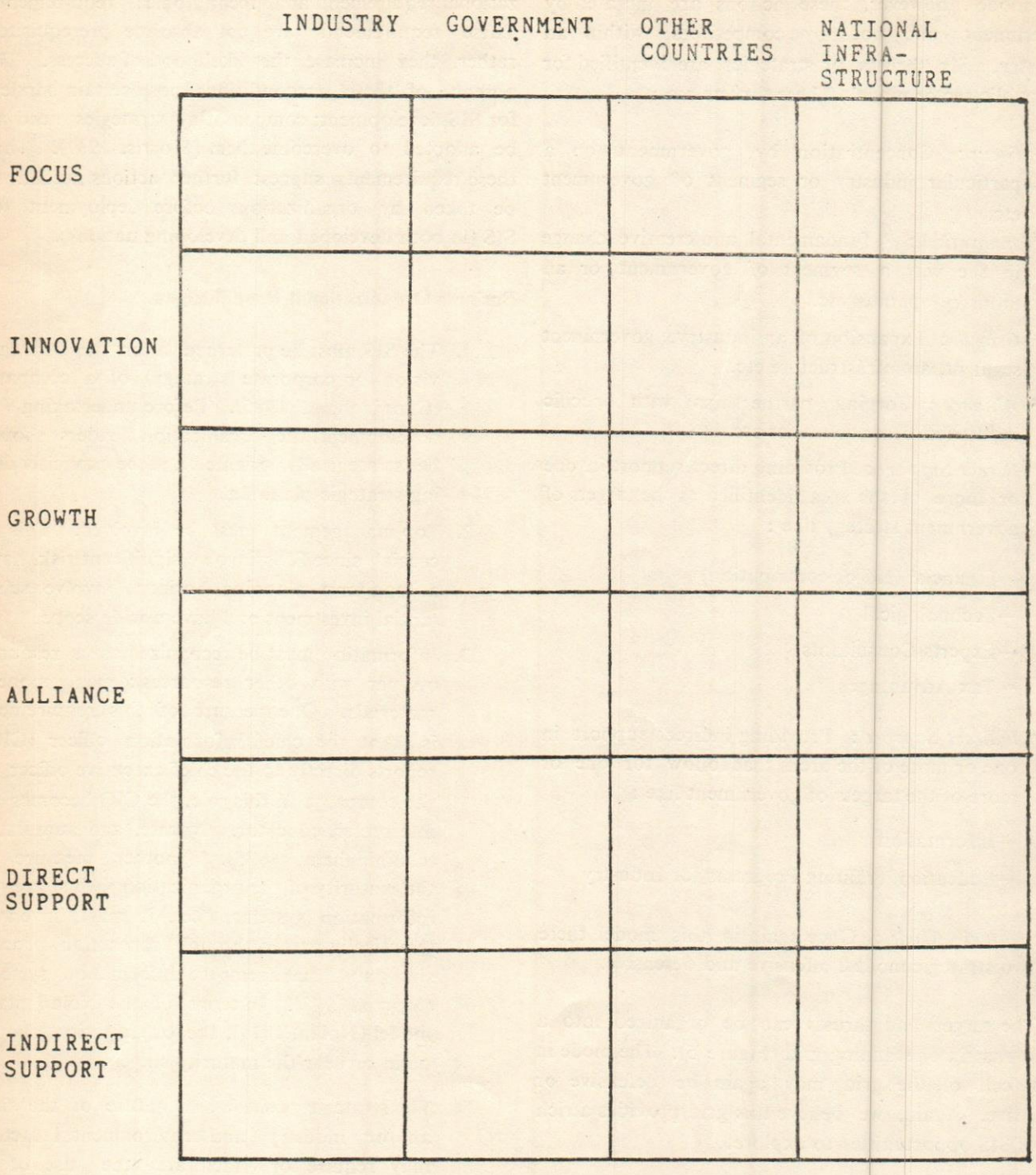

Fig. 5 Strategic Information Systems for Economic Development (SISED) Scanning Grid

intensity of competition, the relationship with the suppliers and customers, and in some nations the logistics systems as well as governmental influences.

5. Creativity must be emphasized. According to Cunningham (1985), the common denominator for all successful SISs is a "flash of brilliance". Harriman, President of Syntectics (Boston Globe, 1986), states that corporations are pursuing creativity actively to counter the

inherent barriers due to organizational structure. Government and individual firms should promote activities and programs designed to improve the creativity of its human resources.

6. The commitment to change and the use of a rational process for implementing change must exist. The presence of entrepreneurs (Wiseman, 1985) and the presence of a project champion (Palvia and Chervany, 1985) have been recommended for implementing change. For SIS, the project champion should preferably be from the management team. A well accepted and rational process is the Lewin-Schein's three-stage change process (Lewin, 1947; Schein, 1964). Faced with the seriousness of cyberphobia, entrepreneurs should build support among employees and managers before, during, and after the introduction of computer systems (King, 1983).

Technology Requirements

According to Cunningham (1985), "in a buyer's world in which every customer becomes a market segment, it has got to be a two-way street : market-driven technology rather than technology-driven marketing." The technology has to constantly adapt to changing needs. The additional technological requirement for a successful SIS, over and above conventional resources, are :

1. Computer-based models. This means acceptable software to do extensive "what-if" analyses in an ineractive and iterative mode. These models include mathematical, decision support systems (DSS), expert system (ES), and simulation models.
2. Computer-based large databases accessible from remote locations. These databases should include operational and tactical data of the company's internal environment as well as relevant data from the external environment.
3. Telecommunication and distributed processing. The targets for SIS are : competitors, suppliers, customers, logistics and government. Since many of these targets are geographically dispersed, telecommunications and distributed processing play a vital role.
4. A synergism of IS technologies. The confluence and connectivity of the islands of computers (micro and mainframe), communications, and office automation leads to significant innovative possibilities (McFarlan, 1983). All three islands are relatively volatile and their connectivity is a significant challenge.

Summary

In this paper, we have demonstrated the viability of using model for the development of strategic information systems for Competitive Advantage (SISCA) and Economic Development (SISED) for developing countries. The SISCA model is developed from ideas frequently discussed in the literature on developed and competitive economies, like the U.S.A. The SISED model is an extension of the SISCA model. These models, properly utilized, should help developing nations in exploiting information technology to accelerate economic growth and social welfare.

Prior to the industrial revolution, most economists subscribed to the "Absolute Advantage Theory" of international trade. Later David Ricardo proposed the "Comparative Advantage Theorem of International Trade" (Stanford, 1983). Today, both the theories are considered to be incomplete. Their failure to adequately explain the dynamics of international trade is partly due to the fact that neither accounts for the impact of technology and information. It was assumed that :

1. There would be no difference in technological levels between nations.
5. Relevant technology would be readily available to trading nations.
3. Relevant information will readily flow among nations.

All three assumptions have since been proven false. The value of being technologically competitive

goes unchallenged today. Even attracting foreign investment which has long been considered a function of a plethora of factors, shows technology "looming larger" than ever before as a major element. Many developing countries are already making determined efforts to assimilate information technology to accelerate economic development. We believe that our contribution, in this context, will help the developing nations and world organizations in promoting the effective use of strategic information systems.

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davp 88/412

Agro-Industrial Residues : Valuable Source for Building Materials

P.K. Srivastava
R.P. Kachru

Agro-industrial residues are of great economic importance as valuable sources of materials particularly in construction activities. They may find gainful utilization in the production of a variety of building materials and products which may be used in the place of conventional materials. The authors argue, in this article, that a variety of building materials produced from such agro-industrial wastes may also reduce the cost of construction.

P.K. Srivastava is a Scientist in the Institute of Agricultural Engineering, Bhopal. R.P. Kachru is the Head of the Post Harvest Engineering Division of the Institute.

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Introduction

There is a need to provide shelter to more than 700 million people and over 240 million animals as well as storage for food grains the magnitude of which is likely to touch a target of 240 million tonnes by the turn of the century. India is facing an acute shortage of about 21 million dwelling units, of which 76% are farm houses in rural areas. In addition, about 25 million people, living in slum settlements of big cities also need low cost dwellings (Khushoo, 1986). Apart from this, India has to maintain a buffer stock of about 30 million tonnes of foodgrains, which also makes tremendous demands on available storage space. For all such structures, building materials like bricks, cement, timber etc. are required. In this context, agro-industrial residues are of great economic importance as valuable raw materials. They may find gainful utilisation in the production of a variety of building materials and products which could be used in the place of conventional materials. A variety of new building materials produced from such agro-industrial residues may also reduce the cost of construction.

This paper attempts to identify and assess various agro-industrial residues, useful from the building industry's point of view. Besides, the paper also presents an account of technologies developed for their conversion into useful building materials.

Agro-Industrial Residues

Agro-industrial residues originate mainly from

crops, animals and agro-processing centres. They include crop residues, wild growing biomass, food processing wastes and animal refuse. The exact quantity, nature and disposal systems of such residues have not been accurately established because of their varied and scattered nature and seasonal availability. However, surveys have been carried out in different parts of the country, on the basis of which it can be estimated that about 350 million tonnes of various agro-industrial residues are annually produced in India in the form of straw (rice/wheat), stalks (maize/sorghum), cobs (maize/sorghum), shells (groundnut/coconut), sticks (jute/cotton), husk (rice/coconut) or peels and vines of fruits and vegetables (Srivastava, et. al. 1981). Due to its scattered and seasonal availability, bulky nature, low density and typical physico-chemical characteristics, much of this stock remains unutilised. Local and traditional uneconomical usage and lack of information regarding their potential as important raw materials for various industries, also contributes to their underutilization.

Some of these agro-industrial residues could be easily processed into the much needed building materials as timber substitutes, base materials, admixtures and fuels in the production of bricks, cement concrete, roofing materials and floorings, and fittings and fixtures, thus providing respite to the conventional building materials sources which are in great demand and have become costly.

An indepth literature survey identifies the following major agro-industrial residues which have possibilities of utilization in the manufacture of different types of building materials :

Wheat Straw: About 32 million tonnes of wheat straw is available annually in India which is conventionally used as fuel, animal feed, grain storage structure etc. It could be used for the preparation of straw board.

Paddy Straw: About 88 million tonnes of paddy straw are estimated to be produced in India. It is mostly burnt in the field but could be used for production of paper, paper/straw board etc.

Rice Husk: More than 18 million tonnes are produced per annum. The husk could be used for production of boards and bricks in addition to its use as animal feed after suitable treatment.

Maize Stalk: About 14 million tonnes of maize stalks are produced in India, presently used as animal feed or fuel. It could be successfully used for production of paper and board.

Bagasse: About 5.25 million tonnes of bagasse are estimated to be produced in India every year. Most of it is used as fuel but has great potential for production of pulp and paper.

The other agro-industrial residues useful from building materials point of view are *sorghum sticks* (32 mt), *gram straw* (11 mt), *pigeon pea stubble* (4 mt), *groundnut shell* (8 mt), *sugarcane trash and dry leaves* (2 mt), *press mud* (0.2 mt), *jute sticks* (3 mt), *cotton stalk* (10.5 mt), *coconut husk* (0.1 mt), *arecanut husk* (0.1 mt) *and rubber wood* (0.3 mt).

In addition to these agro-industrial residues, several other products such as cashewnut shell liquid, wood wool etc. have tremendous scope for applications in the development of various building materials.

Building Materials

Products like building and refractory bricks, cement, concrete, fibre and particle boards, insulation materials, adhesives, joint fillers etc. are some of the conventional building materials which can be prepared from the above mentioned agro-industrial residues (Table 1). The technologies for such conversions of agro-industrial residues into building materials have been developed by various research and development institutions. Some details are given below :

Bricks

Lightweight, cheap and sound building bricks could be produced from some agro-industrial residues. Table 2 presents the characteristics of rice husk and rice husk ash bricks, compared to conventional burnt clay bricks and soil cement bricks.

TABLE 1 : Applications of some typical agro-industrial residues in building construction

Residue	Mode of use	Application
Rice husk ash	Rice husk ground to suitable fineness and mixed with lime	Rice husk cement for masonary mortar, foundation concrete and mass concrete work, bricks.
Saw dust	Cement and saw dust mixed in the ratio of 1 : 1, 1 : 2, 1 : 3	Partition walls, false ceilings, roofing materials etc.
Straws	Mixed with chemicals to form pulp	Corrugated roofing material
Bagasse	Mixed with cement	For roofing and building boards
Coconut husk and coir	Mixed with acquous adhesives	Particle boards, Wall board, roofing sheets
Rice husk	Mixed with binders	Building boards

Source : Kaushik and Vasan, (1985).

TABLE 2 : Comparative characteristics of rice husk/rice husk ash bricks

Type of brick	Compressive strength kg/cm²	Water absorption % in 24 hours	Wheathering loss in weight %	Density, g/cm³	Strength/ density ratio
Rice husk bricks	30-40	15	5	1.50	26.70
Soil-cement bricks medium	18	15	Max. 10	2.00	9.00
Burnt-clay bricks	35	25	—	2.00	17.50
Rice husk ash bricks	50-80	25-30	8	1.00	60.00

Source : Borthakur, et. al. (undated).

Concrete

Tropical Development Research Institute, UK has used rice husk as an aggregate in light weight concrete blocks or bricks. The cement-husk blocks could survive cold weather without deterioration. Light weight concrete blocks were prepared at IIT, Kharagpur by mixing cement, rice husk ash and rice husk in the ratio of 1:4:2 (Pandey, et. al. 1976). The mixture yielded light weight concrete of 47 kg/cm² strength. Central Building Research Institute, Roorkee has also developed a process to make cement-coconut pith concrete which is reported to be fairly cheap as compared to conventional insulating materials. The introduction of coir fibres in concrete helps in improving the strength characteristics. The comparative performance of coir fibrous concrete is presented in Table 3.

Refractory Bricks

Tridymite types of refractory bricks, suitable for lining in boilers, curing/dehydration structures, ship and locomotive boilers, brass foundary furnaces etc. can be manufactured by mixing rice husk ash with aluminous cement and fillers. These refractory bricks are reported to possess good insulating properties and are reported to sustain temperatures of 900-1400°C (FAO Report No. 30—1967), (Maheswari, 1972).

TABLE 3 : Strength characteristics of cement-concrete using coir fibres

Strength characteristics, Mix 1:2, 6:2.4	Percentage of 25 mm coir fibre					
	0	0.5	1.0	1.5	2.0	3.0
Cube strength, kg/cm²	145.0	149.6	164.0	171.5	174.0	155.0
Cylinder strength kg/cm²	122.0	139.0	152.5	146.0	134.0	113.0
Indirect tensile strength, kg/cm²	18.0	19.1	23.4	—	19.0	—
Direct tensile strength kg/cm²	21.0	—	22.5	—	26.6	—
Flexural strength, kg/cm²	32.0	33.0	34.0	—	34.8	24.0
Shear strength, kg/cm²	44.9	—	57.5	—	47.7	—
Impact strength, kg/cm²	434.0	607.0	774.0	—	602.0	570.0

Source : Kaushik and Vasan (1985).

Cementitious Materials

Regional Research Laboratory, Jorhat, in collaboration with Annamalai University, Annamalai, has developed a process for the manufacture of a cement like product from rice husk ash for use in masonary mortar, plastering, foundation and mass concrete work. Cement Research Institute, Ballabhgarh and Central Building Research Institute, Roorkee have also developed a process to make high quality pozzolanic materials from rice husk ash and clay. This material, when mixed with lime, gives a very good quality cementitious material, known as lime-pozzolana cement. This cement, when mixed with conventional portland cement and sand gives portland-pozzolana cement which is reported to be superior for water retention, comparable in compressive strength and cheaper than conventional portland cement-sand mortar. Table 4 presents the properties of rice husk-clay-pozzolana cement. IIT, Kharagpur has developed a similar product, known as 'Ashmoh' from rice husk ash. It is reported that rice husk ash, when mixed with 25-40% lime and water and simply ground in a vibratory grinding mill to 290 micron size, yields a cement like material. The cement thus, prepared has been reported to give compressive strength of 55 to 105 kg/cm² and 80 to 130 kg/cm² compared to 115 kg/cm² and 175 kg/cm² for standard portland cement after 3 and 7 days of curing, respectively (Chakravorty et. al. 1976).

TABLE 4 : Properties of rice-husk-clay pazzolana cement

Sl. No.	Property	Value
1.	Loss of ignition, %	1.50
2.	Sp. gravity	2.34
3.	Lime reactivity, kg/cm² (IS 1727-1967)	64-106
4.	Lime pazzolana mortar, strength kg/cm²	44-72

Source : Central Building Research Institute, (1977).

Boards

Boards of various types are used in flush doors, partitions, false ceilings, cladding, furnitures and in certain decorative constructions. These boards are usually classified in two categories, namely: fibre and particle boards. Fibre boards are made of fibres of

wood or any other ligno-cellulosic material while the particle boards are composed of distinct particles or pulps of wood or other ligno-cellulosic fibrous substances mixed with any organic binder or glue.

A number of agro-industrial residues have been used for preparation of the above boards. These boards could be rivetted, screwed or nailed and are useful for wall panelling and as floor under layment. There are technologies using either PF resin as binder (developed by RRL, Jorhat) or no binder (Mahanta, 1971). Shukla (1976) has developed 3 processes for making such boards which include binderless process, process using sodium silicate and phenal formaldehyde resins as binder. Table 5 presents the characteristics of panel/hard boards.

RRL, Jorhat and Forest Research Institute, Dehradun have prepared particle/insulation boards from bagasse. The insulating boards prepared by FRI,

TABLE 5 : **Engineering properties of rice husk boards**

(a) Density	: 900—1200 kg/m³	
(b) Modulus of repture	: 194.35—302.68 kg/cm²	
(c) Tensile strength		
(i) parallel to surface	: 165.17—208.16 kg/cm²	
(ii) perpendicular to the surface or internal bond strength	: 7.36—11.68 kg/cm²	
(d) Shear resistance	: 22.85—40.55 kg/cm²	
(e) Resistance to screw withdrawal	: 46.89—75.69 kg	
(f) Hardness	: 943.94—1382.54 kg/cm²	
(g) Compression	: at room temp. (30 ± 1 °C)	at elevated temp. (95 ± 2 °C)
(i) Retention of compression	: 7.20—2.40%	16.63—7.93%
(ii) Compressibility	: 3.16—1.21%	6.34—1.15%
(h) Water absorption	: Without wax	Waxed
(i) 2 h immersion	: 25.23—12.63% (db)	11.73—6.03% (db)
(ii) 24 h immersion	: 42.95—21.65% (db)	20.92—9.32% (db)
(i) Thickness of swelling	: Without wax	Waxed
(i) 2 h immersion	: 12.27—5.37%	6.42—3.57%
(ii) 24 h immersion	: 25.93—15.13%	10.11—3.96%
(j) Air permeability coefficient		
(i) at board density 200-600 kg/m	: 686.60×10^{-10} —33.36×10^{-10} cm²	
(ii) at board density 900-1200 kg/m³	: 3.45×10^{-10} —0.36×10^{-10} cm²	
(k) Thermal conductivity		
(i) at board density 200—600 kg/m³	: 0.0339 — 0.0833 kCal/h m² °C	
(ii) at board density 900—1200 kg/m³	: 0.1203 — 0.1573 kCal/h m² °C	

Source : Shukla (1976).

राष्ट्रीय उत्पादकता परिषद् पुस्तकालय नई दिल्ली

Dehradun from bagasse are also reported to possess satisfactory properties such as thermal conductivity, sound absorption coefficient, resistance to moisture and strength. Chemical treament of such boards not only render them immune to termite and fungal attack but also make them reasonably fire resistant.

Coconut husk and coir dust are also used for preparing hard, durable and unlaminated boards of desired thickness, capable of being sawn, nailed or glued. These boards could be subjected to a process of purification which renders it completely insect and weather proof and also imparts a hard stony appearance, capable of taking colour finishes. The pith embedded in coconut husk fibres, containing reactive ingredients, undergo a chemical change during the process of making particle board and impart sufficient bond strength between the chips to form a strong board. The coconut husk board have been reported to be resistant to fire and decay. CBRI, Roorkee has developed a process to prepare wood wool boards (Agrawal, 1985).

FRI, Dehradun has developed a process for making hard boards from sawdust (GOI, 1975). These boards can be painted, varnished or polished and can be used in panelling, partitions, ceilings, cupboards, shelves, doors of all types and as a core for plywood. Table 6 gives the typical characteristics of boards prepared from saw dust and bagasse. In addition to the above described major agro-industrial residues, groundunt husk, wood wool, jute sticks, arecanut husk etc; are also useful in preparation of hard and particle boards.

TABLE 6: **Characteristics of bagasse and saw dust hard boards**

Characteristics	Value	
	Saw dust boards	Bagasse boards
Bending strength, kg/cm²	130	150
Tensile strength, parallel to surface, (kg/cm²)	75	80
Bulk density, g/cm³	1.3	1.3
Water absorption, % after		
2 h	1-2	1-2
24 h	5-10	5-10

Source : Government of India (1975).

Plywood Substitute

Spent maize cobs cut into suitable transverse sections of required thickness and pressed with glue, make an excellent plywood substitute. Increased durability can be achieved by treating the cobs with some light preservative.

Roofing Sheet

Coir wastes, rice and wheat straw, palmyrah leaves etc. are agro-industrial residues, used in providing shelters to millions of poor all over the world in the form of thatchings. CBRI, Roorkee is reported to have developed preservation treatments for protecting these thatches against fire, decay and insect attack which improves their service life and safety (Rai et. al. 1964). Vyas, et. al. (1978) have observed that paddy straw sheet are quite effective for control of the microclimate. The corrugated roofing sheets prepared from coir wastes require 30% less cement compared to AC sheet. These sheets are light but tough and can be trasported over hilly and rough roads without any breakage. They possess good thermal insulation properties and so are expected to provide greater comfort in the tropics as compared to AC and GI sheets. These could be laid on roofs like AC sheets and do not require any further finishing, water proofing or treatments. The material is fire resistant too. The characteristics of such corrugated roofing sheets are given in Table 7.

Expansion Joint Fillers

Bagasse, due to its attractive compression and recovery has successfully been used for preparation of expansion joint fillers and finds applications in all such constructions where joints in slabs, beams, shells, prefabricated components etc. are to be filled up. Chozer and Dixit (1985) have reported development of expansion joint fillers from bagasse in combination with mexphalt solution and animal gum. These joint fillers conform to BIS Test IS : 1836-1961 as regards

TABLE 7 : **Characteristics of corrugated roofing sheets made of agro-industrial residues**

Characteristics	Value
Size	1.5 × 1 m²
Thickness	3.5 — 5.0 mm
Corrugation pitch	10 cm
Corrugation depth	3.7 cm
Water absorption	10—15% in 24 h wetting
Breaking load on	
30 cm span	30.145 kg
60 cm span	65.75 kg

Source : Guha et. al. (Undated).

compression, recovery, loss in weight, change in volume and weathering. These fillers are reported to be economical as they cost only 30% of the joint fillers available in the Indian market (Chozer et. al. 1985). CBRI, Roorkee, has also developed a process for manufacturing expansion joint fillers from coconut pith which conforms to IS: 1838-1961 standards (Jain, et. al. 1964).

Lime Substitute

CBRI, Roorkee, is reported to have developed a method for converting carbonation press mud into building lime according to ISI specifications.

Insulation Material

Rice husk could be used as loose insulation in buildings, animal/poultry shelters and cold storage plants. However, loose filling of rice husk between interior and exterior walls present a fire hazard unless treated with borax/boric acid for flame proofing.

Other Building Materials

Rice and wheat straws are used for preparation of grain storage structures while coir dust could be used in combination with rubber to form composite floorings, ceiling boards and similar products. Such flooring sheets (containing 50% fine coir dust) are reported to keep without deterioration for a period exceeding 5 years (GOI, 1975).

New Building Materials-Economics of Usage

Even 1% reduction in the cost of building materials can lead to a 70% reduction in the cost of housing projects (Chakravarty, 1985). The demand estimate of cement is of the order of 80 million tonnes per year by the end of VII Plan as against the present installed capacity of 25 million tonnes per year. This would require capital investment of the order of Rs. 1,800 millions per year, including modernisation. On the other hand, an ordinary steel batch ball mill can convert a modern rice mill into a mini-cement plant producing about 500 tonnes of cement every year. The fixed and working capital repuirements for the production of 'Ashmoh' cement, 500 t/y, using ball mill of 1.52 m + 1.52 m, 3 tonne iron balls and a 25 kw electric motor as reported by the Regional Extension Centre, Chandra Sekhar Azad University for Agri. and Technology, Kanpur are Rs. 1,15,000 and Rs. 1,63,000, respectively. The cost of production of cement works out to Rs. 16.35/bag (50 kg.) (with the use of additive) or Rs. 14/- bag (without the use of any additive), respectively. The cost of mortar made of lime-pazzolana cement and sand varies between Rs. 61.50 to Rs. 77.50 per cm depending upon the ratio of ingredients, whereas the cost is Rs. 110/cm in the case of cement sand mortar of equal compressive strength.

Similarly, for the production of rice husk bricks, capital requirement is not high and all the equipment required is available locally. For a factory producing 5,000 bricks per day in two shifts, a capital investment of Rs. 40,000 and working capital of Rs. 60,000 per month are suggestad by Borthakur, et. al. (undated). The cost of production of rice husk worked out to be only Rs. 100/- thousand bricks, giving a net profit of Rs. 25/- per thousand bricks. Similarly in the case of rice husk ash bricks, the cost of production, with an investment of Rs. 1,20,000/-, works out to be Rs. 90/- per thousand bricks. These bricks can be manufactured profitably in the areas where burnt clay bricks are costly and husk is

available. These bricks provide good thermal insulation. As the weight of a building on the foundation is a significant design factor, use of rice husk bricks can save the cost of foundation.

For preparation of the boards, the substitute for timber, the total capital investment for a 5 t/d capacity rice husk board plant was estimated to be Rs. 15,25,000 with an average cost of production varying between Rs. 10-13/m^2 at 1976 base prices. The profit from one such plant is given in Table 8. Similarly, the total capital requirement for 10 t/d capacity plant producing hard boards and using sawdust as raw material was worked out to be Rs. 20 lakhs at 1975 base prices and the cost of production of 8 mm thick board was then estimated to be Rs. 374/t or Rs. 0.33/sq. ft. (Shukla, 1976). When coir wastes is used for producing corrugated roofing sheets, the total capital investment for a production capacity of 45 sheets/d (150 cm × 90 size cm) was estimated to be Rs. 1,10,000 at 1978 base prices.

TABLE 8 : **Profit from a 5 t/d capacity rice husk board plant (1976 prices)**

Amount of PF resin used	Production cost Rs./m^2	Annual production cost Rs × 10^3	Selling price Rs/m^2	Annual receipt Rs × 10^3	Profit Rs/y 10^3
8	10	1,400	15	2,100	700
10	12	1,650	16	2,440	590
12	13	1,900	17	2,380	480

Source : Shukla (1976).

The expansion joint fillers made from bagasse are very economical as they cost only 30% of the joint fillers available in market. (Chozar et. al. 1985). Similarly the cost of 1.5 m × 1 m size corrugated roofing sheet made from agro-industrial residue was reported to be Rs. 20/m^2 (Guha, et. al. undated).

In addition to the direct economic considerations, there is also the attractive proposition of using various agro-industrial residues as fuel for the production of different building materials. It is reported that paper and board production requires 12 kCal/cm^3, cellulose fibre : 70 kCal/cm^3, brick/refractory : 0.2 kCal/cm^3 and cement requires 0.8 kCal/cm^3 energy (Chakravarty, 1985). It takes 25 tonnes of coal to make 100 tonnes of cement in an average portland cement manufacturing unit. In such cases, the use of residues of certain crops which have high calorific value (above 17 MJ/kg except for maize stalks, rice husk and rice straw) could be advocated. They can be directly recycled or can be converted into combustible fuel by briquetting, pyrolysis or incinerated for heat recovery through recuperation.

Besides, there is another economic perspective—that of environmental improvement which has a direct bearing on economic benefits and expenditure associated with handling, transportation and disposal of the above mentioned agro-industrial residues. The disposal cost alone of these materials is reported to be as high as Rs. 15-20/t. (Chakravarty, 1985)

Research and Development Strategies

The processes of recycle and the recovery of valuable building materials from different agro-industrial residues have already gained the attention of scientists, technologists and researchers, as evidenced by the above literature survey. Appropriate technologies have been well established at the laboratory and pilot plant level and can be readily taken up for large scale applications in appropriate economically beneficial situations.

However, despite considerable technological developments, their actual performance on utilisation front can be described as insignificant. Hence, there is substantial scope for qualitative and quantitative improvements in such technologies. Another aspect which needs the immediate attention of policy makers is the absence of incentives. This aspect should be considered in the light of pollution problems for which the country pays the cost in terms of reduced public health and lower productivity. Some important areas for research for the development of suitable substitutes are mentioned below :

(1) Data on the various residues are by no means comprehensive and there are large information

gaps on the availability and in some cases even the sources/usage of some of the residues/ wastes are unknown. There is an urgent need for compiling a national directory of residues. In this context, a computerized data bank is vital for storage, classification and retrieval of information. This would identify present and future needs. Moreover this system could also be used for collecting and spreading technical, scientific and managerial information about the utilisation patterns and potential. The research aspect of this proposition is the assessment of physico-chemical characteristics of individual agro-industrial residues.

(2) Development of suitable low cost machinery for processing of residues to produce building materials.

(3) Improvement in the economics of production and utilisation of such building materials, especially of those which are useful for construction of structures for dwellings/farm storage/ animal shelters.

(4) Utilisation of urban and rural wastes and animal refuse as building material rather than as land filling.

(5) Possibilities of using some of the agro-industrial residues as source of cheap fuel in the manufacture of building materials such as cement, bricks etc.

(6) Preparing up-to-date feasibility reports on the technologies for use by entrepreneurs.

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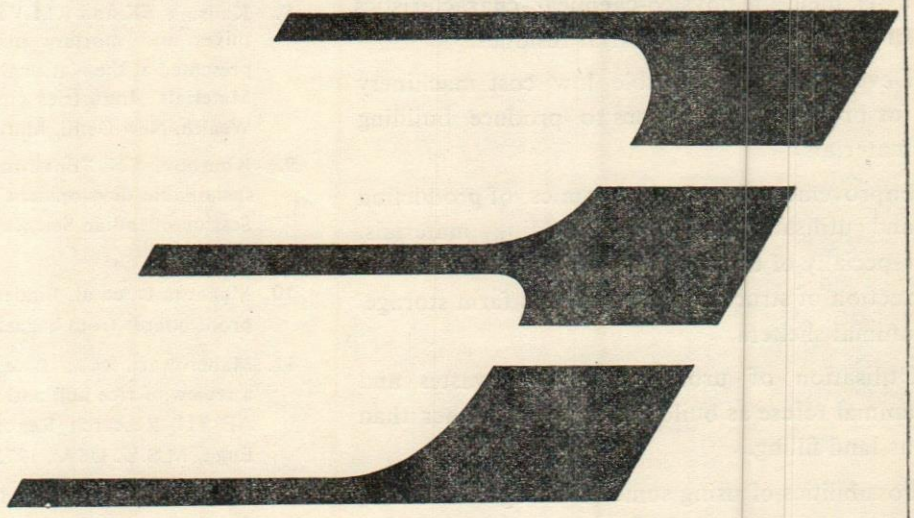

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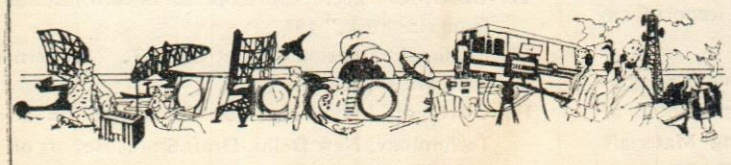

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Standard Operating Procedure for Construction of Bunk Houses

Y. Ramesh Babu
T. Suryanarayana
S.R. Gollapudi

In this article the authors propose a method by which construction costs as well as construction time can be considerably reduced through pre-fabricating of structures that go into the making of bunk houses. The result is an increase in productivity in an important section of construction activity.

Y. Ramesh Babu is Lecturer in the College of Engineering, Gitam, Visakhapatnam. T. Suryanarayana is Deputy General Manager, Hindustan Shipyard Ltd. and S.R. Gollapudi is Deputy General Manager of Bharat Heavy Plates and Vessels Ltd. Visakhapatnam.

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Introduction

Bunk house building is essentially a customer oriented industry; conforming to the stipulated delivery dates and the price per unit are therefore vital factors. As cost and time are inter-related, a fabrication industry which builds bunk houses with shorter construction schedules will succeed in maintaining prices at reasonably satisfactory levels. Thus the cycle time of construction has an impact on the economic viability of the fabrication industry.

The conventional method of sequential fabrication viz., item by item erection, alignment and assembly does not offer much scope for reducing cycle time. But if we adopt a system of sub-assembly and jigs for the steel structures in parallel, cycle time is reduced. What this involves is a re-desgin of the working processes and switchover to another standard operating procedure.

This study was carried out with the cooperation of a number of local fabrication industries. A simplified manufacturing process has been formulated on the basis of this study.

Conventional Method of Fabrication and its Disadvantages

Fabrication of Steel Structures

As far as the steel work of the bunk house is concerned, it is being erected item by item, aligned and then welded to fabricate the final assembly.

This is a very difficult job especially at great heights, besides being more time consuming.

Unless skilled people are available, it is very difficult to check the alignment of loose items. Finally, this type of fabrication is not advantageous for mass production.

Closing of outer shell

After the steel structure has been assembled, wooden liners in the MS angle framework and rubber gasketing are provided. Finally the aluminium sheeting is fixed.

Outfit work

The outfitting work involves different trades viz., sheet metal, J&C, Electrical etc. and their activities follow in a parallel sequence, with inter-dependencies among them.

Concept of Sub-Assemblies & Jigs

Mini Sub-assemblies

Mini sub-assemblies mean the assembly of elements into a built up section. In the bunk houses, a number of fabricated sections in the form of strong beams and girders can be taken up as mini sub-assemblies.

Sub-assembly of a unit signifies an independent physical sub-unit of the steel structure. The sub-assemblies of a unit can be fabricated simultaneously. This also provides scope for downhand welding which in turn helps reduce the total welding time of the unit. Finally sub-assembling promotes the optimum deployment of welders and welding machines.

Quality checks through jigs

Quality checks of individual sub-assemblies can be done through jigs for ensuring perfect alignment and for checking the overall dimensions of the unit. If any inaccuracy is noticed, it can be rectified at the stage of sub-assembling itself.

Steps to be initiated for implementing Sub-assemblies/ Jigs

Identification of Mini & Sub-assemblies

This has to be done after taking into account various factors like maximum scope for downhand welding, convenience in final assembly, development of resources etc.

The following 6 sub-assemblies go towards forming the final unit :

I Base structure
II Roof structure
III Front MS Angle framework
IV Rear MS Angle framework
V Left hand side MS Angle framework
VI Right hand side MS Angle framework

The sequence of operations of each sub-assembly and the final assembly along with the procedural details are given in Annexures I & II. Annexures III & IV give an idea of sub-assemblies IV & V.

It is suggested that the mini sub-assemblies which are identified with asterisk (*) mark in the Annexure-II are to be made ready prior to the commencement of the sub-assemblies in mass production.

Numbering of Elements

The numbering of elements of a structural unit in a working drawing should be sub-assembly-wise; this will differ from the procedure when the entire structure is taken as a unit. Such a numbering process will facilitate the easy identification of the sub-assembly-wise elements. The following codification can be adopted according to the requirements : the first digit indicates the sub-assembly number, the second and third digits indicate the plate numbers, the 4th, 5th and 6th digits indicate the section numbers and the last three digits indicate the brackets lifting/dragging numbers.

Scheduling of mini/sub-assemblies and unit making

The scheduling at the cutting and fabrication shops should be sub-assembly-wise. There should be close monitoring of the despatch of the materials i.e., elements in their sequential order from cutting area to fabrication area to ensure the growth of the structure uninterruptedly.

Design of Jigs

Standard jigs for the fabricatian of :

(i) base structure
(ii) front MS angle framework
(iii) rear MS angle framework
(iv) left & right hand side MS angle frameworks, and
(v) roof structure framework are designed.

This facilitates quick mass production, ensures dimensional accuracy and avoids repetitive making of the jobs.

In the design of jigs, it is suggested that one or two MS plates (preferably pitted) may be used as the ground support on which the guide bars of the jig will be welded according to the loft markings. The jigs have been designed keeping in view factors such as its suitability for mass production, standard size of the bunk houses and the grillage work involved in fabrication.

The frameworks can initially be tack welded when the jig is being used and can later be full welded separately after the jig is withdrawn.

Fabrication of Base Structure

It is advantageous to fabricate the section of the base structure (grillage) in mass production using the standard jig. The skin of the base structure can be laid down after withdrawing the framework from the jig and then full welding can be completed as per sequence of operations indicated in Annexure-II.

Fabrication of Front & Rear MS angle framework

For the mass fabrication of the front and rear MS angle frameworks, there is a convenient jig arrangement along with the sub-assembly. The sequence of operations involved along with the elements required are indicated in Annexure-II.

Fabrication of Left & Right hand side MS frameworks

A common sub-assembly along with the jig arrangement has been made for the fabrication of both the left and right hand side MS angle frameworks.

Fabrication of Roof Structure

To facilitate easy fabrication, the roof structure has been divided into 4 mini-sub-assemblies viz., (i) front (half) frame; (ii) rear (half) frame: (iii) T-bar; and (iv) skin.

Both the front and rear frames are to be fabricated in the jig (shown in Annexure IV) and the final sub-assembly is to be carried out in the camber skid laying the skin first on the skid. A simple sketch of the suitable camber skin has been shown in Annxure-V.

It is also suggested that a loft template be made to ensure perfect cambering of the roof structure.

Final Assembly of Steel Structure

The MS angle frameworks of all the four sides are to be erected on the base structure using plumb and spirit level and then the roof structure sub-assembly is aligned and tacked by giving temporary vertical supports to the T-bar of the roof. The sequence of operations are described in Annexure-II.

The closing of the outer shell by aluminium sheet and other outfitting works can be carried out as per existing system of construction.

ANNEXURE—I **Sub-Assembly-Wise Elements for Bunk House**

Sub assembly No.	Description	Elements		
		Plating	Sections	Brackets/ Lifting/ Dragging
1.	Base structure	1 to 6	601-605 606-613	38-61 60-69 671-674
2.	Roof structure	7 to 15	633-642 624-631 70, 71	B5 (8 Nos.) 36-37
3.	Front MS Angle Framework		658-661 614-615 649-653 620-621 675-680 666 20-23	B 1 (4 Nos.) B 4 (24 Nos.)
4.	Rear MS Angle Framework		662-665 654-657 622-623 681-685 25	B 1 (4 Nos.) B 4 (32 Nos.)
5.	Left hand side MS Angle Framework		643-644 645-646 616-617	B 4 (10 Nos.) B 1 (2 Nos.)
6.	Right hand side MS Angle Framework		-do-	-do-

ANNEXURE—II **Standard Operating Procedure for Fabrication of Bunk Houses**

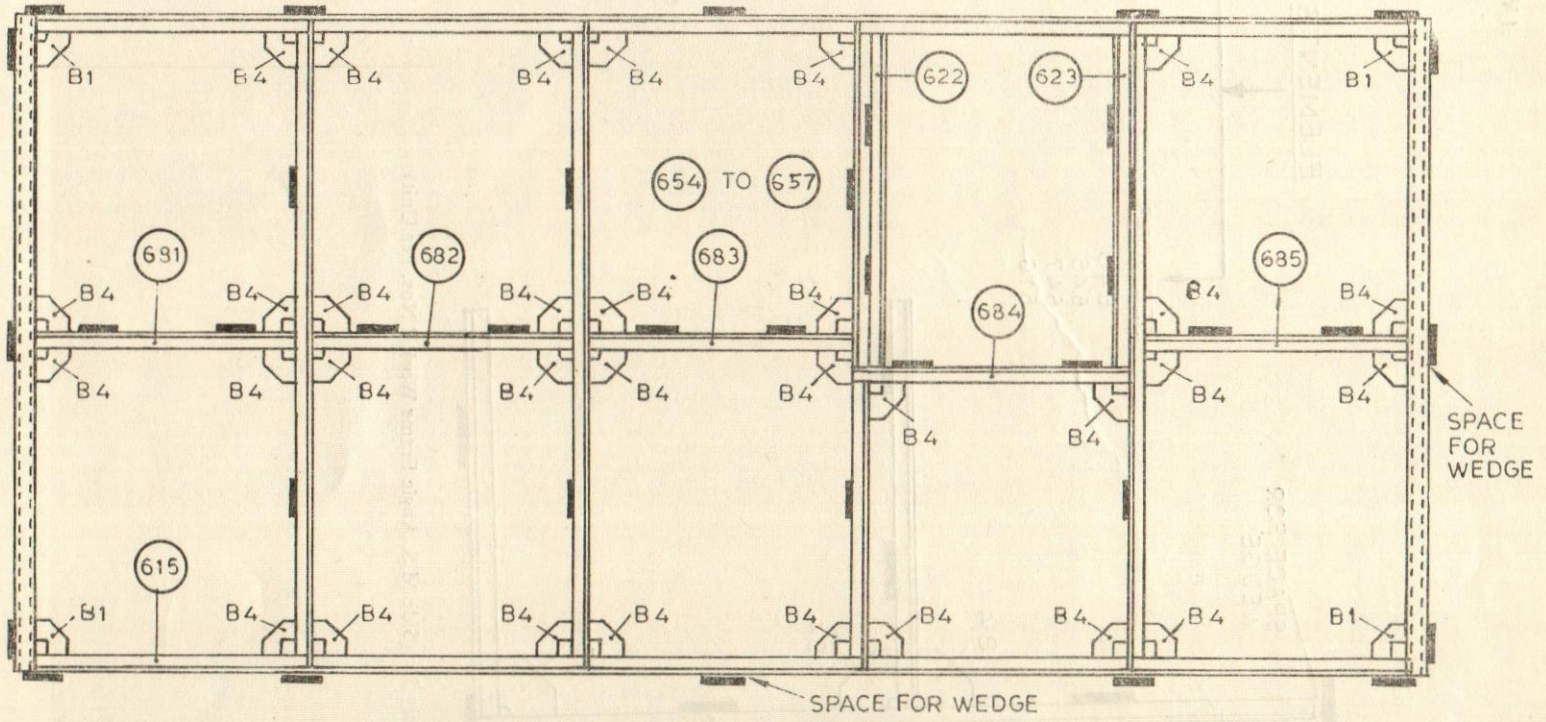
Activity Number	Description	Predecessor	Elements	
			Sections	Plating/ Bkts/Lifting eyes
1	2	3	4	5
	Sub-assembly—I			
101	Lay I-bars in the jig	—	601-605	
102	Lay-U-channels in the jig	101	606-613	
103	Lay Flat bars in the jig	102	26-35	
104	Align & tack them	103	—	
105	Weld lifting & dragging hooks	104	38-61* 66-69* 671-674*	
106	Withdraw the framework from the jig	105	—	
107	Lay the skin* on the framework	106	—	1—6*
108	Tack weld	107	—	
109	Turn the assembly	108	—	
110	Complete full welding	109	—	
	Sub-assembly-II			
201	Lay skin* on the camber skid	—	—	7—15*
202	Loft markings	201		
203	Lay T-bar	202	632 A)* 632 B)	
204	Lay both the front half & rear half frameworks*	203	624-631 633-642	
205	Lay end flat bars	204	70-71 36-37	
206	Align & tack	205		
207	Complete staggered welding to the skin	206		
208	Weld the brackets	207		35—8 Nos.
209	Complete full welding	208		
	Sub-assembly-III			
301	Lay square section pillars* in the jig shown in Annexure V	—	658-661	
302	Lay MS angles in the jig	301	614,615 649,653 620,621 675,676 678,679 650,666	

(Contd.)

ANNEXURE—II Contd..

1	2	3	4	5
303	Align all the angles in the jig	302		
304	Tack weld	303		
305	Lay brackets and tack weld	304		20--23 B 1 (4 Nos.) B 4 (24 Nos.)
306	Remove the framework from jig	305		
307	Full weld	306		
	Sub-assembly-IV			
401	Lay square section pillars* in the jig shown in Annexure V		662-665	
402	Lay all the MS angles	401	654-657 622-623 681-685	
403	Align & tack	402		
404	Lay brackets & tack weld	403		25 B 1 (4 Nos.) B 4 (32 Nos.)
405	Remove frame from jigs	404		
406	Complete full welding	405		
	Sub-assembly—V			
501	Lay MS angles in the jig		616,643 645,646	
502	Align & tack weld	501		
503	Lay the brackets and tack weld	502		
504	Remove from jig & full weld	503		
	Sub-assembly—VI			
601 to 604	Same as above		617,644 647,648	
	Final assembly			
701	Lay sub-assembly 1	110		
702	Erect sub-assemblies 3,4,5, & 6 by giving supports	307,406 504,604		
703	Align to plumb & spirit level & tack weld			
704	Complete full welding			
705	Lay sub-assembly 2 (roof structure) by giving temporary supports below T-bar			
706	Align & tack weld			
707	Align brackets & tack weld			B 1 (4 Nos.) B 3 (8 Nos.)
708	Complete full welding			B 4 (4 Nos.)

* indicates mini-sub-assemblies.

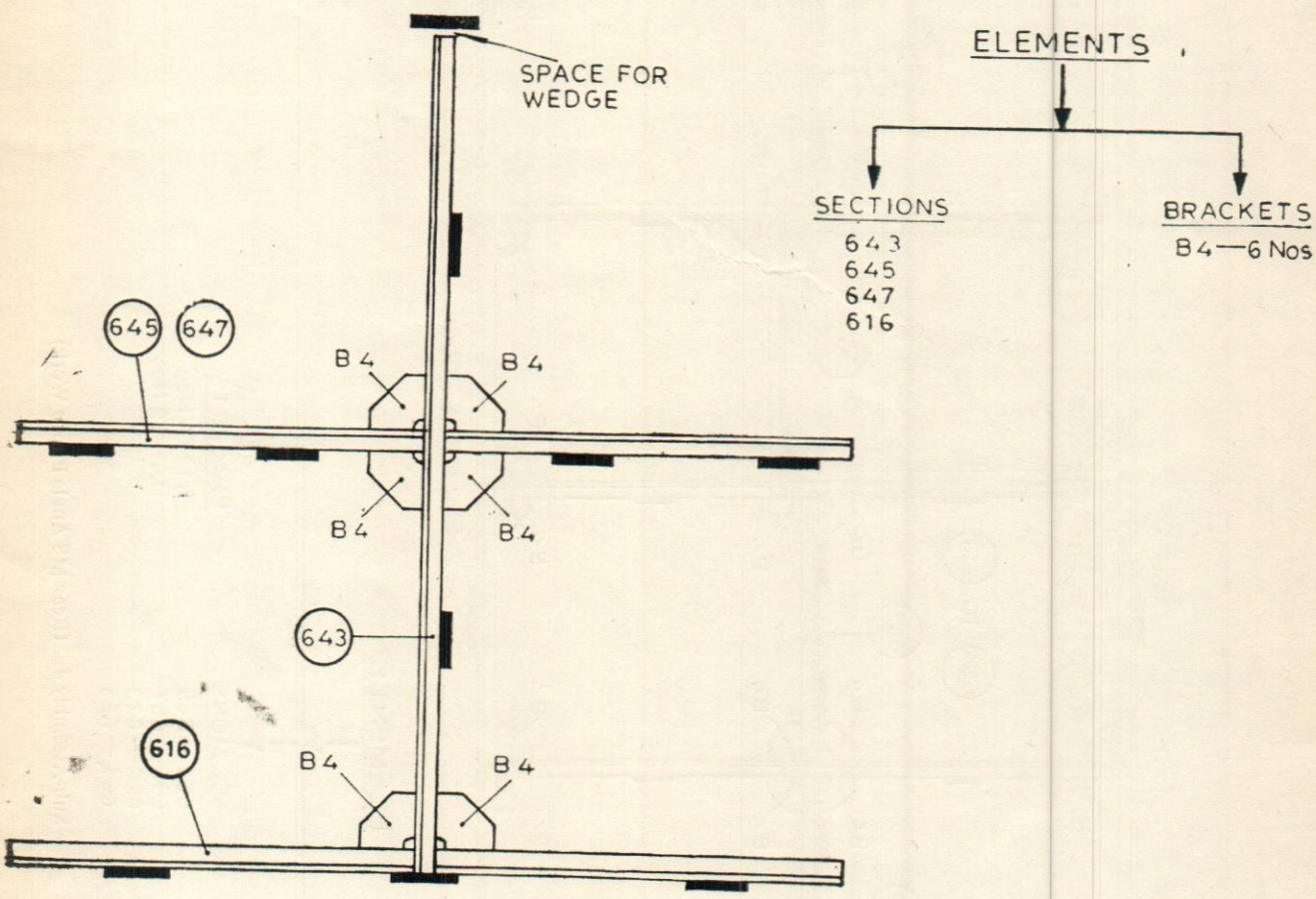


ELEMENTS

PLATES	SECTIONS	BRACKETS
25	662—665	B1—4 Nos
	654—657	B4—32 Nos
	622—623	
	681—685	

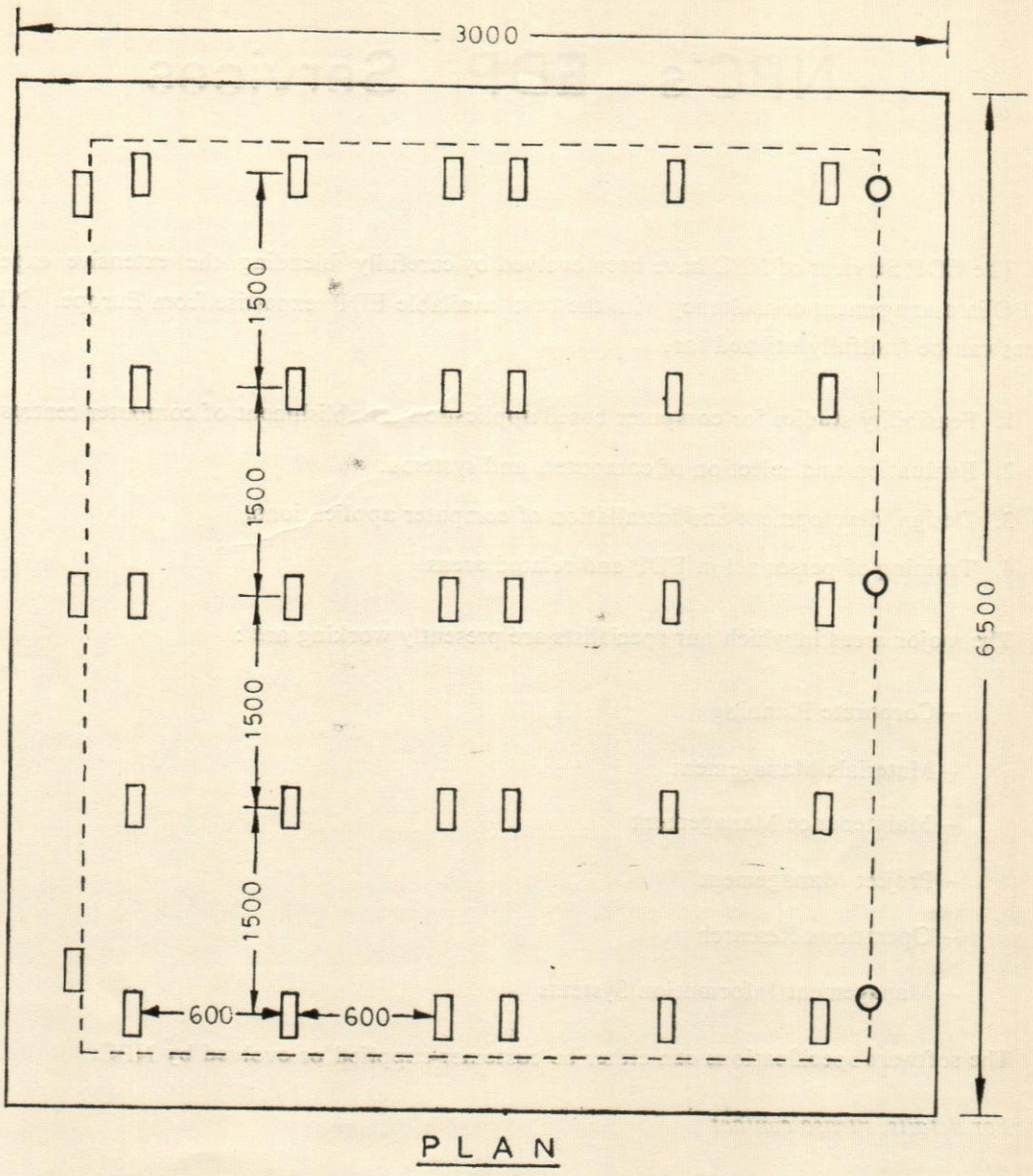
Sub-Assembly 4. (Rear MS Angle Frame Work)

ANNEXURE-IV



Sub-Assembly 5. (Side M.S. Angle Frame Work 2 Nos. Per Unit)

ANNEXURE-V



Camber BK1O Arrangement for Fabrication of Roof Structure

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Inventory Productivity : A World Business View

Nesa L'abbe Wu

This article discusses the production and inventory control through the US Just in Case System, the Japanese Just in Time System and the Optimised Production Technology Way.

N.L. Wu is Professor of Operations Research & Information Systems at the Eastern Michigan University, Ypsilanti, Michigan-48197.

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U.S. Inventory and Production State

Economic State of Inventories

Businesses have been attempting to reduce inventory pile-ups over the past five years. The wild fluctuations in final sales over the past few years have made this very difficult, however.

Manufacturers, who hold nearly half of all inventories, have the hardest time reducing stocks, because sales have been stagnating recently and inventories have been piling up at the factories. Capital goods producers have been especially hard hit as imports continue to grab most new businesses. Retailers and distributors have been living hand to mouth with their inventory because of only mediocre sales and quick delivery times promised by domestic suppliers. Car dealers, surprisingly, are an exception to this.

Manufacturers have the most difficult task in controlling inventories, but they have been leading the way in inventory control by making use of new inventory control systems in an environment of stiff competition, high interest rates, and low inflation rates, an environment that doesn't encourage high stock levels. Because forecasts do not look for any significant changes in interest rates or inflation and because there is still a lot of excess capacity around, further inventory reductions are going to be necessary. While the computer industry has been especially hard hit by excess inventory gluts, they and many other high-tech companies could take a lesson in inventory control from the traditional manufacturers.

Given the fast-changing technology associated with

the computer industry, many high-tech managers have been reluctant to admit that their current inventories have either been out-classed, making them overvalued, or simply been rendered obsolete. This scenario has made the computer industry notorious for overvalued inventories. It has been recently bringing high-tech managers and their accountants under increased pressure to make more realistic valuations of their stocks.

Reducing Inventories via Purchasing

According to Norman Kobert, a Florida-based management consultant, there are a number of points to consider when hedging against stockouts. (Kobert, 1985; Kobert, 1984). All stockouts are not equal in their effect on production and the potential cost benefit of inventory hedging must be considered before blindly reducing all stocks. Three of Kobert's points with brief explanations follow:

1. Aging of commitments by level of requirement : All items are not required at the same time in sequencing of stock commitments. If the overall leadtime for an operation is X-weeks, then individual items are required at X, X-1, X-2, X-3, weeks, etc. The closer delivery can be coordinated to the demand week, the less actual inventory will be on hand.
2. Pipelining : Allows scheduler to gamble on stocks which haven't actually arrived yet. It requires close monitoring of suppliers and subcontractors, as well as internal departmental scheduling. This technique can especially be applied to items of low criticality, because if one is wrong in his expectations, he can easily recover.
3. Make or buy decisions to reduce hedge inventories against irregular demands. One way to account for demand variability other than inventory investment is to consider outside procurement during peak demand times. This technique can sometimes be adopted as a regular operating policy even during non-peak demand periods. Many U.S. companies have been relying more and more on the outsourcing of parts. Obviously, outside purchase during peak demand cuts down inventory carrying costs, but those cost savings must be weighed against the cost of outside procurement. Many U.S. companies are finding that they can actually buy an item overseas cheaper than they can make it, as well as receive a higher quality item in many cases. This is true even after considering extra shipping costs and duties. Outsourcing can be applied to personnel as well as inventories.

As already mentioned, cost must be considered when deciding at what level to carry safety stocks for individual items. Safety stocks can be either a real hedge or an excessive cost, depending on the item under consideration.

According to Kobert, it might be a good idea to define three degrees of criticality in regards to safety stocks for which he establishes the following reaction rules:

* Minor items whose stockout would cause little inconvenience and could easily be overcome : Any safety stock for this type of item would be a needless expense.
* Major items whose stockout would cause expediting inconvenience, and additional costs due to minor production delays, extra shipping and handling charges. etc : Emergency quantities of these types of stocks could be obtained locally at a premium. The extent of the extra costs should determine the size of stock on these types of items.
* Critical items whose stockout would cause major delays in shipment and/or production with excessive costs resulting from both the effects of the stockout and the efforts to overcome the situation : Emergency quantities of these items are not available locally at any cost. Safety stocks would be called for with these types of items, but reasonableness should be considered in determining their size.

In order to successfully implement materials requirement planning (MRP), it would be wise for a company to rely heavily on its purchasing department. According to John P. Flanegan, of the Florida-based

consulting firm Anderson Associates, "...MRP systems are not working anywhere near as well as the computer manufacturers would lead you to believe. And the very best systems all have one thing in common : the people using them don't believe their reports." He contends that in order to have MRP systems that work, it is necessary to have valid systems contracts in force.

MRP calculations and forecasts in and of themselves are not faulty; but they fail to consider the imprecise relationship that usually exists between buyers and sellers. A system contract helps establish a solid working relationship between a company and its supplier and allows production people to talk to other production people in a candid manner not usually considered acceptable in standard business operations. This is almost identical to the buyer-supplier relationship which exists in the just-in-time inventory method as practiced in Japan. The difference lies in the fact that in Japan a supplier is so close that it is almost part of the company which it supplies.

The Japanese Just-in-Time System

Just-in-Time Production (the KANBAN system)

A just-in-time production system is an integrated manufacturing and supply system aimed at producing the highest quality, and, at the same time, the lowest cost products through the elimination of waste. Waste here, is, defined as anything which does not add value to the product; it is anything other than the minimum amount of materials, equipment or workers. The waste incurred in the production process includes overproduction, wasted time spent at machines, losses in the transportation of parts and goods, waste created during processing of goods, wasted time resulting from taking inventory, waste of motion, and waste in the form of defective units.

A just-in-time system is one that integrates and controls the entire process. It specifies what should be stored, moved, operated on or inspected and precisely when it should be done. Just-in-time production continuously strives to improve production processes and methods. It attempts to reduce, and ultimateiy to eliminate, inventories because high inventories tend to cover up production problems.

One of the most popular just-in-time systems is Toyota's KANBAN system. It was developed by Mr. Ohno who felt that overproduction was the central evil which led to waste in other areas. To eliminate the problem of waste, Ohno devised a production system based on two main structural features : the just-in-time concept and automation. The just-in-time concept implies that the exact number of required units is brought to each successive stage of production at the appropriate time. This meant a reversal of the normal thinking process. Ordinarily, units are transported to the next production stage, as soon as they are ready. Ohno, however reversed this. Now, each stage is required to go back to the previous stage to pick up the exact number of units needed. This results in a significant decline in inventory levels.

Just-in-time production necessitates certain changes in the factory and the way in which it is managed. Changes must occur in supplier selection, in plant layout, in production equipment, in scheduling methods, in materials handling methods, in maintenance control, in quality control, and in worker training.

The Japanese have worked very hard to overcome a variety of problems inherent to any production system, and especially to the just-in-time system. Some of these problems are : stockout and component shortages, high setup costs, idle resources and capacity imbalances, worker resistance and motivation, vendor reliability, inventory imbalances, quality losses, maintenance downtime, and all sorts of productivity losses.

The tools used by the Japanese to combat these problems and to make just-in-time possible are numerous. A stable monthly master production schedule, stable bill of materials, small end item lot sizes, high volume production, focussed factories and group technology avoid stockouts and component shortages. Single digit setup time reduces high setup costs. Company Unions that allow for a flexible workforce and also a careful monthly capacity

planning reduce idle resources and capacity imbalances. Worker resistance is minimized because, together with the foreman, the workers act as middle management and enjoy lifetime employment. Subcontract networks ensure vendor reliability, and quality circles reduce quality losses. Maintenance downtime is combatted through the introduction of preventive maintenance, quick maintenance response, and a variety of visual displays. Productivity is constantly improved because of continuous improvement of the production system through automation and because of workforce participation.

Just-In-Time Purchasing

The just-in-time system goes beyond the shop floor. It also includes shipments of purchased goods that start with the just-in-time demand for materials and parts. Since the timing and quantity of parts are best and most accurately known by final assembly, this is where the just-in-time system will start. Final assembly goes to its "suppliers" and brings back only the necessary parts at the required time. "Suppliers" produce exactly the kinds and quantity of parts necessary to replace those taken by the assembly line. To "produce" these parts, "suppliers" go to their own "suppliers" and get only the necessary parts. Thus, the entire chain reacts very quickly to the actual assembly, and just-in-time production is achieved with minimum inventory.

Realize, though, that this system does not call for suppliers to carry large inventories. As a matter of fact, the goal is for the suppliers to carry less inventory than traditional practice. They stay in tune with the production rates of their customers.

Reflections on Just-In-Time Purchasing and Production in U.S.A.

The just-in-time inventory and manufacturing system as practiced in Japan has been experiencing a growing increase in popularity among American manufacturers. At the vanguard of the US's JIT movement are companies such as John Deere, IBM, Motorola. FMC, Eastman Kodak, Hewlett Packard, Apple and GM, to name a few.

What these companies have been finding is that JIT does not always result in zero inventory as is commonly believed. In practice, the Japanese operate with the lowest practical inventory base, while most US companies continue to work with excessive inventories. This leads to the hidden benefit of JIT, and arguably its best feature : the improvement of quality.

In most U.S. companies extra inventories are carried because eneryone wants to guard against bringing the production line to a halt. In Japan, workers know that if they blow a product line there's a good chance they will shut down production; mistakes show up immediately. Carrying zero or near zero inventories forces you to correct mistakes as they happen and to correct the events that caused the mistakes.

At the first work-shop at the Association for Manufacturing Excellence (AME), made up of former members of the Repetitive Manufacturing Group of APICS, the attendees got to see first-hand how the Japanese handle JIT in a tour of NOK's engine seal plant in LaGrange, Georgia. While there was little inventory evident, what impressed the American executives most was the well-defined and standardized routines employed throughout the manufacturing process. NOK management seemed intent on controlling as much as possible any process variables which could have an adverse effect on product quality.

Reduced inventories and improved quality are the two biggest advantages of JIT, but there are two others as well. First of all, JIT forces the manufacturer to choose fewer suppliers, in contrast to where a company has many suppliers, many of whom were adversaries. Also, JIT can really cut down inspection time. According to Gary Flack, a manufacturing consultant at Hewlett-Packard, incoming inspection of some parts has been totally eliminated at various Hewlett-Packard locations, an obvious time and money saving effect. The auto industry serves as a good example of JIT's benefits. GM has appoximately ten-fold the number of vendors that Toyota has, whereas Toyota can build a car of arguably better quality for

substantially less money, even including shipping costs.

It was mentioned earlier that a system contract approach fits nicely with JIT. This is specifically true as it applies to vendor selection. In order for the Japanese to have so few suppliers, actual vendor selection processes are vitally critical. In JIT as practiced in Japan, there is a very close buyer-supplier relationship to the point where the supplier is practically a part of the organization. There are obvious benefits to this, yet there are structural differences between Japanese and US business which do not make it practical for firms to be quite as close in the American environment.

Communication also necessarily improves with JIT, both within the company and with the suppliers. In order for JIT to work effectively, industrial engineers, process engineers, product engineers, buyers, material handlers, and logistics personnel must all work together and keep each other informed as to what they are doing and as to any problems they are having or may foresee from their end. Also, the vendors must be told as soon as possible that a buyer is going to a JIT system. The vendors have to be educated by purchasing personnel as to exactly what is expected of them. Those that cannot fit should be dumped as soon as possible.

As mentioned above, there are many cultural differences between Japan and America. One place this manifests itself is among the labor force. On one hand, the Japanese worker tends to place more emphasis on his job and feels part of a "family" dedicated to one purpose : increased productivity and profit. On the other hand, the American worker has a tendency to look at his job as a means to an end and is concerned with doing what has to be done to keep his job. These cultural differences extend to management as well. JIT's manufacturing system often entails that departments and workers sit idle for periods of time rather than producing work-in-process inventory that piles up behind bottlenecks. Many American managers have had a hard time accepting the fact that idle workers are okay sometimes. Also in a JIT system, instead of sitting idle, sometimes workers from one area could be shifted to help out in a bottleneck area. The problem with this is that, unfortunately, union regulations usually do not allow "job-sharing".

Optimized Production Technology (OPT)

The OPT System

Another revolutionary manufacturing system gaining some popularity in U.S.A. and Western European countries is optimized production technology (OPT), developed by Moshe Eliyahu Goldratt and being marketed by Creative Ouput, Inc. (Fox, 1983; Goldratt, 1984). OPT could most succinctly be described as a procedure to schedule work centers with finite loading, via a two-part package consisting of a simulated manufacturing program and a set of radical shop-floor management rules which enable a company to increase output while lowering inventories and expenses.

The simulated manufacturing program in OPT has four basic modules :

1. Buildnet—a network of all the plant's raw materials, resources, products, and customer orders.
2. Serve—module that locates bottlenecks in the system by running load profiles for each machine and resource.
3. Split—module that divides the network into two parts. The critical portion which contains the bottlenecks, and the non critical portions.
4. Brain—proprietary set of algorithms used to schedule the workers, machines, or tools at the bottleneck operations.

Figure 1 illustrates an OPT network-manufacturing model. The Serve module has been run and has identified Machine Center A as a bottleneck. The Split module would then divide the network into bottleneck and non-bottleneck segments. The Brain module then uses algorithms to determine job sequence as well as process and transfer batch sizes. Machine Center A then, would be scheduled at 100% utilization with enough inventory stationed by it to ensure there would always be enough work to do. Of course, the subassemblies would be able to handle the output from

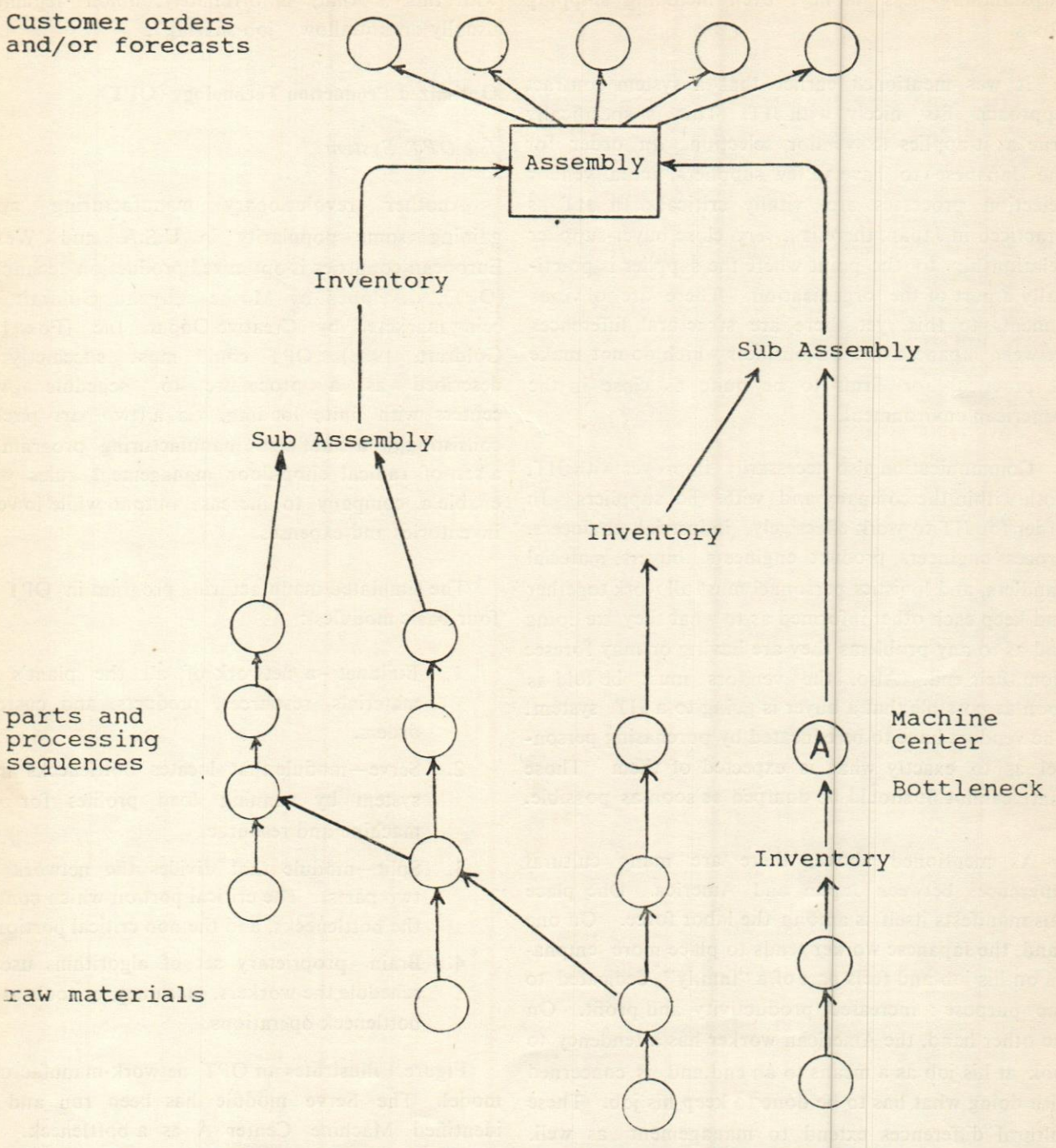

Fig. 1 : OPT Network Manufacturing Model (Reprinted from Creative Output Inc. Literature)

Machine Center A without delay beacuse they are not bottlenecks, but extra inventories could be placed at these areas to ensure that the product can be rushed through to finished inventory as soon as it comes off Machine Center A. It should be added that the master schedule, considering the given raw materials and customer orders, would have been done by the Buildnet module.

OPT, in essence, forces production managers and workers alike to coordinate their work and the flow of parts through a system with one consideration:

"bottlenecks" are what ultimately constrain manufacturing output. By identifying bottlenecks in advance and then scheduling all manufacturing activities productivity can be substantially increased. It is the bottlenecks and the demand for parts that determine what we can produce and when we can produce it.

But, as mentioned above, OPT is a two-part package. The manufacturing simulation is just a tool which can be used by managers to see where bottlenecks occur and how to schedule around them. The other part of OPT, and the more important part, is the actual management philosophy, which goes against the traditional philosophy which says that productivity is the highest when all workers and machines are going full tilt at all times. Traditional accounting methods hold that, from a cost standpoint, it is always better to run a batch of 1,000 parts through a machine than it is to run 100 parts. But if 900 parts are just sitting idle in inventory, then that is not really desirable.

OPT Scheduling Characteristics

Following are the basic precepts of OPT scheduling as drawn from *Inventories and Production magazine* (Fox, 1983) :

1. The utilization of a non-bottleneck resource is not determined by its own potential, but by some other constraint in the system—it cannot work at full capacity because it is dependent on output from another work situation.
2. Activating a resource is not the same as utilizing that resource—a non-bottleneck work center has excess capacity and should not be used 100% of the time, but only for the time it is needed.
3. An hour lost at a bottleneck is an hour lost by the entire system—bottlenecks are a systems limiting factor.
4. An hour saved at a non-bottleneck is a mirage —for the same reasons as in 3 above.
5. A transfer batch need not and sometimes should not equal the process batch.
6. The process batch size should be a variable—batch sizes should be dependent upon processes and will change throughout the system.
7. Capacity and priority need be considered simultaneously and not sequentially; output of the entire system must be considered when prioritizing jobs at a work center.
8. Murphy is not an unknown and its damage can be isolated and minimized—potential problems can be identified in advance and appropriate actions taken.
9. Plant capacity should not be balanced—a balanced plant is theoretically impossible, unless output at each stage is always in the same exact cycle.
10. The sum of local optimums is not equal to the optimum of the whole—as shown, optimizing throughout at each work center would be suboptimization on the whole because of bottlenecks; in order to optimize the entire system, it is necessary to suboptimize some work stations.

Summary of OPT Productivity Rules

OPT suggests two sets of productivity rules: one set for non-bottleneck machines and another set for bottleneck machines. Some of these basic rules are:

Non-Bottleneck Machines:

1. Reduction in batch size decreases in-process inventory.
2. Average rate of production is defined by the rate that the bottleneck machines can absorb the work.
3. Always provide work for bottleneck machines.

Bottleneck Machines :

1. Rate of material released into the system is defined by the bottleneck machines.
2. Increase batch size, decrease setups, increase productive time at bottleneck machines.
3. Download bottleneck machines.
4. Perform QC on parts entering bottleneck machines.

5. Have a dedicated set of people for bottleneck machines.
6. Improve processing at bottleneck machines.

Similarities and Differences between OPT and JIT

As can be seen, OPT is in many aspects similar to JIT. Both systems have as a basic premise the idea of running perceived bottlenecks at 100% capacity and, by doing so, increasing productivity and decreasing inventory to its lowest practical level. Both philosophies also ignore idle resources—they believe it is better to have an unused machine or worker as opposed to piling up unused inventories. Because of this last philosophy, both have had some problems being accepted by the more traditional managers as it goes against what they've believed all their lives. It might be noted, however, that both are gaining in acceptance among U.S. companies.

The basic difference between OPT and JIT lies in the simulated manufacturing program that is part of OPT. This program allows OPT to simulate a plant's production accurately enough to allow managers to identify bottlenecks and problem areas in advance. This is a definite advantage over JIT, which tends to correct problems in production systems after they occur. Also, while JIT is best suited for a repetitive manufacturing environment, OPT is best suited for a job shop situation, such as builders of machines, locomotives, etc., although there is no reason OPT could not be used in a repetitive manufacturing setting.

Concluding Remarks

American industry has the means available to improve efficiency, especially through the use of systems such as JIT and OPT. Both systems have proven very effective for those who have adopted them. Also, to wholly embrace JIT might be impractical because of the inherent cultural differences. Still, the main roadblock to instituting a new production philosophy such as JIT and OPT remains the management acceptance. To have idle capacity is not easily digested because everything Ameriean management ever learned about manufacturing was that full capacity use was the thing to do. The best way to convince any manager is the bottom line, and as more companies have success with OPT and JIT, we will see more changes in opinions from managers. It is believed that OPT is slightly superior, mainly because it projects problems in advance as opposed to the more management by exception approach of JIT.

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Joint Ordering Policy Based on Least Total Cost

R.P. Gupta

In this article the author develops a joint ordering policy for Materials Requirement Planning System based on least total cost per period. The requirements for different items are grouped for various periods so that the total costs are least per period.

R.P. Gupta is in the Department of Commerce and Business Management, Punjab University, Chandigarh.

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Introduction

The concept of joint ordering has not been extended adequate attention by researchers for Material Requirements Planning (MRP) Systems. Callarman and Whybark (1981) has described and compared three procedures (Least Unit Cost, Least Period Cost, and Mclarens' Order Moment) for Materials Requirement Planning Systems. Gupta (1985, 1986) has developed the Least Unit Cost Method, McLaren's Order Moment Methods for MRP Systems with several all units discounts. Here the concept of joint ordering policy is developed for Materials Requirement Planning System using Least Total Cost per period approach. The lowest of ordering and carrying cost per period is evaluated for joint ordering policy. The joint orders for various products are placed for various periods. The quantities of those periods requirement for grouped items are selected which have the lowest carrying and ordering cost per period.

Least Cost per period Method For Joint Ordering Policy

Let R_{ij} be the requirement of ith item during j^{th} period, $i = 1, 2, 3 \ldots n$ are the number of items, which are supplied by a supplier, $j = 1, 2, 3 \ldots n$ are the periods in the planning horizon.

Define :

C_o = Ordering Cost per order

C_e = Carrying Cost per period (percentage)

P_i = Unit Cost of the ith item

TABLE 1 **Requirements of Products : Period wise**

Periods/ Products	1	2	3	..	j	..	n
1	R_{11}	R_{12}	R_{13}	..	R_{1j}	..	R_{1n}
2	R_{21}	R_{22}	R_{23}	..	R_{2j}	..	R_{2n}
3	R_{31}	R_{32}	K_{33}	..	R_{3j}	..	R_{3n}
—	—	—	—	—	—	—	—
m	R_{m1}	R_{m2}	R_{m3}	..	R_{mj}		R_{mn}
Total	$\sum_{i=1}^{m} R_{i1}$	$\sum_{i=1}^{m} R_{i2}$	$\sum_{i=1}^{m} R_{i3}$		$\sum_{i=1}^{m} R_{ij}$		$\sum_{i=1}^{m} R_{in}$

The total cost per period is computed for ordered quantities equal to whole number of periods' requirement for all the m items which are supplied by a single supplier. Here it is assumed that those units which arrive in the period, in which these are used, incur no carrying cost. $TCPP_j$ is the total cost per period when j periods requirements joint order is placed for all m items supplied by the supplier, where $j = 1,2 \ldots n$. Now, choose that the total cost per period ($TCPP_1, TCPP_2 \ldots TCPP_n$) which is the minimum. Suppose this occurs for k periods ($TCPP_k$ is the minimum) requirements of all m products. After this, again for the remaining periods the procedure is repeated and a minimum cost is selected. This is continued till all periods of the planning horizon are exhausted.

Column one of Table 2 represents the order size for all m products for one period requirements, for two periods requirements for three periods requirements and so on up to n periods requirements. Column two shows the period of requirements. Column three shows the prices P_i ($i = 1,2, \ldots m$) of m products. Column four represents the inventory carried in units. When one period requirement is ordered for all m products, this is consumed during first period; therefore, no inventory is carried. When two periods requirements are ordered, the first periods' requirement is consumed during first period and second period's requirement of all m products is carried for first period so that it is consumed during second period, therefore no inventory is carried during second period. The total inventory carried is second period's requirement for one period. Similarly when three periods requirement of all m products is ordered, the first periods' requirement of all m product is consumed during first period, the second and third period requirement of all m products is carried during the first period. During the second period, second periods requirement is consumed and third periods requirement is carried. During the third period, this third periods' requirement is consumed. Therefore the inventory carried is :

$$\sum_{i=1}^{m} \sum_{j=2}^{3} R_{ij} + \sum_{i=1}^{m} R_{i3} \qquad (1)$$

Similarly when n periods requirement of all m products is ordered the inventory carried is :

$$\left[\sum_{i=1}^{m} \sum_{j=2}^{n} R_{ij} + \ldots \sum_{i=1}^{m} \sum_{j=3}^{n} R_{ij} + \ldots + \sum_{i=1}^{m} \sum_{j=k+1}^{n} R_{ij} + \ldots + \sum_{i=1}^{m} R_{in}\right] \qquad (2)$$

TABLE 2 **Proposed Method of Computing the Total Cost Per Period**

Order Size	Periods or Reqmt.	Price per Unit	Inventory Carried in Units	Inventory Carried in Rupees	Inventory Carrying Cost in Rupees	Total Cost Per Period TCPP
1	2	3	4	5	6	7
$\sum_{i=1}^{m} R_{i1}$	1	P_i $i=1, 2..m$	0	0	0	$\frac{C_o+O}{1}=C_o$ $=TCPP_1$
$\sum_{i=1}^{m}\sum_{j=1}^{2} R_{ij}$	2	P_i	$\sum_{i=1}^{m} R_{i2}$	$\sum_{i=1}^{m} P_i R_{i2}$	$C_c \sum_{i=1}^{m} P_i R_{i2}$	$\frac{C_o+C_c \sum_{i=1}^{m} P_i R_{i2}}{2}$ $=TCPP_2$
$\sum_{i=1}^{m}\sum_{j=1}^{3} R_{ij}$	3	P_i	$\sum_{i=1}^{m}[\sum_{j=2}^{3} R_{ij}+R_{i3}]$	$\sum_{i=1}^{m} P_i[\sum_{j=2}^{3} R_{ij}+R_{i3}]$	$C_c \sum_{i=1}^{m} P_i[\sum_{j=2}^{3} R_{ij}+R_{i3}]$	$\frac{C_o+C_c \sum_{i=1}^{m} P_i [\sum_{j=2}^{3} R_{ij}+R_{i3}]}{3}$ $=TC\ P\ P_3$
—	—	—	—	—	—	—
$\sum_{i=1}^{m}\sum_{j=1}^{k} R_{ij}$	k	P_i	$\sum_{i=1}^{m}[\sum_{j=2}^{k} R_{ij}+\sum_{j=3}^{k} R_{ij}+\ldots+R_{ik}]$	$\sum_{i=1}^{m} P_i[\sum_{j=2}^{k} R_{ij}+\sum_{j=3}^{k} R_{ij}+\ldots+R_{ik}]$	$C_c \sum_{i=1}^{m} P_i[\sum_{j=2}^{k} R_{ij}+\sum_{j=3}^{k} R_{ij}+\ldots+R_{ik}]$	$\frac{C_o+C_c \sum_{i=1}^{m} P_i[\sum_{j=2}^{k} R_{ij}+\sum_{j=3}^{k} R_{ij}+\ldots+R_{ik}]}{k=TCPP_k}$
—	—	—	—	—	—	—
$\sum_{i=1}^{m}\sum_{j=1}^{n} R_{ij}$	n	P_i	$\sum_{i=1}^{m}[\sum_{j=2}^{n} R_{ij}+\sum_{j=3}^{n} R_{ij}+\ldots+\sum_{j=k+1}^{n} R_{ij}+\ldots+R_{in}]$	$\sum_{i=1}^{m} P_i[\sum_{j=2}^{n} R_{ij}+\sum_{j=3}^{n} R_{ij}+\sum_{j=k+1}^{n} R_{ij}+\ldots+R_{in}]$	$C_c \sum_{i=1}^{m} P_i[\sum_{j=2}^{n} R_{ij}+\sum_{j=3}^{n} R_{ij}+\sum_{j=k+1}^{n} R_{ij}+\ldots+R_{in}]$	$\frac{C_o+C_c \sum_{i=1}^{m} P_i[\sum_{j=2}^{n} R_{ij}+\sum_{j=3}^{n} R_{ij}+\sum_{j=k+1}^{n} R_{ij}+\ldots+R_{in}]}{n=TCPP_n}$

This can be expressed as :

$$\sum_{i=1}^{m}\left[\sum_{j=2}^{n} R_{ij} + \sum_{j=3}^{n} R_{ij} + \ldots + \sum_{j=k+1}^{n} R_{ij} + \ldots + R_{in}\right] \text{units} \qquad (3)$$

Column five (Table 2) represents the inventory carried in rupees. The inventory carried in units is multiplied by unit prices P_i. Column 6 represents the inventory carrying cost which is obtained by multiplying the inventory carried in rupees with the carrying cost per period in percentage. Column 7 calculates the total cost per period. This total cost per period is obtained by dividing the sum of ordering cost and carrying cost by number of periods. Out of this total cost per period, the minimum total cost per period is selected. Say, this occurs for period k requirement. Now, the first order of all m products for k periods requirement is placed and then the same procedure is repeated for the remaining n—k periods. Again the total cost per period is calculated for (n—k) periods and out of these the minimum is selected. This process is continued till all the periods of the planning horizon are covered. This gives the joint ordering policy for all periods requirement of all m products based on Least Total Cost Per Period.

Example A company has twelve months requirements in units as follows. It incurs carrying cost 2% per month and ordering cost is Rs. 100 per order.

TABLE 3 **Data on Requirements of Different Products**

Periods/ Products	I	2	3	4	5	6	7	8	9	10	11	12	Total Reqmt.
Product I	10	20	20	70	180	10	250	270	230	40	0	10	1110
Product II	20	30	20	80	30	40	50	30	70	40	50	30	490
Product III	50	70	100	120	110	90	120	80	70	60	40	20	930
Product IV	0	50	80	180	0	80	180	150	10	100	130	180	1140
Total Reqmt. of four Products	80	170	220	450	320	220	600	530	380	240	220	240	$\sum_{i=1}^{4}\sum_{j=1}^{12} R_{ij} = 3670$

The unit prices quoted by a supplier for these four products are Rs. 5.00, Rs. 2.00, Rs. 1.00, Rs. 10.00 respectively. Using the least total cost per period, we want to find the joint ordering policy for the company.

TABLE 4 **Detailed Calculations**

Ordering Size R_{ij}	Number of Periods Requirement	Unit Price	Inventory Carried in Units	Inventory Carried in Rupees	Inventory Carrying Cost	Total Cost Per Period
1	2	3	4	5	6	7
$\sum_{i=1}^{4} R_{i1}=80$	One (First Period)	$P_1=5.00$ $P_2=2.00$ $P_3=1.00$ $P_4=10.00$	0	0	0	$\frac{100+0}{1}=100$
$\sum_{i=1}^{4}\sum_{j=1}^{2} R_{ij}=250$	Two Periods (1st, 2nd)	,,	20 30 70 50	100 60 70 = 730 500	14.6	$\frac{100+14.6}{2}=57.3$
$\sum_{i=1}^{4}\sum_{j=1}^{3} R_{ij}=470$	Three Periods (1st, 2nd, 3rd)	,,	60 70 270 180	300 140 270 = 2810 2100	56.2	$\frac{100+56.2}{3}=52.07^*$
$\sum_{i=1}^{4}\sum_{j=1}^{4} R_{ij}=920$	Four Periods (1st, 2nd, 3rd, 4th)	,,	270 310 630 750	1350 620 630 = 10100 7500	202	$\frac{100+202}{4}=75.5$
$\sum_{i=1}^{4} R_{i4}=450$	One Period (4th)	,,	0	0	0	$\frac{100+0}{1}=100$
$\sum_{i=1}^{4}\sum_{j=4}^{5} R_{ij}=770$	Two Periods (4th, 5th)	,,	180 30 110 0	900 60 110 = 1070 0	21.4	$\frac{100+21.4}{2}=60.7$
$\sum_{i=1}^{4}\sum_{j=4}^{6} R_{ij}=990$	Three Periods (4th, 5th, 6th)	,,	200 110 290 160	1000 220 290 = 3110 1600	62.2	$\frac{100+62.2}{3}=54.1^*$

(Contd.)

TABLE 4 (*Contd.*)

1	2	3	4	5	6	7
$\sum_{i=1}^{4}\sum_{j=4}^{8} R_{ij}=1590$	Four Periods (4th, 5th, 6th, 7th)	,,	950 260 650 700	4750 520 650 7000 $=12920$	258.4	$\frac{100+258.4}{4}=89.6$
$\sum_{i=1}^{4} R_{ij}=600$	One Period (7th)	,,	0	0	0	$\frac{100+0}{1}=100$
$\sum_{i=1}^{4}\sum_{j=7}^{8} R_{ij}=1130$	Two Periods (7th, 8th)	,,	270 30 80 150	1350 60 80 1500 $=2990$	59.8	$\frac{100+59.8}{2}=79.9$
$\sum_{i=1}^{4}\sum_{j=7}^{9} R_{ij}=1510$	Three Periods (7th, 8th, 9th)	,,	730 170 220 170	3650 340 220 1700 $=5910$	118.2	$\frac{100+118.2}{3}=72.7$*
$\sum_{i=1}^{4}\sum_{j=7}^{10} R_{ij}=1750$	Four Periods (7th, 8th, 9th, 10th)	,,	850 290 400 470	4250 580 400 4700 $=9930$	198.6	$\frac{100+198.6}{4}=74.65$
$\sum_{i=1}^{4} R_{i10}=240$	One Period (10th)	,,	0	0	0	$\frac{100+0}{1}=100$
$\sum_{i=1}^{4}\sum_{j=0}^{11} R_{ij}=460$	Two Periods (10th, 11th)	,,	0 50 40 130	0 100 40 1300 $=1440$	28.8	$\frac{100+28.8}{2}$ 64.4*
$\sum_{i=1}^{4}\sum_{j=10}^{12} R_{ij}=700$	Three Periods (10th, 11th, 12th)	,,	20 110 80 490	100 220 80 4900 $=5300$	106	$\frac{100+106}{3}=68.67$
$\sum_{i=1} R_{i12}=240$	One Period (12th)	,,	0	0	0	$\frac{100+0}{1}=100$*

* Optimal value.

The optimal policy is as given in Table 5.

TABLE 5 **The Optimal Policy Plan Table**

Order Number	Number of Periods Included	Order size in Units	Order size in Rs.	Carrying cost in Rs.	Ordering cost in Rs.	Least Total Cost per Period	Total Cost in Rs.
1	3 (1, 2, 3)	50 70 220 130	250 140 220 = 1910 1300	56.2	100	52.07	156.20
2	3 (4, 5, 6)	260 150 320 260	1300 300 320 = 4620 2600	62.20	100	54.1	162.20
3	3 (7, 8, 9)	750 150 270 340	3750 300 270 = 7720 3400	118.2	100	72.7	218.2
4	2 (10, 11)	40 90 100 230	200 180 100 = 2780 2300	28.8	100	64.4	128.8
5	1 (12)	10 30 20 180	50 60 20 = 1930 1800	0	100	100	100

Conclusion

Normally production control manager is concerned with maintaining the MRP System and material manager is concerned with obtaining the best price for material. The model developed here takes care of both production and material systems. The scheme worked here considers jointly ordering from one vendor based on the least total cost per period.

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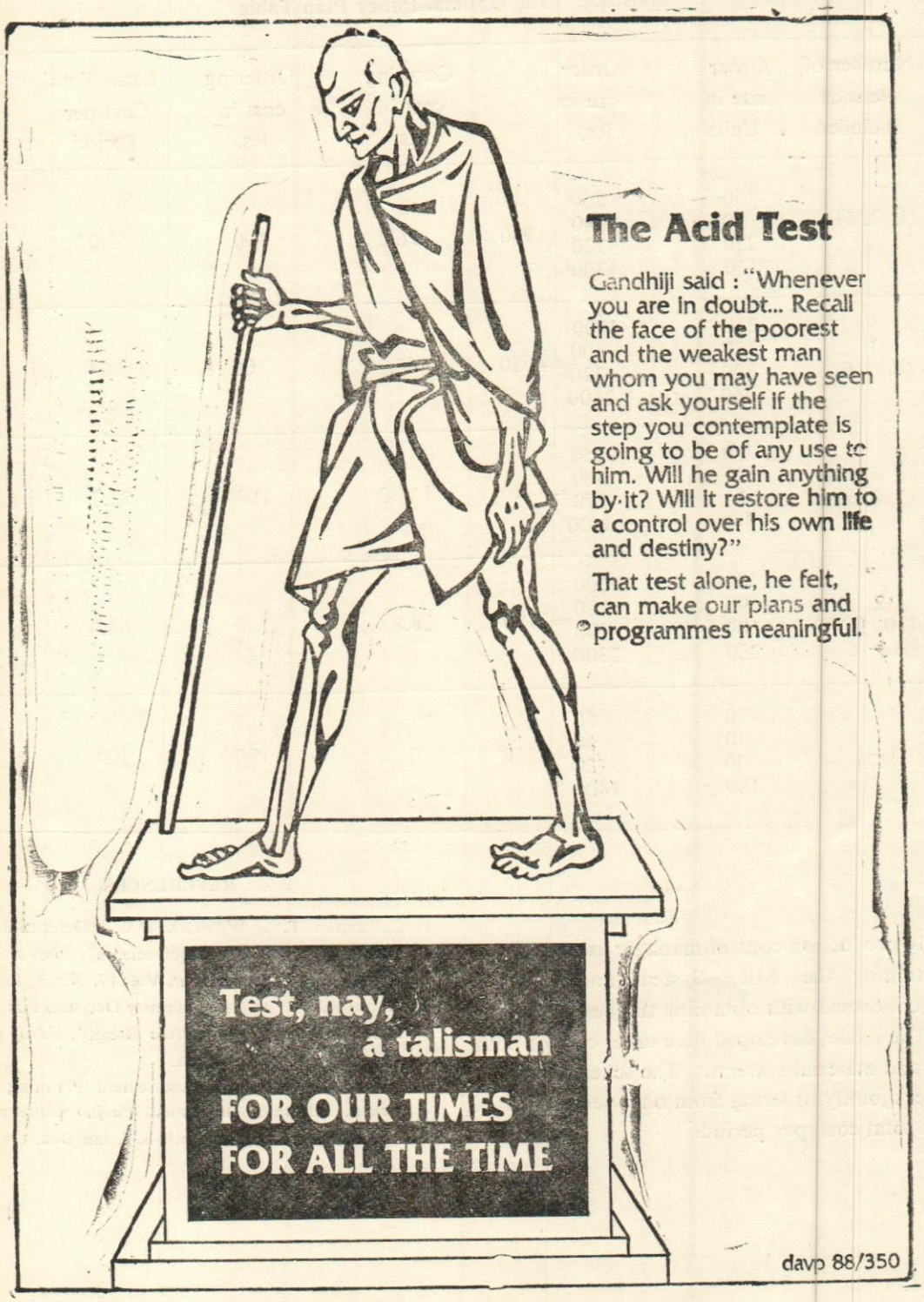
The Acid Test
Gandhiji said : "Whenever you are in doubt... Recall the face of the poorest and the weakest man whom you may have seen and ask yourself if the step you contemplate is going to be of any use to him. Will he gain anything by it? Will it restore him to a control over his own life and destiny?"
That test alone, he felt, can make our plans and programmes meaningful.
Test, nay, a talisman
FOR OUR TIMES
FOR ALL THE TIME
davp 88/350

Managing Work Discipline

J.L. Rastogi

Discipline is a product of positive characteristics of the people at work and those of the organisational environment. Any discrepancy in these may result in imbalance/maladjustment. Managing work discipline calls for appropriate strategies to deal with the needs of each situation, according to the author.

J.L. Rastogi is a Colombo Plan Expert in Kathmandu.

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Discipline is one of the important factors having a direct bearing on people's productivity. It may have a positive or a negative connotation. When it is used as a noun, it is a positive concept, and means "a pattern of conduct or behaviour on the part of people at work which is compatible with the objectives and needs of the organisation. It implies acceptance of managerial authority, obedience of/compliance with reasonable and lawful orders and observance of rules and regulations including permissible deviations."

Discipline, however, may be either self-discipline or motivated discipline. Self-discipline arises from within an individual and is strengthened by intrinsic rewards facilitated by a conducive organisational environment. Motivated discipline, on the other hand, is externally induced through equitable administration of extrinsic rewards and punishments.

In general, appropriate rewards—financial and non-financial—do reinforce positive behaviour by increasing opportunities for need satisfaction; however, at times, the use of negative incentives through threats and punishments may not only be essential but also desirable to prevent deviation from accepted norms of behaviour. To yield the best results, positive and negative incentives have to be integrated and administered in an equitable manner.

The term discipline when used as a verb has a negative overtone and would imply only managing indiscipline, through the use of appropriate threats and punishments. It has, however, only a short term impact. The behaviour of the incumbent is, usually, oriented towards minimum compliance with a view to avoiding threats and punishments, and the motivating

effect of this approach wears off as soon as these are withdrawn.

How is it that inspite of the clear-cut distinction between discipline (as a noun) and disciplining (as a verb), our managers continue to concentrate on managing indiscipline rather than promoting positive discipline ? The reasons are not far to seek. Firstly, being deviations from the accepted norms, cases of indiscipline can be easily identified and isolated. Secondly, inadequate/improper handling of indiscipline is likely to vitiate the organisational environment. And finally, the distinction between managing indiscipline and promoting discipline tends to get blurred in practice. Managing indiscipline is an integral part of promotion of positive discipline, and adequate and proper handling of indiscipline would go a long way in promoting discipline. Cases of indiscipline reflect a conflict, very often, between the delinquent's needs and aspirations and the organisation's norms and expectations. These help us in identifying the gaps/deficiencies in the organisational working, and make us aware of the need for action, for problem solving and decision making. However, promotion of discipline calls for a much more comprehensive strategy than merely the effective management of indiscipline.

Understanding Behaviour

Discipline being a pattern of conduct of behaviour, its proper management requires a thorough understanding of the principles of human behaviour, as also the variables affecting it. To many of us, it may seem that the pattern of conduct/behaviour is a result of one's personality characteristics, e.g., one's values, attitudes, interests, commitment, loyalty, aspirations, responsibility, etc. But in practice it may not be necessarily so. Personality characteristics are, no doubt, important but these alone do not fully explain people's behaviour. If these are the sole determinants of one's conduct/behaviour, it should be consistent both on the job and outside. However, in many cases we may identify two sets of distinctive behaviour —one, on the job, and the other, outside the work place. Very often the same persons who are regarded as passive, irresponsible and indisciplined on the job, have been found to be very active, responsible and disciplined outside. They not only assume responsibility, but often seek it in social, religious and/or political activities. They have been found to exercise self-direction and self-control in the service of the objectives to which they are committed.

In fact human behaviour is much more complex than it is ordinarily presumed. According to Maier (1973), it is a product of interactions between two sets of variables—characteristics of the individual and characteristics of the situation/environment in which he finds himself. The situation is a source of stimulation and the individual's behaviour is in response to stimulation from the environment. Often we may not be aware that we have been stimulated and believe that the behaviour is spontaneous. But in practice spontaneous behaviour is more an exception than the rule. However, in the context of human behaviour, the situation/environment is not what it is, but how it is perceived by the individual concerned. Each one of us is likely to perceive the situation/environment through our own coloured glasses, and hence interpret it differently resulting in different sorts of behaviour.

Determinants of Behaviour

No doubt, even in the context of work, the broader environment in a country in its various facets, viz. technological, economic, socio-cultural, educational, political-legal, etc., does have a significant impact on human attitudes and behaviour; but here we will confine ourselves to a more limited set of variables, namely, the forces relevant in organisational working, many of which are within the control of management. However, because of the interacting and interdependent nature of these variables and their constituents, it is difficult to isolate their specific impact.

The people's characteristics influencing behaviour may comprise two sets of interacting variables—personal and group. The personal variables include factors like background and culture, values and attitudes, knowledge, skills and experience, level of aspirations and personality orientation. On the other hand, the group variables relate to the degree of

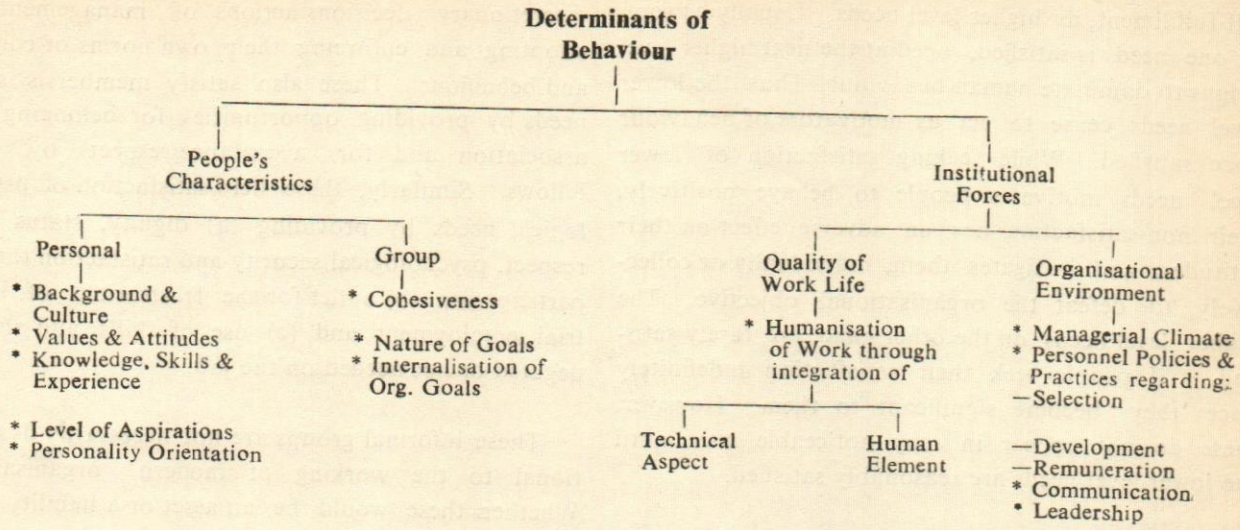

Fig. 1

group cohesiveness, the nature of group goals and norms and the degree of internalisation of organisational goals by the group.

The family and cultural background plays a very significant role in determining people's characteristics, orientations and behaviour. If one comes from a family/environment in which initiative, responsibility and orderly behaviour are positively re-inforced and rewarded, the person is likely to be more disciplined and cooperative. On the other hand, if one has been subjected to autocratic direction and control in one's early life, he is likely to be either completely submissive or stubborn in his later life, depending on his exposure and experiences.

Values and attitudes are yet another set of factors which one acquires over a period of time. Values are certain socially oriented ideals and aspirations which are deemed to be desirable, the degree of commitment which guides one to decide what he ought or ought not to do. Attitudes are a person's orientation towards the major components of one's life-experiences. However, knowledge, skills and experience contribute towards behaviour by making the person conscious of his own values, attitudes and commitments. While knowledge provides one a perspective, skills create certain obligations; and experience helps one integrate oneself with the environmental imperatives and thus arrive at an optimal solution.

The level of aspirations as reflected in one's degree of need satisfaction also has a direct bearing on one's behaviour. According to Maslow (1954), human needs are organised in a series of levels—a hierarchy of importance :

1. Physiological needs : for food, clothing, rest, shelter, etc.
2. Safety needs : for protection against danger, threat and deprivation.
3. Social needs : for belonging, for association, for acceptance by one's fellows and for giving love and affection.
4. Egoistic needs :
   (a) relating to self-esteem : for self-respect, self-confidence, autonomy, achievement, competence, knowledge, etc.
   (b) relating to one's reputation : for status, recognition, appreciation, respect from one's fellows, etc.
5. Self-fulfillment needs : for realising one's potential and for continuous self-development.

The first three of these needs, viz., physiological, safety and social, may be grouped into lower level needs, while the remaining two, viz., egoistic and

self-fulfillment, as higher level needs. Usually as soon as one need is satisfied, need at the next higher level beigns to dominate human behaviour. Thus, the lower level needs cease to act as motivators of behaviour once satisfied. While seeking satisfaction of lower level needs motivates people to behave positively, their non-satisfaction has an adverse effect on their attitudes, and instigates them, individually or collectively, to defeat the organisational objective. The higher level needs, on the other hand, are rarely satisfied, and people seek their satisfaction indefinitely once they become significant to them. However, these do not appear in any noticeable way until the lower level needs are reasonably satisfied.

Again, people with different personality orientations, viz., need for achievement (*n ach*), need for affiliation (*n aff*) and need for power (*n pow*) reflect different patterns of behaviour. The behaviour of a person high on *n ach* is oriented towards himself and his own success. He works hard to excel and has tremendous capacity to take initiative, assume responsibility and show results. He would be most effective in an environment which provides for autonomy, recognition and personal growth. However, behaviour of an individual high on *n aff* is likely to be more people oriented. He would be most effective in an environment which recognises human dignity and people's potential to learn, create and achieve. He works best in situations requiring people's involvement and cooperation. But the behaviour of one high on *n pow* tends to be dominating. He makes use of pressure and threats in his relationship with others. This type of personality may not be appropriate for effective working of modern organisations.

The informal groups at work have a significant impact of people's attitude and behaviour. These arise spontaneously out their informal interactions facilitated by some common cause or other integrating factors like region, caste or religion; or age, sex or seniority factors not reflected in the organisation chart, but prevalent in a formal organisational setting. Besides acting as an agency of social control and an effective means of communication, these groups provide alternate means for need satisfaction. The groups provide security to the members against arbitrary/discretionary decisions/actions of management by adopting and enforcing their own norms of conduct and behaviour. These also satisfy members's social needs by providing opportunities for belonging, for association and for acceptance/respect by their fellows. Similarly, these help satisfaction of psychological needs by providing (a) dignity, status, self-respect, psychological security and satisfaction through participation (b) outlet for the frustrations of industrial employment and (c) use of skills and abilities negated or not needed on the job.

These informal groups are not necessarily dysfunctional to the working of modern organisations. Whether these would be an asset or a liability to an organisation would depend on the approach of management towards these, on the one hand, and their cohesiveneses, nature of their own goals and their compatibility with the organisational objectives, on the other. If the existence of these groups and their constructive role in organisational working are recognised, and the management tries to strengthen their goals, the groups and their members are likely to extend their wholehearted cooperation to attain organisational objectives. On the other hand, if the members view the management as a threat to their existence as a group they will have an attitude of antagonism, resulting in dysfunctional behaviour.

The behaviour of people as members of informal groups is also determined by group cohesiveness, viz., the degree to which the members would stick closely to group values and norms. It has been observed that a cohesive group is likely to exhibit greater teamwork, gain greater social satisfaction from working together, have higher morale, less turnover and absenteeism than a group which lacks cohesion. The degree of compatibility of group goals with the organisational objectives. and internalisation of the latter by the group would also influence the nature of behaviour on the part of the members.

Institutional Forces

Two of the interacting institutional factors influencing work behaviour are quality of work life and the organisational environment. While the former

depends on the degree of humanisation of work through appropriate integration of technical and human elements of production, the latter would depend on the managerial climate, personnel policies and practices, quality of leadership and communication within the organisation.

People are not only interested in equitable pay packets, but also in the quality of work life. Although the nature of technology largely dictate the type of work organisation possible, the human element remains an equally active and vital force to make any venture a success. Thus, what is important to elicit positive behaviour, while taking care of the technological imperatives, is the extent to which human dignity, needs and potentials have been recognised in work design, and an environment created which is not only physically pleasent to work in but which also provides for satisfactory work relationship, and for opportunities, involvement, achievement and personal growth.

On the other hand, managerial climate as a constituent of overall organisational environment has immense relevance for the behaviour of people. Like individuals, every organisation, over a period of time, develops a culture, traditions, norms and standards. It is these which set the expected behaviour pattern within the organisation, conformity to which is recognised and rewarded; while deviations, discouraged often punished. The managerial climate itself is reflected in, besides other things, the quality of rules, regulations and procedures, the way these are formulated and interpreted and the extent to which these are implemented. For instance, if the rules, regulations and procedures are perceived as fair and equitable, and are seen to be facilitators rather than hinderences, and to be implemented earnestly, people will develop trust and confidence in the organisation and respond positively to its needs and objectives. However, vague, complex and/or discretionary rules, regulations and procedures and their bureaucratic interpretation and enforcement are likely to be dysfunctional, leading to apathy, and sometimes even negative behaviour.

There is a direct correlation between behaviour and the quality of human resources in an organisation, the latter largely determined by the nature of personnel policies and practices. For instance, a scientific selection process, opportunities for development and equitable remuneration integrate human needs, capabilities and potential with organisational objectives, requirements and expectations. This will bring about a higher degree of commitment and positive behaviour; on the other hand, whimsical personnel policies are likely to have a depressing and negative impact on people's morale and behaviour.

Again a manager gets the type of behaviour from his subordinates he deserves in terms of his own leadership orientation. An employee/relationship oriented manager adopts a leadership strategy based on the acceptance of human dignity and competence and aims at building effective work teams/groups with high performance goals by providing appropriate guidance, support and motivation. Such a manager is likely to have a favourable impact on his subordinates' behaviour. On the other hand, a job/task oriented manager is more concerned with production even at the cost of human dignity, needs and interests. He tries to get work done by making use of pressures, and if needed, threats. He is totally unconcerned with the impact of his leadership strategy on the morale, attitudes and behaviour of people in the long run.

The quality of communication within the organisation is yet another critical force having a bearing on people's behaviour. An open and appropriate communication system makes one aware of one's obligations/rights/benefits/privileges, points of weakness and strength; and highlight the opportunities and challenges available. It also facilitates quicker recognition of one's capabilities.

Incompatibility and Maladjustment

The state of discipline in any organisation at any point of time would depend on the nature of mix of people's characteristics and institutional forces. It should, however, be noted that the opposite of discipline is not necessarily indiscipline, but just no-discipline. Similarly opposite of indiscipline is not necessarily discipline, but only no-indiscipline.

Thus, between discipline an indiscipline there may be a state of no-discipline/no-indiscipline. While discipline elicits a positive response a no-discipline/no-indiscipline situation may result in an attitude of apathy/indifference. Indiscipline results in negative behaviour. Also, while no-discipline/no-indiscipline may be reflected in a high rate of absenteeism, turnover or an increased number of grievances or disputes, the state of indiscipline may have a different way of manifesting itself—as for instance in the conscious or unconscious violations of organisational rules, regulations and procedures, as well as its norms and expectations. It may even result in industrial action.

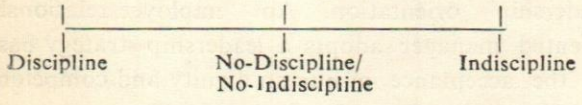

Fig. 2 Discipline—Indiscipline Continuum

The contributory causes of maladjustment and no-discipline would vary in different situations. A situation in which people's characteristics are positive and institutional forces negative, would be dysfunctional because the organisation would not be in a position to make proper use of people's capabilities. The reverse situation where institutional variables are positive but people's characteristics negative, would be equally frustrating, because people would fail to keep pace with the organisational requirements and expectations, leading to a state of no-discipline or even indiscipline. However the situation would be still worse where both the people and institutional dimensions are negative. There is likely to be confusion and chaos all around reflecting a lack of commitment on the part of the people and arbitrary/discretionary use of authority and control on the part of management.

Need for a Diagnostic Approach

In the organisations, the state of no-discipline/no-indiscipline is generally either ignored or not deemed worthy of corrective steps. However if any act of indiscipline is noticed, it is magnified; managers get emotionally involved and tend to blame the people, in this process ignoring the institutional variables. Consequential remedial actions, therefore, fail to yield the desired results.

What is needed is a meaningful/realistic approach towards discipline. Our strategy has to be adopted to the speciffc needs of each situation. This calls for continuous assessment of people's characteristics and institutional variables, proper diagnosis of the imbalances between them, if any, and immediate appropriate remedial action before these result in a pathological condition. Thus in a situation in which people's characteristics are positive but institutional forces, negative, an attempt should be made to develop the necessary infrastructure and environment that would not only recognise human dignity, capabilities and potential, but also motivate them to work productively, cooperatively and with economic, social and psychological satisfaction. It calls for an improvement in the quality of work life and also in the overall organisational environment, as not only directly reflected in institutional priorities, allocation of resources and practices but also as perceived by the people working for the organisation.

An appropriate quality of work life depends on the proper integration of the technical and human aspects of work. Thus while serving the technical requirements of the job, the human needs, interests and aspirations must be taken care of. No doubt, a pleasant and healthy work setting would have a favourable impact on the attitude and behaviour of people at work. but these would be more effective if associated with the tasks which are recognisable and meaningful for those who perform them; provide for satisfactory relationships; create a sense of responsibility and provide opportunities for achievement and personal growth.

Again, to be most effective, the appropriate quality of work life has to be supplemented by a favourable organisational environment as reflected in a conducive managerial climate, progressive personnel policies and practices and suitable leadership and communication strategies. The managerial climate conducive to the effective working of modern organisations would help to establish a work culture based on such norms and values which, while being fair and equitable, not only recognise people's capabilities, potential and achievements, but also encourage excellence, innovations and personal growth. The progressive personnel policies and practices, particularly relating to selection,

		People's Characteristics	
		Positive	Negative
Institution Forces	Positive	Perfect Adjustment, Discipline	Maladjustment, No-Discipline/ Indiscipline
	Negative	Maladjustment, No-Discipline/ Indiscipline	Confusion and Chaos, No-Discipline/ Indiscipline

Fig. 3 State of Discipline

development and remuneration would facilitate optimisation of the human assets by obtaining, retaining, and utilising the best of talents. Similarly, supportive leadership through the greater involvement of people would create a high degree of commitment and dedication on the part of the latter towards work and the organisation, while a systematic, proper and appropriate communication system would remove many of the misperceptions and misgivings in organisational relationships, and facilitate better integration of people—as individuals and as members of the informal groups—with the organisation.

On the other hand, in a situation involving positive institutional forces and negative people's characteristics, the managerial strategy has to be more people oriented. While retaining and strengthening plus points on the instititutional front, the organisation has to recognise and promote positive qualities in human nature and the constructive role of informal groups. The personal traits, orientations and attitudes are not necessarily inherent in human nature, but are largely products of the processes of socialisation, and experiences in life. Although the basic personality traits and attitudes are already largely developed in people by the time they take up jobs, the scientific processes of selection, initiation and developments go a long way in helping them to review, in the light of the changing realities, their own perceptions, and acquire those qualities which are more compatible with the organisational values and norms of behaviour. Thus, a supporting organisational infra-structure and environment would, while discouraging undesirable traits like antagonism, hostility, resistance, defiance, uncooperative attitudes and unrealistic points of view, not only recognise and re-inforce but also promote desirable qualities like loyalty, enthusiasm, drive, commitment, acceptance of responsibility and self-confidence, on the one hand, and the spirit of achievement, excellence and personal growth, on the other. Similarly, the management would have to recognise the existence of people's informal groups and integrate them with the organisation to make use of their positive dimensions in the latter's working.

An organisational situation with both negative people's characteristics and institutional forces, however, calls for all the more vigorous efforts on the part of the management to facilitate a transition from confusion and chaos to discipline by taking a more positive approach towards people and their needs, interests and aspirations, at the same time adapting a progressive strategy to integrate these with the values, norms and priorities of the organisation.

Thus, irrespective of the nature of the situation, the responsibility for the state of discipline in any organisation rests with the management. The promotion and management of discipline would depend on a proper diagnosis of the needs of each situation and appropriate measures to deal with specific imbalances and maladjustments between the people's characteristics, on the one hand, and the institutional forces, on the other.

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Experiences of the Integrated Rural Development Programme: Some Policy Implications

J.S. Sodhi

How effectively are IRDP schemes implemented? The author cites a number of micro and macro level studies, including the one that he carried out in Bhandara District of Maharashtra, to illustrate the loopholes that currently exist. He also prescribes a number of measures to overcome them, all designed to increase the involvement of officials entrusted with the implementation.

J.S. Sodhi is Professor and Incharge, Rural Labour Studies Programme, Shri Ram Centre for Industrial Relations and Human Resources, New Delhi.

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The objective of this paper is to present an incisive view of the Integrated Rural Development Programme (IRDP) as revealed by a number of micro and macro level studies. In addition, a case study on the programme, conducted by the author in Bhandara district of Maharashtra is also presented. The paper presents a comparative analysis with the help of findings of some of the important studies (Appendix 1) on the subject. Since the Eighth Plan is under formulation, such an analysis is expected to help in clearly focussing the issues involved.

The Bhandara District Study

A study was conducted in six blocks of the Bhandara district in Maharashtra. The field work was undertaken in April 1986. Based on stratified random sampling, a sample of 252 beneficiaries was selected. Personal interviews were held with the head of the beneficiary households in their village. The primary data so generated was supplemented by the informal interviews with the concerned officials.

Identification of households

IRDP guidelines stipulate that the identification of households was to be completed with the help of a survey of the housholds below the poverty line. Any household with an annual income of upto Rs. 3,500 was eligible to be categorised as below poverty line. Accordingly in Bhandara district, the identification of households was completed through a survey in June 1982. The survey was conducted by the teachers and

the village level workers of the state government agencies. After the survey, the list of Below Poverty Line (BPL) families was prepared by the District Rural Development Agency (DRDA) officials. The survey obtained information regarding the income levels of the households and their preferences for various schemes. The identified beneficiaries and other members of the village community made the following observations regarding the survey :

(i) The teachers involved in the survey were not adequately trained for the job. The responses were elicited by them on a small printed card and no worksheets were attached for calculating the net income of the households.

(ii) The village community was not aware of the purpose of the Survey.

(iii) The Survey was done in haste.

These findings are confirmed by some earlier studies in Maharashtra and other parts of the country. The study in Satara reported that the enumerators never received any guidelines from the block level authorities (Sodhi, 1987). The Report of Thane highlighted that the functionaries involved in the survey were not aware of any instructions in this regard (Aranha and Kaundinya, 1985). Other reports found similar weaknesses in the identification of households through the survey (NABARD, 1984; PEO,1985). The only notable exception seemed to be Rajasthan where all the preparatory work was done by May 1980 (Ahuja, 1983).

Lack of adequate training and poor commitment on the part of enumerators resulted in large scale inclusion of ineligible households and the exclusion of eligible ones in the BPL list. In Bhandara district, 56 per cent of the sample beneficiary households had an annual income above Rs. 3,500 at the time of survey. More than half of the households were, therefore, ineligible and as such should not have been included in the BPL list. These results are strengthened by the findings of studies in other districts. The proportion of ineligible housholds was found to be 26 per cent and 15 per cent respectively in the two major studies (PEO, 1985; NABARD, 1984). The evaluation reports of Thane and Satara revealed that the percentage of those wrongly selected was 40 per cent (based on the fact that the beneficiaries were the farmers, who were owning 5 acres and above land) and 45 per cent respectively (Aranha and Kaundinya, 1985; Sodhi, 1987). Similarly, in one of the districts of the South, one study found that 21 per cent of the sample beneficiaries were wrong selections (Centre for Development Studies, 1983).

Comprehensive policy guidelines, therefore, need to be formulated now for proper identification of the households below the poverty line. The BPL list may be modified by the DRDAs. The data must be gathered afresh through a door to door survey. The survey should be conducted every year to include newer entrants to the poverty line and also to exclude those who have crossed it. Equally important is to impart appropriate training programmes for the enumerators.

Coverage of households

Poorest of the poor : In the selection of the households, an important issue is the adoption of the Antodaya approach in the implementation of the IRD programme. The data on the income-wise distribution of all the beneficiaries in Bhandara district was not available and, therefore, the sample beneficiaries data has been used to highlight whether or not the poorest of the poor have been assisted at the first instance. Our study in Bhandara district revealed that there was no beneficiary households whose income was less than Rs. 1,000 p.m. (Table 1) although according to the BPL survey, there were 18 per cent (35, 792) households, whose total annual family income was below Rs. 1,000. The Antodaya approach was, therefore, completely ignored in the district, while implementing the programme.

In other districts too, the poorest of the poor were not necessarily the first and always in a minority among the beneficiaries (PEO, 1985). The Thane district study found that the proportion of landless workers was marginal, implying thereby that the poorest were not selected (Aranha and Kaundinya, 1985). In Delhi, only 6.6 per cent of the sample beneficaries were the poorest of the poor with a

TABLE 1 Coverage of the Poorest of the Poor in the IRD Programme

Name of the study	Number of Households with annual Income	
	Upto Rs. 1500	Others
Bhandara	Nil*	252
PEO	178 (20.5)	690 (79.4)
NABARD	480 (31.8)	1487 (68.2)
Jaipur*	28** (7.3)	355 (92.7)
Quilon	15 (28.8)	37 (61.2)

* Household income upto Rs. 1,000 per annum.

** Number of households upto a per capita income of Rs. 200 per annum.

Figures inthe parentheses represent the horizontal percentages.

household income of upto Rs. 1,500 (Sudan, 1984). The studies in Akola, Satara and Sawai Madhopur also strengthen the finding that the poorest of the poor were not given assistance at the first instance (Sodhi 1985; 1986; 1987). The programme meant for the poorest, therefore, did not reach them in adequate numbers and they were not accorded the priority envisaged in the guidelines.

For the selection of the poorest of the poor, a conscious policy effort now needs to be made. Beneficiaries seemed to have been selected on a first come first served basis. These are generally the better off sections from among the households below the poverty line. Despite the procedure of selecting the households in the Gram Sabha meetings, even in the earlier Antodaya programmes, many of the beneficiaries did not come from the poorest section (Pant, 1981). Since the poorest of the poor do not come forward on their own, the authorities need to give them assistance through deliberate efforts.

Scheduled Castes and Tribes: The coverage of Scheduled Castes and Tribes has been accorded a high priority in the IRD programme. The Government of India had laid down that 30 per cent of the households, assisted under the IRD programme, must belong to these categories. In Bhandara district, our study found that 40 per cent of the sample beneficiaries were from the Scheduled Castes and Scheduled Tribes (Table 2). The total coverage, accoring to the Planning Commission's study, was about 32 per cent (22.5 per cent SC's and 9.2 per cent ST's). Area wise, the coverage was less than expected in some of the hill districts and the agriculturally less developed districts (PEO, 1985). Other studies showed that the coverage was 27 per cent in Quilon (Centre for Development Studies, 1983), 25 per cent in Tirunelveli and Periyar districts (Canara Bank, 1987), 47 per cent in Hyderabad (State Bank of Hyderabad, 1983), 58 per cent in Jaipur (Ahuja, 1983), 26 per cent in Satara (Sodhi, 1987) and 42 per cent in Sawai Madhopur (Sodhi, 1986). Only one study found an exceptionally low coverage of 4 per cent among the sample beneficiaries (NABARD, 1984). The programme, therefore, mostly gave adequate coverage to the Scheduled Castes and Scheduled Tribes population.

Bonded Labourers: Another aspect of the coverage of the poorer sections of the BPL households related to the special directive of the government, to integrate the IRD programme with the schemes for rehabilitation of bonded labourers. None of the studies, however, has looked into this aspect and our enquiries in Bhandara district did not yield any information, because there was no information with the DRDA. It is, therefore, difficult to assess whether the bonded labourers have at all been included in the IRDP and to what extent. Even the data on the all India coverage did not yield any information on this aspect.

Planning at the block level

The IRDP involves meticulous planning at the block level. The block plans are expected to ensure optimum utilization of social resources, integration of various on-going programmes being implemented by different departments and formulation of development plans with the objective of providing economically

TABLE 2 Coverage of Scheduled Castes (SC) and Scheduled Tribes (ST) among the IRDP beneficiaries

Name of the study	No. of households*	No. of households belonging to			
		SC	ST	SC and ST	Others
Bhandara	198697**	—	—	81173 (40.8)	117524 (59.2)
PEO	1170*	343 (29.3)	127 (10.8)	470 (40.2)	700 (59.8)
NABARD	2058296	—	—	890995 (43.3)	1167301 (56.7)
Parbhani	31659**	—	—	5903 (18.6)	25756 (81.4)
Jaipur	380**	—	—	230 (60.5)	150 (39.5)
State Bank of Hyderabad	310	113 (36.4)	28 (9.0)	141 (45.5)	169 (54.5)
Quilon	128	31 (24.2)	Nil	31 (24.2)	97 (75.8)
Tirunelveli & Periyar	60	—	—	15 (25.0)	45 (75.0)
Delhi	9628**	—	—	2914 (30.3)	6714 (69.7)

* No. of beneficiary households.
** Total number of eligible families for IRDP benefits.
Figures in the parentheses are the horizontal percentages.

viable activities for the rural poor. The IRD block plan has necessarily to be linked with the development programmes of other departments which would eventually be a component of the comprehensive plan.

The IRD block plans are expected to be prepared in two stages: (i) A five year development profile or a perspective plan and (ii) An annual action plan.

In Bhandara district our study found that the authorities had not prepared the five year perspective block plan. The field team was told that this was due to the fact that the DRDA was set up only in the middle of 1982 i.e. more than a year after the issue of guidelines for preparation of a block plan (1980-85). Due to this time lapse, the DRDA authorities in Bhandara felt that it would not be useful to undertake the perspective plan exercise. Therefore, only the annual action plans were prepared. For preparing the annual block plans, the DRDA authorities collected statistical information from the blocks and held discussions with the block and bank representatives. Approval of these plans was then sought at the state level Consultative Committee. In addition to the preparation of annual plans, the lead bank of Bhandara district had also drawn up a detailed district credit plan for 1983-85.

The experience of other evaluation reports also showed somewhat similar results. The remarks of the study by the Planning Commission (PEO, 1985) are:

(i) The exercise of perspective plan was not attempted in about half of the studied states.

(ii) Even where this exercise was taken up, it covered only few districts within a state.

(iii) Instead of formulating the perspective plans on the basis of families or the cluster of villages, the DRDAs have divided the physical and financial targets into the existing blocks irrespective of the size, population and potential for development.

The PEO study further stated that all that the DRDAs seemed to be interested in was to make provisions of the credit to be obtained from the banks and no careful exercise had been attempted for the successful implementation of the programme.

Our study in Bhandara district found that the factors which contributed to non-preparation of the perspective plans were (i) lack of training and guidance for the preparation of block plans (ii) non-involvement of the commercial banks at the planning stage (iii) lack of data for preparation of such plans and (iv) the indifference of the DRDA officials towards the preparation of perspective plans.

The preparation of the block plan is probably the only method of ensuring that the IRD programme becomes a truly developmental endeavour. The steps indicated in the preparation of the plan are comprehensive enough and it may be advisable to follow them even now.

Time Lags

Two important criteria to judge the efficacy of the implementation machinery are: the gap between applying for assistance and its sanction, on the one hand, and the sanction and disbursement of the assistance on the other. In Bhandara district, our study found that the average time gap between submitting the application and getting it sanctioned was 2.8 months and the receipt of the assistance was delayed by another two months. The average time taken for getting assistance after submitting the application was therefore about five months (Table 3a – 3e). The authorities had hoped that the time required for clearing the application and giving assistance would not be more than ten weeks. The time taken in Bhandara, therefore, was very high.

The State Bank of Hyderabad study has given more details about the time taken at various stages of giving assistance. The time from identification to the preparation of application was 70 days, the time taken in the BDO's office in sponsoring the application to the banks was 50 days and the banks took, on an average, 34 more days for sanction and another 24 days in releasing the loan (State Bank of Hyderabad, 1984). The Jaipur study found that the time taken between the date of application and disbursement of loan was less than 40 days for 43 per cent of the beneficiaries and 40 to 80 days for 30 per cent of the beneficiaries (Ahuja, 1983). In Satara district, the time taken between application and sanction was about three months (Sodhi, 1987).

TABLE 3a **Households at various stages of obtaining assistance**

(Percentage of Households)

Months	BHANDARA			PARBHANI
	Between submission of application and sanction	Between sanction and obtaining the assistance	Between submission of application and obtaining assistance	Between submission of application and getting assistance
Upto one	2.4	3.6	0.8	30.2
1-3	70.2	86.1	49.2	57.7
3-6	25.4	10.3	36.7	4.0
6 and above	2.0	—	13.1	8.1
Total Time Gap (Months)	3	2	5	

TABLE 3b **Households at various Stages of Obtaining Assistance**

(Percentage of Households)

Months	PEO	
	Between identification and sanction	Between sanction and actual provision
Upto one	65.0	82.6
1-3	9.7	12.1
3-5	5.6	4.0
5 and above	19.6	1.4

TABLE 3c **Households at various stages of obtaining assistance**

Months	QUILON
	Between application and disbursement of loan (% households)
0-3	21.2
4-6	23.1
7-9	5.8
10-12	30.8
13 and above	19.2

TABLE 3d **Households at various stages of obtaining assistance**

Days	JAIPUR
	Between application and disbursement of loan (% households)
Upto 40	42.9
41-80	30.5
81-120	6.4
121 and above	20.4

The time lag data showed that the time taken for processing the application was much higher than the expectations. Moreover, some of the studies also showed that the community showed lack of enthusiasm in applying for assistance after getting information for the same (Sodhi, 1985; 1986; 1987). It was expected of the officials at the village and block levels that they would try to remove the misgivings of the households below the poverty line and systematically educate them about the benefits of the programme. Actual experience revealed that this was not done and insufficient information filtered to the target beneficiaries. The village level workers generally shared the information with a selected few.

TABLE 3e **Households at various stages of obtaining assistance**

Item	STATE BANK OF HYDERABAD			
	Identification to preparation of application	Sponsoring of application by BDO to Bank	Sanction of application by the bank	Release of loan
Average No. of days	70	50	34	20
% of households	40.2	28.7	19.7	11.3

Discussions with bank and block officials in Bhandara district revealed that the time lags were high due to a feeling of mistrust between the commercial banks and the block officials. The applications were generally scrutinised twice, at the block level as well as at the banks.

The DRDA officials generally complained to the field team in Bhandara district that there were undue delays at the banks. The experience of some of the studies in this regard showed that these are mostly due to the wrong timings of sending applications to the banks. In Sawai Madhopur district, for example, the lead bank office reported that a large percentage (over fifty) of the applications were forwarded by the blocks during January-March i.e, during the last

quarter of the year, because the blocks have to complete their yearly targets (Sodhi, 1987). The study by NABARD reported that 60 per cent of applications in a year were forwarded to the banks during the second half of the year (NABARD, 1984). In the states of Andhra Pradesh, Karnataka and Maharashtra, 41 per cent of the applications were received by the banks during the last quarter of the year (State Bank of Hyderabad, 1984). Other micro studies in Akola and Satara (Sodhi, 1986; 1987) too revealed the same trend.

Impact on Income

Most of the activities of the IRD programme are undertaken with a view to enhance the income level of the beneficiaries. This is the most important objective of the programme and a large number of studies have, therefore, devoted a considerable part of their analyses to the impact of various programmes on the increase in the income of the beneficiary households.

The study in Bhandara district found that the annual income of each beneficiary household had increased by Rs. 1,020 per annum due to the IRDP assistance. Programmewise, the income of the milch cattle beneficiaries had increased by Rs. 1,296 per annum. Other programmes in Bhandara district were bullock cart, piggery and goat and sheep rearing and the beneficiaries reported annual income increases of Rs. 852, Rs. 708 and Rs. 652 per household respectively. A comparative picture of the impact on income as reported by other studies is presented in Table 4.

The analysis of additional income, due to assistance, becomes much more meaningful when seen alongwith the expected incomes, the relative level of poverty and the likelihood of the beneficiary households crossing the povetry line. The estimates of the expected incomes have been prepared programmewise by the respective state governments. A comparison of the additional incomes of the beneficiaries in Bhandara with the estimates prepared by the Maharashtra Government (Guidelines on IRDP,

TABLE 4 **Average additional annual income per household (Rs.) due to the IRDP assistance**

Study/ Schemes	Bhandara	PEO	Jaipur	Delhi	Akola	Dhule	Sawai Madhopur
Milch Cattle							
(i) One	12961	—	1093	—	724	768	321
(ii) Two	—	—	—	3491	1978	1081	501
Bullock pair	856	—	—	—	292	—	1101
Goat Units	559	—	64	—	203	—	1096
Piggery units	1296	—	300	—	630	—	—
Bullock pair and cart	—	—	2585	—	—	925	4917
Animal Husbandry	—	1071	—	—	418	—	—
Sheep rearing	—	—	92	—	—	—	1048
Camel cart	—	—	9200	5920	—	—	3722
Agricultural Schemes	—	1105	—	—	—	—	—
Dugwells	864	—	—	—	700	1328	652
Secondary sector	—	1575	—	—	—	—	—
Tertiary Sector (ISB)	1272	2770	—	—	648	1666	—

Govt. of Maharashtra, 1983) showed that there were wide gaps between the expected and actual incomes e.g. the additional incomes from milch cattle was only one-third of the expected income leaving a wide gap of Rs. 2,431 per household per annum. The additional income from the bullock pair and sheep beneficiaries was only 30 per cent of the expectations.

An analysis of poverty levels showed that 54 per cent of the households were below the poverty line at the time of taking assistance. The assistance provided had helped about 24 per cent of the sample beneficiaries to move above the povetry line. It is, however, important to know that about two-third of those moving above the poverty line belonged to the higher income groups of Rs. 2,400-3,500. Only 20 per cent of the households with an initial income of Rs. 1,200-2,400 had crossed the poverty line (Table 5).

TABLE 5 **Distribution of households crossing the poverty line due to IRDP assistance**

Name of the study	Percentage of beneficiary households crossing the poverty line
Bhandara District	24.0
PEO	49.4
NABARD	47.1
Jaipur District	23.2
Quilon District	48.1
Akola District	42.0
Dhule District	37.0
Sawai Madhopur	40.0

The Planning Commision's study found that there were 75 per cent beneficiaries below the poverty line at the time of taking assistance. The assistance enabled about half of these beneficiaries to cross the poverty line. However, most of them were the relatively better-off sections within the poverty group. Among the poorest of the poor group, only 8 per cent crossed the poverty line (PEO, 1985).

The NABARD study found that a little less than half of the beneficiaries had crossed the poverty line. The study hlighlighted that the rest of the households had moved from the lower income to higher income groups but were not able to cross the poverty line (NABARD, 1984).

The Jaipur study estimated that 41 per cent of the eligible beneficiaries had moved above the poverty line. The land-based activities helped to raise more than three-fourth of the beneficiaries above the poverty line and the activity of sheep rearing helped only 1 per cent of the beneficiaries to cross the poverty line. The scheme of camel carts, bullocks and pumpsets proved to be a great success and a much larger proportion of beneficiaries, who were assisted in these programmes crossed the poverty line as compared to the beneficiaries in other programmes (Ahuja, 1983).

The studies of Tirunelveli and Periyar districts showed that out of the 70 per cent of the beneficiaries who were below the poverty line, 55 per cent were able to cross it after getting some assistance. The activities of dairy and bullock showed a much higher income than sheep rearing (Canara Bank, 1983).

The estimates of the households below the poverty line are on the basis of a household income of upto Rs. 3,500 per annum at the price level of 1979-80. If adjustments of the price level are made for the years in which the studies were conducted, the profile of households crossing the poverty line changed. The rural bank's study estimated that, if the household income is adjusted for the level of prices prevailing in 1982-83 (the year of the survey), the proportion of households crossing the poverty line declined from 47 per cent to 22 per cent (NABARD, 1982). Similarly, the Planning Commission study estimated that if the escalated value of the annual income of Rs. 3,500 was taken into consideration at the time of the survey, only 20 per cent, compared to 49 per cent, actually crossed the poverty line (PEO, 1985).

Thus, the impact of the programme has been below expactations and in real terms only about one-fifth or less could move above the poverty line. Most of

these studies have been completed during the first five years of the programme and it is also debatable if the beneficiaries will be able to maintain continuity of additional incomes from the IRDP assistance in the long run. If the experience of past programmes is any guide, it is not too unrealistic to assume that the income impact will not last long. There is, therefore, a possibility that a percentage of IRDP beneficiary households will slide back in to the poverty group.

Concluding Remarks

The Eighth Five Year Plan is likely to give an impetus to the IRD Programme. It is, therefore, important that the experiences of the implementation of the programme and impact are taken note of and appropriate steps taken to improve its functioning. To begin with, the list of households with the DRDA should be modified to ensure that the limited outlays of the programme are utilized for the target group only. The selection of programmes to be taken up for the beneficiaries should be based on the needs of the area and its population. Even within the programme, shortcomings will have to be removed. For example, in the animal husbandry programme, milch cattle has been identified as the main asset. Here, the quality of milch cattle needs to be improved. The provision of adequate and timely veterinary services should also be accorded high priority.

In the minor irrigation programme, a major problem has been that the works have not been completed fully. Wells must be dug up to the required depths. Attention would also have to be paid to the construction of irrigation channels to get additional incomes from renting out water. Besides the package of programmes in the broader category of the ISB needs to be strengthened with increased assistance. Only then will the programme have the potential of generating sizable incomes. In the Scheme of Training of Rural Youth for Self Employment (TRYSEM) the selection of trades should be undertaken after a detailed survey. The training component of this programmes needs to be strengthened and the DRDA authorities should help all the trained youths in getting loans from banks. The availability of raw materials and marketing channels should be one of the important determining factors while taking up specific programmes in the districts and blocks.

As things stand, the beneficiary is on his own (except when the loan has to be recovered) after the disbursement of assets. No follow-up is done on the utilisation of assistance. There is, therefore, paucity of official information on the possession or otherwise of the assets. Some of the beneficiaries we studied in Bhandara were not in possession of their assets even before the full repayment of debt. Morever, a large number of those who were in possession of assets were not utilizing them fully. The officials, were unconcerned about this aspect. and did not look for measures to improve the utilization of assistance. Regular verification of assets and their proper utilization by the beneficiaries must become an important concern of the DRDA authorities.

A significant policy change and intervention of the Government is required to raise the accountability of the officials involved in the implementation of the programme. This may be in the areas of identifying the right people, a maximum coverage for the poorest of poor, preparation of the perspective plans and maximum utilization of the assets given to the beneficiaries. The vital link with the beheficiary, may, therefore, have to be kept even after given the assistance. Training can play an increasingly important role in changing the attitude of the officials, which should now be provided at regular intervals for all the officials involved in the implementation of the IRD Programme.

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APPENDIX 1—Details of Other IRDP Studies

The research studies on the evaluation of the IRDP programme were undertaken mostly during 1982-1986. They examined various aspects of the programme and an attempt has been made in the paper to compare the results wherever it has been possible to do so. A brief description of the studies referred in the text is given below.

SATARA Study: Evaluation of the IRD Programme, with special reference to the TRYSEM Programme. The study was conducted by the Shri Ram Centre for Industrial Relations and Human Resources, New Delhi. The field work was done in 1985-86. In the district, the study covered three blocks and 162 beneficiaries.

THANE District Study: The study was conducted by the College of Social Work, Bombay. The field work of the study was done in 1984. The study covered two blocks of the district, four villages and 73 sample beneficiary households.

NABARD Study: The study was conducted by the National Bank for Agriculture and Rural Development, Bombay. The field work of the study was done in 1983. The study covered 15 states, 30 districts, 60 blocks and 1409 sample beneficiary households.

PEO Study: The study was conducted by the Planning Commission, New Delhi. The field work was done in 1983-84. The study covered 16 states, 33 disiricts, 66 blocks and a total of 1170 sample beneficiary households.

QUILON District Study: The study was conducted by the Centre for Development Studies, Trivandrum. The field work of the study was done in 1983. The study covered one block in the district, two villages and 128 sample beneficiary households.

AKOLA District Study: The study was conducted by the Shri Ram Centre for Industrial Relations and Human Resources, New Delhi. The field work of the study was done in 1985. The study covered two blocks, 15 villages and 191 sample beneficiary households.

SAWAI MADHOPUR District Study: The study was conducted by the Shri Ram Centre for Industrial Relations and Human Resources, New Delhi. The field work of the study was done in 1986. The study covered six blocks, 77 villages and 830 sample beneficiary households.

ALLAHABAD AND FATEHPUR Districts Study: The study was conducted by the G. B. Pant Social

Science Institute, Allahabad in 1981, It covered a sample of 300 Antodaya beneficiaries in the two districts.

DELHI Study: The study was conducted by the Indian Institute of Public Administration, New Delhi. The field work of the study was done in 1983. The study covered 5 blocks, and 92 beneficiaries.

TIRUNELVELI AND PERIYAR Districts Study: The study was conducted by the Canara Bank in 1983. It covered two districts and a sample of 60 beneficary households.

HYDERABAD Study: The study was conducted by the State Bank of Hyderabad. The field work was conducted in 1983. The study was done in 19 branches of the State Bank of Hyderabad in the states of Andhra Pradesh, Karnataka and Maharashtra. The total sample of the study was 310 beneficiary households.

JAIPUR District Study: The study was conducted by the Institute of Development Studies, Jaipur. The field work was done in 1983. The study covered 9 blocks. 73 villages and 380 sample beneficiary households.

DHULE District Study: The study was conducted by the Shri Ram Centre for Industrial Relations and Human Resources, New Delhi. The field work of the study was done in 1985. The study covered two blocks, 14 villages and 179 sample beneficiary households.



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Industrial Productivity : Some Issues Relevant for Policy Making

Arun Ghosh

The author analyses the reasons that make the Indian Economy a high-cost one and recommends a two-fold solution, one of which involves a change in the internal working of industries and the other the industrial environment. The former requires a change in the work culture and the latter an increase in the competition faced by Indian industries.

Dr. Arun Ghosh was formerly Secretary to the Government of India and Chairman, Bureau of Industrial Costs and Prices.

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The issue of productivity in industry is of considerable significance today. For one thing, available data appear to indicate that the over-all capital : output ratio in India has been increasing over time, implying that we have been required to make steadily larger investments to get the same volume of output. This has an adverse implication : that either the efficiency of our investment—in terms of direction of investment—has been progressively going down or that the management of our assets, our labour and our material resources has been deteriorating.

These are important issues which need to be carefully examined, for we need to adjust our broad economic policies, indeed the very basis of our planning, in the light of the answers to the questions that arise in this context. It is relevant in this connection to note that increasingly, our policy makers have been talking not of increasing the rate of investment in the economy, but of the efficiency of use of our existing assets, so that in a sense, the focus is already on the best means of raising efficiency. It is for this reason that attention is today focussed on the liberalization of industrial (and import) policy, liberalization of technology import, and modernization of the industrial structure.

These are all important measures. However, it is possible that in our anxiety to find a quick answer to the problem of the present low level of productivity in Indian industry, we are missing the wood for the trees.

The phenomenon of increasing capital: output ratio is one that needs to be further analysed. For one

thing some increase in the capital: output ratio is inevitable when a large proportion of the investment is for the development of infrastructure facilities. Roads, rail transport, power supply, communications, all have a high captial : outpul ratio. Indeed, for facilities like roads, there is no direct output arising from investment. The increase in output comes from the increased economic activity that follows from the availability of better roads and communications. And to the extent that investment in infrastructure has been a major area of thrust in the plan, some degree of increase in the over-all (incremental) capital : output ratio is inevitable.

Gestation Period

But there is also an unfortunate side to this development. The gestation period of our investments is needlessly high. In fact, the period of construction of our projects has been getting increasingly prolonged in recent years. To some extent, of course, infrastructure projects may be expected to have a somewhat longer gestation period than specific industrial projects—dams, roads, railways and communication systems take longer to complete than, say, a flour mill or a textile mill. But then, even by the normal standards of the former, the gestation periods of our projects are far too long.

To the extent that the gestation period of new investments is longer then warranted, the capital: output ratio is bound to be higher than it ought to be. In the first place, delays in construction tend to increase capital costs, both because of escalation of prices over time and because of the higher accumulated interest during construction period which has to be capitalized. Secondly, at any given point of time, there is an accumulation of unfinished projects, and past investments on them do not give the output that could be expected from them. Hence in an over-all sense, the capital; output ratios keep on increasing merely because of delays in project construction.

How serious the problem has become, of late, can be judged from two sets of data. According to the annual report of the Ministry of Programme Implementation, as of 31 March 1987, considering only central government projects, each of a minimum value of Rs 20 crores, the *total* cost of unfinished projects (excluding those likely to be completed during 1987-88) was approximately Rs 73,500 crores: what is worse, some of the projects have been under construction for as long as 13 years. Secondly, a specific project like the Visakhapatnam Steel Plant, which is now expected to be commissioned by 1990-91, would have taken some thirteen years to complete as compared to, say, the Pohang Steel Plant in South Korea which took 30 months to complete, and indeed our own Bhilai Steel Plant (first phase) which was commissioned in about there and a half years from the commencement of construction.

What are the *causes* for such delays in construction of projects? The Economic Administration Reforms Commission (EARC) found that our financial procedures are responsible to a great extent for the present state of affairs. It cited the example of the Kudremukh Iron Ore Project (involving an investment of some Rs 700 crores) which was completed ahead of schedule, merely by changing the procedures for the allocation of funds for project implementation, and by giving the project authorities both the responsibility and the power to speedily implement the project.

Incomplete Projects

A second point that arises—to which the EARC did not understandably devote any attention—stems from the very large number of unfinished projects in hand, all of them competing for the limited financial resources available with the government for project implementation. If, as per the annual report of the Ministry of Programme Implementation, the total investment needs in the future involved in all major central government projects is Rs 73,500 crores, and if one assumes that the future needs of funds would be half this figure, or, say, 50 per cent of the total investment involved, the pending projects alone would require some Rs 37,000 crores to complete. This is a figure derived merely on the basis of a statistical probability, and not by adding up the future requirement of funds for all pending projects, and would, therefore, be subject to error. The figure does not, however, include large projects approved recently, like the Narmada Valley Project, the cost of which is currently estimated at Rs 15,000 crores over a period of some 20 years.

What is significant here is the enormity of the total amount of funds required, especially in the light of the paucity of resources with the government. Sanction of funds in driblets is only likely to escalate the cost of all projects, delay their completion and accrual of benefits thereof, and raise the over-all capital output ratio for the economy as a whole.

What is obviously required in such a situation is action on three fronts: first, the maximum economy, indeed austerity, in the matter of current administrative expenditures by government; secondly, a deliberate moratorium on new project starts until at least the more significant of the pending projects is completed; and finally, a thorough screening of all pending projects and their prioritization, so that the more important of them can be quickly completed. This last task cannot be the responsibility of any one ministry or department and can be undertaken only by an authority like the Planning Commission. Unfortunately, the very tough decisions necessary in this context are somewhat difficult in practice, because of sectoral or local pressures.

As indicated earlier, the increasing capital : output ratio in the economy as a whole is a major cause for concern in any study of industrial productivity; and a systematic drive to lower the capital : output ratio by speedy completion of projects would have the immediate result of (a) reducing the burden of capital servicing cost in respect of infrastructure facilities, and (b) making available the benefits of better infrastruture facilities, sooner rather than later. Apart from the direct impact (on the over-all capital : output ratio, through a lowering of the capital cost), improvement of the infrastructure is likely to have a directly beneficial role on industrial productivity.

Infrastructure : Power

Infrastructure costs in India are today inordinately high, and impinge on industrial costs heavily when compared internationally. The high proportion of infrastructure costs to total costs raises over-all industrial costs. For example, power costs in India have been escalating rapidly in recent years, and high power costs tend to raise over-all industrial costs. Moreover factors like irregular supply, tripping, voltage fluctuations and restrictions on peak hour loading may raise industrial costs from anything between 10 per cent in normal circumstances to as much as 20 per cent or more in certain exceptional circumstances.

The above figures are startling, but are based on diverse studies on the subject, and are not difficult to demonstrate in broad terms. Inadequacy of power supply has increasingly led industry to rely on relatively less efficient captive power generation; and frequently, the cost of such power is something like twice the cost of power from the grid. Assuming that power costs are, say, 10 per cent of the total cost of an industrial undertaking, and assuming that the unit has to provide 50 per cent of its base load from captive generation, the total power cost would jump from some 10 per cent to 15 per cent of the total cost. It is relevant to note that recently, the government has made it obligatory for large new industrial undertakings to provide for a minimum of 33 per cent of power on a captive basis, with the recommendation that project authorities would be well advised to provide for a higher percentage of their power requirements on a captive basis.

The cost of power tripping, of voltage fluctuations and of unscheduled power shedding can be quite high; and depending on the industry, the impact on costs considerable. Two examples may be given; in one instance, in an aluminium manufacturing unit, the molten metal got congealed in the "pots" where alumina is refined into molten aluminium, requiring a shutdown of the plant and indeed, the replacement of the "pots", involving not only loss of production but also additional capital investment to salvage the plant. In another case, in a plant manufacturing antibiotics, entire batches of the antibiotics—in the process of being manufactured—had to be thrown out periodically because of "contamination" arising from power tripping. The costs have never been quantified but are certain to be quite heavy.

In many operations, restrictions on peak load demand have had the effect, according to one recent study, of raising costs by anything from 5 to 10 per cent. True, these costs are not all cumulative. But for continuous process industries, especially metallurgical and chemical industries, the costs of poor

quality of power supply can be quite high as indeed illustrated by the case of the pharmaceutical industry.

These are extreme examples, where the inadequacy of power supply could lead to increases in unit costs by 20 per cent or even more. More typically, a 10 per cent increase in unit cost because of the inadequacy as well as the unevenness of power supply is quite common. The inadequacy of other infrastructure facilities, by way of transport and other facilities can also increase industrial costs significantly. It is known, for instance, that uncertainties of transport compel the management of industrial undertakings to keep much larger inventories than necessary (or maintained in other countries). With the cost of money as high as it is today, an increase in inventories from say fifteen days' requirements of production (as normal abroad), to three to six months' stocks (as customary for many industries) can have a major impact on the cost of inventories, and therefore on total costs. If material costs are, say, 50 per cent of total costs, six months' inventories—as compared to one months' inventory of materials—may lead to an increase in inventory costs by more than 20 per cent.

It would, therefore, be recognized that "externalities" are a major factor in the present high cost structure of Indian industry; and any improvement in the infrastructure facilities available can help to bring down industrial costs quite sharply. This is a point which needs to be kept in mind in the formulation of policies for increasing the efficiency and productivity of industry.

Internal Management

While "externalities" are important, internal management is no less so; and perhaps it would be correct to state that the management of men, materials and finances in most industrial undertakings in India today leaves much to be desired. Indeed, it has become quite fashionable today to blame labour and overmanning for the present high structure of industrial costs, and this view is constantly put forward not only by spokesmen of industry but also by many policy makers. It is necessary to put this issue in its proper perspective.

Efficiency of production may be said to depend on three factors : efficiency in the use of capital; efficiency in the deployment of labour; and efficiency in the use of materials (and power) in the process of production. (Proper use of by-products falls under the last category.) We have, in part—though only in part—looked at the problem of efficient use of capital. Efficiency in the use of labour and materials involves both labour participation and good management. Indeed, even in regard to labour participation, management has a heavy responsibility, for instance, by imparting the required skills through on-the-job training, better work environment, and other means.

One should not, of course, deny the problems created by a rigid policy of "no retrenchment"; most of all, this engenders in the management a feeling that modernization should not even be attempted because of the reluctance of labour to adapt itself to new equipment and new tasks. Because of the difficulty of retrenchment, many managements have argued that modernization may lead to the employment of *more* labour rather than less. The jute industry is a classic example of absence of modernization because of a somewhat rigid policy as to labour. Nonetheless, barring one or two such extreme examples—especially in "sunset" industries—the role of labour policy in the present high cost structure of industry is much exaggerated.

Take the case of the steel industry. Here, employment of labour per tonne of steel produced is the highest in the world, in fact several times the employment of labour per unit of output in other steel producing countries. Nevertheless, it still remains true that in India, labour cost as a percentage of the total cost of production of steel varies between only some 12 and 15 per cent (in the case of the plants under SAIL). Further, next to South Korea, Japan and Brazil, labour costs per tonne of steel are still lower in India than in all other steel producing countries. In fact, inadequate maintenance—for which management must be made squarely responsible—and suboptimal use of materials have been responsible for much the greater part of capacity underutilization and inefficiency of production, observed in Indian industry.

It is in the overall management of all available resources of men and materials that our capacity utilization (as well as the quality of product) declines, and costs go up. It would be useful, in this context, to cite some figures and to illustrate how the laxity of internal management has led to both a steady decline in industrial productivity and to the continuance of high industrial costs in India.

Take again the example of steel plants. Part of the problem arises from poor maintenance and inadequate replacement, which are management responsibilities. More specifically, the yield of hot metal per cubic metre of available blast furnace capacity per day, is a standard index of productivity at an important stage of steel production in an integrated steel plant. This output depends on a large number of factors in which the ash content of coke and the iron content of the iron ore, as also the size and design of the furnace have a bearing. But the more important factors are uniformity of the input mix, the timely input of different materials, control over the furnace temperature, top gas pressure, and a host of other factors within the purview of shop floor management. When the Bokaro Steel Plant was commissioned in the seventies and had only one blast furnace, it attained an output of 1.3 tonnes of hot metal per cubic metre of blast furnace capacity per day. This parameter (at Bokaro) over the past several years (until 1984-85, the latest year for which published data are available) has been as follows :

1980-81	1981-82	1982-83	1983-84	1984-85
0.83	0.89	0.82	0.86	0.90

The comparable figures for the Tata Iron & Steel Company are of the order of one tonne per cubic metre of capacity per day. One has to note in this context the much older vintage of TISCO blast furnaces. The comparable figures for the other steel plants during 1984-85 are :

Bhilai	*Durgapur*	*Rourkela*	*IISCO*
0.90	0.62	0.70	0.59

The answer to the riddle lies in maintenance (the IISCO and Durgapur being sadly neglected plants), and the management of the available materials in a manner conducive to maximizing the yield rate. (It may be surmised that productivity would have sharply increased in the steel plants during 1987-88, since output has increased quite singificantly). The sharp variations not only from one plant to another but also in the same plant from year to year indicate differences in the quality of management. It should be noted here that the blast furnace productivity in Japan and South Korea has now reached around 2 tonnes per cubic meter of capacity per day; during the seventies, the same blast furnaces in Japan gave an output of some 1.2 tonnes per cbm/day. In other words, improvisations with regard to inputs (eg. use of greater sinter burden), control over input feed so as to ensure uniformity of inputs, electronic control over temperature inside the blast furnace as well as the application of top gas pressure and other technological innovations have brought about the observed improvement in productivity. All these are factors within the control of management.

Power consumption is an important index of management innovativeness and efficiency; and Indian industry has been notorious in regard to the excessive use of power per unit of output. Aluminium smelting illustrates the problem vividly. In India, power consumption per tonne of aluminium produced varies between some 18000 kwh and 20000 kwh. The figures in respect of the National Aluminium Company (NALCO) (based on the latest technology) are not available, but the foreign collaborators of NALCO, namely M/s Pechinay of France, have achieved a power consumption of some 13500 kwh per tonne of aluminium. While to some extent, plant design is responsible for this state of affairs, management of the plant as well as the quality of power available can make a big difference to the total consumption of power in an aluminium plant. With the cost of power accounting for a very large part of the final cost of aluminium production, a 50 per cent increase in the total quantum of power consumed (per tonne of aluminium) can make a big difference to the final price of the metal.

Such examples abound in all industries. The cost

of power (in 1981) per tonne of cement produced varied from Rs 22.1 to Rs 64.6 in various cement plants in India; the total energy consumed varied from 3.671 gega calories to 6.636 gega calories per tonne of metal produced by different steel plants (in 1980-81); again the total energy consumed (by way of coal, electric power and furnace) per tonne of white printing paper varied from 9.3 billion kilo calories to 23.05 billion kilo calories (the international standard being something like 4 billion kilo calories). In the sugar industry, the cost of sugarcane varies greatly from one area to another, but the variations in conversion costs are even more startling. In 1981-82 four sugar factories had a conversion cost of less than Rs 400 per tonne, while five factories had conversion costs ranging from Rs 3000 to 4000 per tonne, and one factory had a conversion cost higher than Rs 4000 per tonne. (Ghosh, 1982, 1984). It speaks volumes, not only of the inefficiency of managements but the inefficiency of the very system which permits such highly inefficient producing units to continue to function at the cost of the consumer.

In a study of the textile industry in India in the early eighties, the World Bank found that most of the units operated under 19th century conditions, with poor ventilation and lighting, outmoded, ill-kept and badly maintained equipment, and a general environment which could only lead to inefficient production. Preparatory equipment which might improve the quality of cotton for yarn spinning was generally conspicuous by its absence, leading eventually to poor quality of textile production. In a research study comparing long term productivity trends in India and the USA, a Dutch researcher found the index of productivity in the Indian cotton textile industry (USA=100) to have declined from 39.6 in 1937 to 15.7 in 1975 (Bart van Ark, 1987).

Enterprise

The point that emerges from the above trends observed in Indian industry is that for some reason, the management of Indian industry has not been attuned to seeking steady productivity gains; whether it is because of a sheltered market, or because of the lack of an "industrial culture", Indian industry has not evinced the spirit of enterprise that has characterised manufacturing industry in the developed countries. This characteristic is exemplified best in the use of age old, inefficient Lancashire boilers for generating steam by many units in the manufacturing industry. After the oil price hike of November 1973, the Petroleum Conservation and Research Association (PCRA) conducted a survey of the establishments using such outmoded boilers, in 1975-76. It was then found that with the higher price of furnace oil (after the oil price hike), replacement of the 5000 odd outmoded boilers (then in operation) by modern, fuel, efficient boilers was likely to be fully paid for in less than one year, sometimes in less than six months. Accordingly, a major publicity campaign was mounted by the PCRA, with a view to economising on the use of oil. In 1978-79, when a repeat survey was organised by the PCRA, it was found that the outmoded boilers had been replaced in less than five per cent of the concerned establishments; the number of old, fuel inefficient boilers still exceeded 5000. The reason given by the management of the concerned establishments was that they were used to the old boilers and did not want to take any risks involved in a change of boilers; some others implied that since costs and prices were going up generally, they were not particularly bothered because they were making good profits anyway, without changing the boilers.

It is in this context that it is necessary to view the problem of productivity in Indian manufacturing industry. It is obvious that mere financial incentives—while important—are not enough. There is need for an *attitudinal change*. And this attitudinal change can only come about by reducing the semi-monopoly or "cartelization" of important segments of industry. The most important desideratum in this context is freedom of entry; and the recent liberalisation of industrial licensing is, to that extent, a justified approach to industrial policy at the present juncture.

It is necessary to foster increased competition, and introduce a system which would reward efficiency and penalise inefficiency. There are too many areas of unwarranted intervention, as for example in the sugar industry, where past official policy has only helped to

perpetuate inefficiency. Even in the case of the cement industry, where "dual pricing" helped to increase capacity, a wrong policy approach – making levy cement a percentage of output rather than of rated capacity of cement plants—has encouraged cement producers to form a cartel and depress production, in the interest of jacking up the price of free sale cement.

Import Liberalization

The policy of import liberalization has, however, a different impact on the Indian economy, and needs much greater deliberativeness and pre-planning than has been in evidence. The reasons are simple. As long as total production costs are higher in India than abroad for reasons beyond the control of manufacturing industry, care has to be taken to ensure that Indian manufacturing industry is suitably protected. Two examples should suffice. The manufacture of equipment for power generation and transmission by BHEL is efficient by international standards; in fact the conversion costs of BHEL are lower than those of competitors abroad, but BHEL equipment is more expensive than imported power equipment because of the higher prices of steel and other inputs in India. BHEL has no control over the latter; and in this situation to permit the import of power generating equipment (either against external aid or against suppliers' credit) would be tantamount to slowing down India's efforts at industrialization. Similar is the instance of the import of machine tools from Japan for the Maruti Udyog Ltd., in preference to equally good machine tools manufactured by HMT, at the insistence of the Japanese collaborators. Such a policy is wrong in principle for the reason that any possible productivity gain at Maruti Udyog Ltd. are likely to be more than offset by the discouragement to the process of industrial growth of the economy.

Likewise, the freedom to import capital goods—at a concessional rate of import duty—by manufacturers in India, in the name of modernization, is not likely to be helpful *unless the importers of capital goods are made to face external competition themselves*. In other words, piecemeal import liberalization is unlikely to foster competition; it can only harm the indigenous industry. Import liberalization has, therefore, to be carefully planned.

An opposite conclusion would be reached when one examines the case of the Indian tyre industry—with nearly a dozen collaborations with all the major foreign tyre manufacturers—which has of late formed a cartel with a view to pushing up prices. In such instances, the threat of import of tyres is the only remedy. In other words, the threat of import should be used to curb monopolies and the formation of cartles; but actual import, to the detriment of domestic production, should be undertaken only after very careful consideration. There is, it seems, too much emphasis today on superficial modernization of the production process, somewhat haphazardly and piecemeal through the import of equipment and technology without an attempt to raise the general level of skills.

Industrial Culture

But, as stated at the outset, as long infrastructure costs are high, Indian industry would continue to have a high cost structure. And to the extent that much of the infrastructure has to be provided by the Government—either directly, as for instance roads, or through government owned companies, as for instance in power or steel – one has to look for other ways of improving efficiency, eg. by streamlining procedures, encouraging efficiency, and otherwise bringing about the development of an "industrial culture".

Better education and training and better skill formation are some steps towards such a transformation. The other lies in finding an *institutional solution to the problem of management* of public enterprises. The recommendations of the EARC (to which referance has been made earlier), made as far back as 1983, are still valid today. There is need for "autonomy" of State enterprises from governmental control and direction; there is also need for the development of a managerial cadre which will take pride in performance and which will be judged (and rewarded or penalised) on the basis of performance—for which yardsticks can be easily laid down. In short, it is in the efficient operation of public enterprises that a large part of the total costs of manufacturing industry would depend. The example of the Railways is relevant here; by and large, the Indian railways are better managed than many other segments of economic aetivity; and by and large, Indian railway opera-

tions have so far been left to the control of the Railway Board, without too much political interference. (And where there is intervention, it has led to the introduction of a diseconomy, as for instance through the introduction of prestigious superfast passenger trains which take up a great deal of line capacity; or free travel to all manner of politically favoured groups, which affects to railway finances).

Conclusion

To sum up, the search for higher productivity involves a multi-tiered approach. At one end, it involves the fostering of an "industrial culture", which is a slow and long process. At the other end, it involves the increasing introduction of greater competition, through both incentives and disincentives, which need to be carefully planned. For example, competition through the removal of barriers to entry is a formula which has proved useful, and may yet be more useful if this formula is effectively pursued (not merely in "form" but in substance). On the other hand, competition through import needs to be more carefully weighed and assessed and applied in a well planned orderly manner. Disincentives (eg. for wasteful use of power) need to be especially thought of where financial calculations of return are disregarded; there is even a case for shutting off power supply to units which refuse to change over to fuel-efficient production methods.

Most of all, there is need for increased emphasis on improved conditions of work, for these are known to improve productivity. A better plant layout, proper movement of materials (eg. on a conveyor belt where necessary), better maintenance of equipment, better ventilation and lighting, greater cleanliness, the supply of proper uniforms (for work) and subsidized meals from the cafetaria are known to have increased labour productivity enormously, eg. several times the costs incurred. There is need for "educating" managements in this regard.

Finally, it is no use seeking higher productivity through over-capitalisation (eg. through the use of robots) in Indian industry. Not only are wage-rates in India much lower than abroad, justifying labour intensive rather than capital intensive methods wherever possible; but the need is to raise the average, over-all productivity of the entire labour force, which is only possible through increased employment but with higher productivity of labour all round.

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Energy Conservation in Indian Industry

V. Raghuraman

Developed countries have reduced their energy intensities primarily as a result of pragmatic policies and programmes in the industrial sector. Considerable scope exists for Indian industries to improve their energy efficiency. The voluntary efforts of the industries and cautious Government responses need to be galvanised into cohesive, goal-oriented programmes. Some of the measures in accelerating the energy efficiency in the Indian industrial sector have been spelled out in this paper.

V. Raghuraman is Director (Fuel Efficiency) in the National Productivity Council.

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The Indian energy scene is replete with continuing energy shortages with no promise of respite in the foreseeable future. The problem is seemingly acute in the power sector, though, the shortfall in capacity addition in the Seventh Plan is expected to be much less proportionately than under earlier plans. And, although' there is a raising trend of plant load factor (PLF) of the thermal power stations, the gap is likely to be over 9000 MW in 1989-90. On the oil front the possibility of striking another Bombay High is still elusive and current production is stagnating at 30 million tonnes. The Adivisory Board on Energy (1986) has estimated that there will have to be an investment of Rs. 450,000 crores for acheving a production of 450 million tonnes of coal, 654 billion units of power capacity (138,000 MW) and 50 million tonnes of oil, which will have to go towards meeting the demand till 2004-2005. Even if this figure is only indicative, the resources required to be mobilised to realise these figures do not seem within reach, if the Seventh Plan experience is any guide. The oil, power and coal sectors estimated their requirements at Rs. 113,000 crores while the allocation made was Rs. 54,000 crores. In addition the oil requirements need to be met substantially by imports (40-50 million tonnes every year), a drain on our precious foreign exchange resources.

The country is, thus, faced with the challenge of meeting the serious energy shortfalls and economic stagnation. The situation obviously calls for innovative strategies and action on both the supply and demand fronts. The planning mechanism in our country has leaned heavily on augmenting supplies. It is well known that supplying new sources of energy takes many years. Hence, there has to be a greater

emphasis on the management of demand. In this context, energy efficiency offers a practical means of acheiving our national goals. This is exemplified by the experience of the industrialised countries.

Scenario of the Developed Nations

Before 1973, most analysts thought that energy use and GNP move together in lock-step. The energy events of the seventies ushered in the "Cogeneration Revolution" in the developed countries similar to the "Agriculture Green Revolution" in our country. This has given those countries a respite from shortages. In the United States while GNP has grown by 40% energy demand has increased only marginally. USA has further plans to reduce its energy consumption by 2.5% annually till 2000 A.D. Japan and West Germany use half as much energy per unit of economic output as the Untied States (Fig. 1).

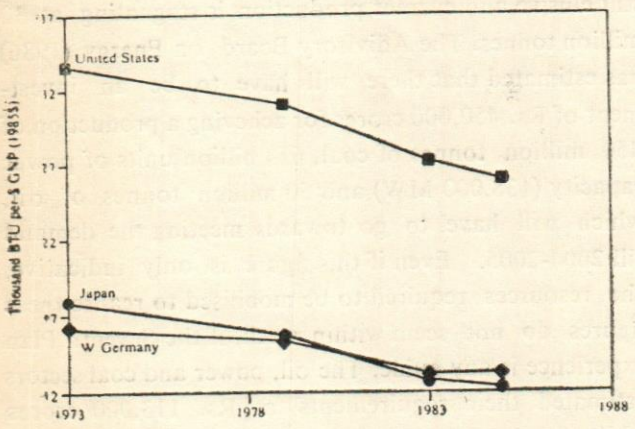

Fig. 1 Energy Intensity Reductions, 1973-85

In the EEC countries (OECD, 1987) the industrial sector has cut its energy consumption per unit of output by 24% between 1973 and 1983.

Rapid advances have taken place in enhancing industrial energy efficiency. This is very well proved by the overall energy output ratios. The principal features (world Energy Conference, 1986) underlying the improvements in the efficiency in the industrial sector are:

(a) **Technical Progress**: Despite declining real energy prices before 1974, the trend in the improvement of energy efficiency was visible due to modern energy consumption equipment involving high capital investment.

(b) **Changes in the Pattern of Industrial Output**: Energy intensive industries consume the bulk of the industrial energy requirements. With escalating energy costs, the prices of products from energy intensive industries also rose and demand for them declined in relative terms, resulting in reduction of their share of the GDP.

(c) **Increase in Energy Prices**: Price induced measures which clearly brought in cost escalation in manufacturing encouraged the industries to reduce energy inputs.

The lower phase of economic growth after the oil crisis has definitely had an impact on the level of energy consumption. Though it is dificult to assess the individual contribution of the above factors, it is estimated that in USA during 1972-81, the energy efficiency of the manufacturing sector has improved by 18%. Out of this 7% was attibutable to the technological improvements, 7% due to shifts in product mix and only 3% was price induced. While estimates from UK suggest a 50% contribution attributable to changes in the product mix, during 1970-73, estimates in Japan, Canada and Sweden show that about half of the overall improvement in energy efficiency is due to changes in products.

Potential for Future Energy Conservation

It is generally recognised that there are three stages of energy canservation in industry.

1. Housekeeping

This involves improvements in monitoring and control aimed at reducing wastage, and requiring no significant investments.

2 Retrofit

This, normally, involve a small investment with big paybacks designed to improve the energy efficiency of the existing equipment.

3. Process Technology Improvements

These imply major investments that significantly alter production processes through the introduction of new and efficient equipment and control systems.

Several cases for various industries in OECD countries indicate that, virtually, all price-induced improvements in energy efficiency to date have been due to the first two stages which have accounted for perhaps 5-10% of the improvements in energy efficiency. It is expected that very little can be gained from further housekeeping improvements, although there is considerable scope for further efficiency gains due to retrofitting. The major gains for the coming decades will accrue through improvements in process technologies, development of newer materials etc. which require large scale capital investments. The decisions for these investments are affected by economic factors, as for instance, the need for new products or increased production capacity rather than by potential energy savings.

Energy Saving Potential

Based on a number of macro-projections, it has been indicated that about 30% of energy industry in West Europe could be saved by using the existing technology and with investments which are economic in the current climate of energy prices. A breakdown of the technical potential and estimated savings till 2000 AD is given in Table 1.

From the technical standpoint, these estimated savings are generally applicable to all developed countries. Gains in efficiency are not likely to be large, perhaps only 10-15% in the 1980s and 1990s. This is because the heavy industries are relatively efficient and their capital intensity makes adoption of new technologies difficult; the potential is greater in small and medium industries. However, the wide variety of technologies that exist and the problems of training and overcoming ignorance are also noticeable constraints.

TABLE 1 **Energy Savings in Western Europe from 1972 (Figures in Percentage)**

Industry	Technical	1976	1985	2000
Iron & Steel	25-35	0	10-15	15-30
Other furnaces	25-35	3-5	10-20	15-30
Chemical (Fuel)	15-25	0-2	5-20	15
Others	20-30	4-8	10-15	15-26

Source : World Energy Conference, (1987).

In the developing countries, organised energy conservation efforts are still at the infancy stage. Among the countries in the Far East, South Korea is the olny one with an organised conservation programme and the current thrust of activity is on the performance of audits and the gathering of information for development of a data base and specific plant goals (Table 2).

Thus, it can be seeen that substantial savings can be obtained, especially in large industries; however small industries which are common in these countries do not have the capability to invest in the newer technology which may be highly capital intensive and expensive. It is more viable for those countries that have relatively abundant supplies of labour to utilise technologies substituting labour for both capital and energy.

The Indian Scene

Indian industries are characterised by their high specific energy consumption (Table 3). The industries, in general, are yet to make their impact felt on the GNP vs energy growth rates though there have been individual industries which have benefitted from organising energy conservation at the unit level.

Though price induced measures and restricting the use of furnace oil in industries were initiated earlier, the first serious attempt by the Government of India

TABLE 2 **Potential Energy Saving in Selected Industries in Developing Countries**

Industry	Developing Countries' total Commercial Energy Consumption Million tonne/ year	Potential Saving % Category A	Category B
Iron Steel	109	3	15-20
Petroleum Refining	54	7	15-25
Cement	52	11	18-25
Chemicals (Ammonia)	19	2	20-25
Pulp & Paper	15	11	12-15
Aluminium	13	2	10-15

Source : World Bank Report (1983).

Note : Category A : refers to small investments consisting mostly of combustion efficiency improvements, insulation, steam system efficiency improvements and other housekeeping measures; paybacks within 10-20 months.

Category B : refers to large investments in retrofitting existing plants and additions to facilities including waste heat recovery, cogeneration, increased use of waste fuels, simple process changes and controls and replacement of inefficient equipment; paybacks in 2 to 5 years. Savings in categories A & B are not necessarily additive in several plants.

TABLE 3 **Comparison of Energy Use in Selected Industries in India and Advanced Countries**

(Million Kcal/tonne)

	Steel	Cement	Pulp & Paper	Fertiliser
India	9.50	2.00	11.13	11.25
Italy	4.03	0.89	—	9.92
Japan	4.18	1.20	—	—
Sweden	5.02	1.40	7.56	—
UK	6.07	1.30	7.62	12.23
USA	6.06	0.95	9.70	11.32
West Germany	5.21	0.82	—	—

Source : Tata Energy Research Institute (1984).

in the field of enregy conservation was the setting up of an Inter-Ministerial Working Group (IMWG) on utilisation and conservation of Energy in 1981, to recommend policies and programmes for achieving desired goals and targets for energy conservation. In 1982-83, the industrial sector accounted for 40% of the energy consumed, equivalent to 88 million tonnes of coal per annum. From a sample of 200 industrial energy audits conducted by the National Productivity Council covering twelve sectors of the industry, the picture that emerged of the total saving potential is as outlined in Table 4.

TABLE 4 **Potential Energy Savings in Industrial Sector : (Industrial Sector : Conservation Potential : 25%)**

Energy Form	Unit	Present Annual consump.	Savings Possible	Investment required for creating eql. resource (Rs million/ unit)	Total Invest-required (Rs. Million)
Coal	Million tonnes	70	17.5	500	8750
Oil	,,	4	1.0	1800	1800
Electricity	,,	60 Btu/kwh	52.5 MW	0.900	47250
Total Investment for creating equivalent to energy capacity					57800
Investment required for implementing Energy Conservation Measures					36000
Annual Expenditure Saving in industrial sector by implementing conservation measures					19250

Thus, it can be seen that Rs 19,250 million per annum saving potential existed in the industrial sector which could be realised with an investment of Rs 56,000 million. The equivalent investment to create additional energy capacity would mean an investment of Rs. 57,800 million. Thus, energy conservation investments were 1.6 times cost effective. Inspite of this, the response of industry as a

whole has been lukewarm. While some of the units in organised industry in the large scale sector have been alert and responsive, medium and small scale units have not appreciated the extent of possible savings and lack the expertise to achieve sustained savings. Another disquieting factor is that industries which are already efficient are striving to be more energy efficient but the inefficient ones are continuing to be wasteful in their practices. The challenge, therefore, lies in motivating the inefficient units to adopt energy efficient practices and improved technology.

It was recognised that while the immediate benefits to the individual enterprise may be marginal in the cost of energy saved, the cumulative effect on the economy as a whole is substantial. Further benefits to the economy accrue due to a cleaner environment and by avoided supply costs such as the cost of transportation, additional mining of coal, oil prospecting, etc.

Suggested Policy Measures

Keeping these in view the 1MWG spelled out some important policy guidelines:

(i) Good housekeeping measures such as tuning of combuston equipment, avoiding leakages, better insulation, proper maintenance, optimum use of capacity etc., go a long way in reducing energy consumption levels. There is need to evolve housekeeping standards for industries and to propagate the message of conservation through the mass media; labelling of appliances for energy consumption was also emphasised.

(ii) The main motivation for any industry to conserve energy lies in the ultimate financial economy. In this task, rational energy pricing policies and tax incentives for energy savings resulting from conservation efiorts play an important role. The report took into account the need to encourage industrial units to monitor their energy usage. A suggestion was made that the companies should include information on energy use in their annual reports and record energy—saving achievements.

(iii) Policies to reward energy efficient units during fuel and power shortage situations and thereby induce industries to boost energy conservation efforts wers highlighted. The need for carrying out overall social-cost benefit analysis of national conservation programmes at the macro-economic level, taking into account shadow prices, foreign exchange considerations, opportunity cost of subsidies etc. was stressed.

(iv) Co-generation systems need to be adopted on a large scale. Units consuming over 25 tonnes per hour of steam should be encouraged to adopt total energy systems and industrial conglomerates requiring large quantities of process steam should be persuaded to realise the full potential of the energy resources through co-generation. According to the IMWG, a potential of 1500 MW of additional power can be achieved in such industries through co-generation, without any extra fuel consumption being involved.

(v) By their very nature, energy conservation programmes will have to cover the activities of many government departments. An apex level steering group should, therefore, be set up with the responsibility of reviewing and monitoring various programmes, the formulation of suitable policy measures, the creation of formal organisational units wherever necessary etc. Such a group will ensure coordinated implementation of the programmes.

(vi) Financing energy conservation investment would require preferential treatment. It would be necessary to set apart separate budgets for energy conservation. Methods may have to be devised to generate adequate funds, if necessary by imposing a small cess on the fossil and other fuels consumed by the industry. Out of this cess, a revolving fund to be expanded by around Rs 100 crores every yeary over a span of ten years, should be set up for funding energy conservation schemes in the industrial

sector as a distinct programme. Since long term requirements of funding may be large, careful thought may have to be given by the appropriate government agencies. It might be necessary to identify the right agencies for administering these. These funds should be available not only for the marginal investment on equipment but also for the supporting training and educational activities.

The Industry Response

With respect to the above recommendations, there has been discernible progress in the adoption of good hausekeeping measures especially with regard to the consumption of fuel oil by industries. The post oil crisis era witnessed the setting up of the Petroleum Conservation Research Association (PCRA) which has been conducting diagnostic fuel utilisation studies in the industrial sector since 1976. As a result of PCRA studies (PCRA, 1987) a saving potential of 0.415 million kl of fuel oil has been achieved in 1625 industrial units out of a 3.38 million kl. consumption level which is about 9.7% of the total consumption in the industries studied. However, for the coal and electricity sectors, such organised efforts are yet to be established on similar lines. Over the years, there has been a growing awareness among the industries about the need for energy conservation. This is revealed by a follow-up study of 178 units conducted by the National Productivity Council in 1986. This exercise indicated that 70 units (40%) have implemented energy conservation programmes successfully while 29 unite (16%) are yet to start energy conservation programmes. The pace of implementation has generally been very slow and the energy savings achieved are Rs. 102 million against a saving potential of Rs. 840 million indicating that only 12.3% of the saving potential has been achieved in these units. Another survey conducted by the Federation of Indian Chambers of Commerce and Industry in 341 units has revealed that several industries are able to realise savings as in Table 5.

Some progressive units seem to be doing well in areas like energy accounting, auditing, housekeeping, replacement of machnery, instrumentation etc. The

TABLE 5 Energy Saving Achieved by Respondents

	No. of Units	As of total respondents
Upto 5%	128	37.54
5-10%	72	21.11
10-15%	34	9.97
15% and above	43	12.81

Source : FICCI (1988)

above survey has revealed that there are several constraints being faced by units in achieveing energy conservation which can be summed up as given in Table 6.

TABLE 6 : Constraints in Energy Conservation Identified by the NPC Follow up Study

Constraints	No. of Respondents	%
Incentives are not adequate	127	37.24
Soft Loans needed	118	34.80
Requisite equipment not available	108	31.87
Trained manpower not available	106	31.09
Consultancy services not available	102	29.91
Internal resource limited	99	20.03
Return on conservation not attractive	87	25.51
Non-availability of appropriate information on energy saving measures	85	24.93
Energy cost too low	71	20.82

Source : FICCI (1988).
Columns are not additive.

Non Energy Intensive Industries

Inspite of the large potential for energy conservation, such industries have generally not been responsive to these programmes. There is a need to discip-

line the inefficient units by determining their legitimate energy requirements through scientific energy audits. Industry associations such as the CEI, ASSOCHAM and FICCI have been taking initiatives to motivate such industries to be energy conscious. However the measures implemented by the industries are routine housekeeping types, not involving any capital expenditure (except the glass industry which has discarded the oil-guzzling unit melters).

Energy Intensive Industries

Energy intensive industries are, by and large, price administered; energy efficiency is linked to technology and closely related to the economies of scale. Fertiliser is, for example, a sector where the installed capacities match those obtaining in developed countries. As a result, the fruits of energy efficiency are being realised. The aluminium sector was charactriesd by low capacity utilisation due to power restrictions. This has been obviated in the case of the recently set up National Aluminium Company with a captive power plant; the technology chosen is less energy intensive, consuming 14,500 kwh per tonne as against 16,500 kwh in other conventional plants. The cement industry withnessed progressive trends since the price de-control in 1982, where there has been a spurt in conversion due to energy efficient dry process. The refineries and petro-chemical units have organised energy conservation programmes and have incoporated waste heat recovery systems. The paper, textile and chloralkali sectors have not yet recorded significant gains, though leaders in the group have recorded good progress. As a rule, existing units are not enthused to invest in energy conservation, as there is not much incentive under the administered price environment. The new units are. however, regulated through the licensing mechanism and energy efficient features are being examined.

The energy shortage scenario entails innovative courses of action to ward against industrial stagnation such as the weaning away from energy intensive materials; priortising the end use of energy intensive materials; seeking alternate venues for processing e.g. in Mozambique hydel potential could be developed to smelt aluminium from the enriched Alumina shipped from India. Decision could also be taken to import energy intensive materials instead of energy. Such policy guidelines need careful thinking but have distinct merits in reducing the energy intensity in the manufacturing sector.

Fiscal Measures

On the fiscal side the government has announced the following provisions :

(a) 100% depreciation allowance for notified energy conservation equipment in 1983 (Annexure 1).

(b) Customs duty reduction for notified energy conservation equipment/devices in 1988 (Annexure 2).

The lists are restrictive and do not cover all energy conservation equipment. The provision of 100% depreciation allowance is mandatory for industries to benefit from energy conservation investments. This restricts units making marginal profits from making use of this provision, as they will not be in a position to announce dividends to share-holders if they exercise the write off option in one year. It would have been better if the provision was to allow enough leeway to avail of the depreciation allowance, as deemed fit by the industry with the ceiling upto 100%.

While the concept of a revolving fund specifically for financing energy conservation investments is yet to gain ground, IDBI has come out with the

— Energy Audit Subsidy Scheme

— Energy Conservation Equipment Finance Scheme.

The energy audit subsidy scheme promotes rational use of energy through energy audits in industries. The emphasis is on setting up targets or coordinates for specific energy consumption levels based on reasonably good housekeeping, operational and in-depth energy audit exercise. The costs towards the energy audits by approved energy consultants would be subsidised by IDBI. A complementary scheme funds the energy conservation investment.

The novelty of the scheme is the provision of soft loans with interest rates declining from 14% to 10% depending upon the percentage saving or reduction in unit level energy consumption as compared to the standard level of energy consumption. The scheme limits the promotions contribution to 10%. The energy audit costs borne by the units would be treated as part of the promoters' contribution, and there is a moratorium of two years on the repayment of the loan. However, the loans are limited to 5% of the gross fixed assets to the company and with a ceiling of Rs. 4 crores. It is hoped that in times to come, the ceiling will be revised upwards. Such a step would be necessary if capital intensive projects such as co-generation are to be implemented. This step by the IDBI would fulfil the long felt needs of the industry for concessional finance and separate investment schemes for energy conservation.

Conclusion

Policies to promote co-generation are yet to be formulated. A nodal organisation for a concerted programme of energy conservation has not been instituted so far. Though the office of Adviser (Energy Conservation) had come into being by 1987, the organisation needs to be strengthened with requisite personnel and the objectives well defined. There has been efforts by the Advisory Board on Energy to frame the Energy Conservation Law with the help of the Indian Law Institute. The blueprint is still in the discussion stage. The Bureau of Indian Standards is showing greater initiative in drafting standards on energy conservation. But the entire energy conservation programme still lacks a focus, as the successive five year plans have not considered energy conservation as a resource for planning. The seventh plan approach document stressed the need for industries to adopt good housekeeping practices; but no positive programmes or allocations were spelled out. It is hoped that the Eighth Plan will draw up a comprehensive energy conservation plan with adequate financial allocations, with the nodal office of the Adviser (Energy Conservation). A well thoughtout energy efficiency agenda would go a long way in reducing energy intensity in the manufacturing sector and the methodology evolved could be profitably adopted for the other sectors of economy. Thus, a thrust on energy conservation in the Eighth Plan could foretell an energy easy position helping to attain the targetted 6% growth rate. The experience of developed nations has conclusively proved the merits of energy conservation as a major plank in energy management.

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ANNEXURE 1 List of Energy Conservation Equipment Eligible for Accelerated Depreciation

100 per cent Depreciation Allowance on written down vallue is allowed on energy saving devices and systems listed below :

(Item under IIIF(2A) under part I of Appendix I to the Income Tax Rules 1962, effective from April 1983).

(a) Spcialised boilers and furnaces

(i) Ignifluid/fluidized bed boiler
(ii) Flameless furnaces
(iii) Fluidized bed type heat treatment furnaces
(iv) High efficiency boilers (thermal efficiency higher than 75 per cent in case of coal fired boilers and 80 per cent in case of oil/gas fired boilers)

(b) Instrumentation and monitoring systems for monitoring energy flows :

(i) Automatic electrical load monitoring system
(ii) Digital heat loss meters
(iii) Micro-processor-based control systems

(c) Waste heat recovery equipments and co-generation systems

(i) Economisers and feed water heaters
(ii) Recuperators and air pre-heaters
(iii) Backpressure turbines for co-generation.
(iv) Heat Pumps
(v) Vapour absorption refrigeration system
(vi) Organic rankine cycle power system
(vii) Low inlet pressure small steam turbines.

(d) Power factor correcting devices

(i) Shunt capacitors and synchronous condenser systems.

ANNEXURE 2 List of Energy Conservation Equipment Eligible for Reduced Import Duty

Import duty in respect of following 15 specified energy conservation equipments has been reduced to 40% (35% basic+5% Auxiliary) ad valorem vide notification No. 30/88 Customs, dated 1.3.1988

Sl. No.	Description
1.	Flameless furnaces for reheating and heat treatment applications.
2.	High velocity recirculating furnaces for reheating and heat treatment applications.
3.	Low excess air burners (below 10% excess air).
4.	Fuel oil emulsion burners.
5.	Regenerative burners for application in forging and heat treatment furnaces.
6.	Self-Recuperative burners (Burners using pre-heated air).
7.	Flat flame burners.
8.	Heat pipes for extracting heat from low temperature fluids and gases.
9.	Heat pumps for space heating, water heating, cooling applications.
10.	Free ball bucket steam traps with no links/hinges.
11.	Automatic microprocessor based load demand controllers from efficient load management.
12.	Microprocessor based combustion control system for boilers.
13.	Light sensitive time switches for street light controls.
14.	Microprocessor based automatic anode overpotential controllers in caustic, chlorine and aluminium industries.
15.	Microprocessor based universal programmable timers for continuous and batch processes, such as in type industry and rayon industry.

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The Productivity of the Marketing Man: Some Behavioural Aspects

S.K. Roy
R. Ravi Kumar

What are the behavioural traits that go towards maximizing marketing productivity ? This paper examines this issue and explores ways in which such productivity can be enhanced though appropriate behavioural interventions.

S.K. Roy & R. Ravi Kumar are Faculty Members in the Indian Institute of Management, Bangalore-560076.

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Behavioural-science research and practice in the Indian organisational context today has achieved considerable specificity. In most areas, generic formulations, increasingly, have given way to situation-specific applications.

Setting-specific behavioural work is available today in such diverse and wide-ranging fields as (a) educational establishment (Mathai et. al., 1977), (b) defence and police organisations (Roy, 1974; Valech, 1986), (c) the small-scale sector (Patel, 1978); (d) the rural context (Moulik, 1980); (e) large-size system (Balakrishna et. al, 1980); (f) bank organisations (Das, 1975); (g) public vis-a-vis private sector organisations (Sharma, 1983); and (h) government bureaucracy (Changati, 1979). Moderator variables such as culture (Sinha, 1973; Chattopadhyay, 1975) and organisational level (Varghese, 1975) have also been investigated. Evidence on meta-settings, particularly the studies of turnaround management (Khandwalla, 1981), contribute further to the specificity.

The functional area constitutes a specific management setting. Different functional areas, no doubt, have their own unique problems and constraints, and behavioural-science interventions, whether through research or training, which may be highly valid for one function, say manufacturing, may not necessarily be so for another, say, finance or marketing.

The present paper provides an overview of behavioral-science factors and interventions that are particularly relevant for marketing productivity in

Indian organisations. The Paper—I deals with the concept of marketing productivity with particular reference to the Indian environment. It outlines certain behavioural inputs in respect of which Indian experiences are available. It provides a summary and indicates particular directions for applied work.

Marketing Organisations: Changing Profile

Qualitative shifts in the marketing function are evident today. Shifts are noticeable not only in the environmental ambience but in the organisational dynamics as well.[1]

As far as the environmental factors are concerned, the increasing number and size of manufacturing units implies greater competition. Overcapacity in the two-wheeler industry is a case in point. Second, firms today have to dispense their goods over increasingly distant and scattered markets, exerting greater strains on the distribution systems. The effective distribution area of even consumer non-durables has increased manifold, involving rural distribution and deficient infrastructures. Third, in a situation of abundant choices, the consumer has assumed greater significance. Profitability is possible only as a corollary to consumer satisfaction. This environment demands departure from the conventional emphasis on the product, as also departure from discrete, unintegrated management actions. In industrial marketing, for example, sophisticated technology, and the customer's freer access to his own principals, make him more discerning, demanding greater precision in marketing.

Fourth, governmental policy fluctuations bring about rapid shifts in demand patterns, which even the highly strategic-oriented managements cannot anticipate. The recent governmental policy not to permit further licenses in the DAP fertilizer sector, for example, substantially dislocated firms that had earlier specialized in executing turnkey contracts, forcing them to diversify into pollution control and such other businesses. Unpredictable developments, such as inadequate monsoons, bring about demand recession and glut conditions, badly affecting fertiliser marketing, for example (Rao, 1984). Finally, there is the phenomenon of the "exploding" middle-class, which brings about unexpected and far-reaching shifts in demand patterns, e.g. in consumer electronics and in packaging materials. Marketing environment is the disturbed-reactive type and certainly not the placid and randomise conditions of yore (Emery, 1965).

Within the firm too, significant changes are evident. First, the grievance resolution ambiguities are increasing. Marketing organisations are far more conflict-prone today. White-collar unionism in the pharmaceutical industry is an example. Second, marketing organisations today reflect a vastly changing manpower composition particularly at the supervisory and managerial levels. From the nationally known management education institutions, for example, ever increasing proportions of management graduates, a majority of them engineers, are joining marketing. Third, the effective compensation levels of marketing personnel both at entry as well as at the profit-centre levels of accountability are comparatively higher. Such compensation levels not only then make people more sensitive and expectant in terms of their non-money needs, but also generate greater pressures for career and compensation planning. Finally, the work environment is characterised by greater stress.[2]

The challenge of the marketing function is likely to increase as the emergent tasks, such as rural marketing, become more demanding in the future.

Applications for Marketing Productivity

We examine four behavioural-science application areas viz. The Hiring Process including the Assessment Centre Techniques, Developing Marketing Personnel, Organisational Structure and MIS and Advertisement Research and Evaluation.

1. The present discussion on the marketing environment in India has benefitted from Neelamegham (1978). Also see Ramaswamy et. al. (1983).

2. For a relevant discussion on stress, see Mamoria (1985).

The Hiring Process

Predictor measures that yield satisfactory selection ratios relate both to (i) ability assessment and (ii) temperamental factors (Mandell, 1955).

The marketing man needs to display ability in verbal fluency, verbal comprehension, and social intelligence. Effective intelligence, i.e., spontaneous generation of problem-solving alternatives, given the time constraints, also no doubt becomes significant, particularly in personal selling situations. While standardised psychometric tests are available today for all the relevant abilities, these are assessable through the more convenient non-test measures as well, particularly the stress interview and the leaderless group discussion technique.

For the non-test measures to be predictive, however, interviewers and observers must have better goal clearity as to exactly what criteria they seek to identify. Lack of such clarity yields only certain omnibus stereotypes of little discriminative value. Social intelligence and sensitivity are better assessable through psychological tests, particularly through the empathy-based tests (Guildford, 1967; Ginzberg, 1964).

Temperamental, including the motivational factors, do not, however, lend themselves to valid non-test assessment. Personnel selection situations, especially in an unemployment ridden country like India, inevitably generate intense competitiveness, and non-test measures such as the interview, can yield only faked and socially desirable responses. For valid test assessment, it is, however, imperative that the forced-choice psychological inventories are used, which confront the applicant with equally desirable multiple choices.

Temperamental variables significant for marketing productivity, particularly at the supervisory and managerial levels, relate to stress and risk tolerance, expressiveness, practicality, self-assurance, assertiveness, flexibility, and tough-mindedness. Specific interest and value assessments also prove useful especially for senior-level marketing positions. Tests apart, careful analysis of biographical data, and then detailed exploration of the available cues through the personal interview, often proves highly rewarding.

For internal selection from amongst company candidates, the assessment centre technique proves useful. Current job performance ratings, even if valid, may not predict future potential; jobs at different hierarchical levels make qualitatively different demands. An assessment centre battery typically employs in basket tests, group tasks, job skill exercises, and sociometric ratings (Mackinnon, 1975).

A common inadequacy in the selection of marketing personnel is our failure to distinguish between consumer marketing and industrial marketing. While the former requires the ability to improvise, and social perceptiveness, industrial marketing situations involve many other considerations such as the nature of the customer's business, the key problems where the company products may be of assistance, who the people exactly are that would make the buying decisions, and what the competitor strategies are. Personnel selection tools, and also the criterion measures employed, should correspondingly be different.

Developing Marketing Personnel

Today's personnel training and development in the marketing area has two concerns: products information and persuasion techniques. A much wider variety of need-specific personnel development should, however, prove more meaningful in view of the total marketing milieu. Four areas seem particularly relevant: 1. Training for Effective Intelligence. 2. Communication Sensitivity. 3. Rationality and Assertiveness Training. 4. Composite Competence Development.

Training for Effective Intelligence

Short-range performance, and the influence process are central to the marketing technology. "Effective intelligence", therefore, becomes cardinal, i.e., the ability to articulate in given situations, and at short notice, appropriate problem-solving responses and also simultaneously handle a range of variables both cogni-

tive and social (Guildford 1967). Simulation techniques based on behavioural modelling produce adequate results in this regard, to the extent behavioural rehearsal and feedback are incorporated in the training process (Moses, 1978).

Grid-based training for marketing productivity is also relevant (Blake, 1970). It identifies behaviour which is likely to be weak and inffective in selling situations and locates the underlying reasons. Self-evaluation exercises, then, highlight the different grid positions and their respective advantages and disadvantages.

Communication Sensitivity

Communication training and workshops designed for marketing personnel normally emphasise verbal articulation, fluency and skills. In complex marketing situations, however, the communication input is equally important. At the same time, the articulate could be quite insensitive to environmental intangibles.[3] Communication training should therefore equip sales personnel with the ability to perceive and monitor, in interpersonal and small-group contexts, the more intangible and subtler aspects of human and business interactions.

Appropriate variants of the T-Group methodology (Craig, 1967), and also communication games with structured observation (Goldstain, 1974), could prove useful. The socially intelligent do, of course, internalise such training cues faster.

Rationality and Assertiveness Training

Marketing jobs are inherently stressful because effectiveness involves a large number of external and short-term human contacts—often with the unfamiliar.[4] The selling role entails a disadvantage in terms of the power relationship too, carrying greater liability to negative and dysfunctional emotions and feelings.

Assertiveness training helps rationally restructure their cognitive system and minimise their self-limiting beliefs and thought-patterns, and can therefore be highly productive. In particular Ellis, rational-emotive techniques (Ellis, 1962) and Beck's cognitive techniques (Beck, 1961) could yield enduring results in marketing training. The trainer must, however, have proper familiarity with the operant conditioning methodology (Skinner, 1953).

Composite Competence Development

Marketing mix is an interdependent system of product identification and development through pricing and credits dicisions, customer feedback and advertisement research. Composite competence, therefore, become essential for overall system effectiveness. Managers even at senior levels, however, have career background either in terms of sales or product development. The general and integrative exposures are absent.

Classroom settings cannot, however, be expected to contribute to composite competence development as much as role development, viz. job rotation and redesign. Incumbents must not, however, perceive such exercises as punitive.

Organtsational Structure and MIS

Three kinds of distortions are evident in Indian marketing organisations, viz., 1. Lop-sided job structure of intermediate-level managers. 2. Field feedback distortions. 3. Compensation imbalances.

Job Structure of Intermediate-level Managers

Thc complex problems of information witholding and feedback are well documented (Lawler, 1971). The diversity and far-flung nature of marketing operations, if anything, confound the problems further.

Authentic field feedback must, however, reach the central marketing establishments for policies and operating systems to be realistic. Formal systems cannot however, radically, retrieve all the dynamic and subtle information available in the field, particularly informa-

3. Correlation between articulation and intelligence, too, is doubtful. See Mandell (1970).
4. For a discussion on the "Contact Occupation" see Cattel (1957).

tion about customer product mix and product-service mix. Only field personnel in face to face encounters can provide such feedback information.

In practice, however, company meetings generally develop a downward traffic. There is subtle resistance and a pejorative climate develops, blocking field feedback (particularly in its subtler aspects). The dynamics of selective information given and selective perception both come in to play. Large blind-spots develop in the policy-making centres. The grid model can be usefully applied to marketing operations for auditing its overall communication effectiveness (Blake, 1970).

Compensation Imbalances

Equity plays a significant role in financial compensation vis-a-vis the quantum (Lawler, 1971). Marketing organisations betray two distortions in compensation structures having far-reaching implications particularly in view of the emergent industrial relations climate.[5]

First, the effective compensation, including perquisites, of top-level marketing managers seems disproportionately higher than that of the other functional-heads. Internally, too, their compensation levels seem inequitable compared to those of the other levels within marketing. Better rationalisation using more appropriate benchmarks appears overdue.

Second, the base compensation of sales personnel in a large majority of industries is relatively lower than that of their counterparts in the other functions. Historical fortuities seem to have determined the relative compensation levels. Job analysis and compensation restructuring appear overdue particularly in the context of such job costs as stress, employment security, degree of direct accountability, dependency of external resource, etc.

Advertisement Research and Evaluation

Advertisement research, including motivation research, has long been an important area. It ought to attract the attention of our psychological and sociological researchers particularly in view of the increasing television coverge, growth of rural markets, formation of consumer associations, etc.

Applied research could relate to questions in respect of (a) "the product personality"; (b) identifying the exact satisfaction consumers derive from particular products; (c) specifying what unique features consumer perceive in the product brands they use; and (d) determining the relative strengths of the various demand-creating forces under particular marketing conditions (Grissy, 1971).

Summary and Direction

Four behavioural-science application areas were outlined in the context of the changing characteristics of Indian marketing organisations. These relate to : A. The Hiring Process including Assessment Centre Techniques. B. Developing Marketing Personnel. C. Organisational Structure and MIS. D. Advertisement Evaluation and Research.

Two specific directions of organisational applications are apparent today, viz., (i) rural marketing; and (ii) industrial relations. First, it appears hightime that marketing organisations undertake appropriate planning and review exercises in oder to develop better capability for the emergent rural marketing, particularly in the pharmaceutical, transport and fertilizer sectors. Modified organisational structures and systems are required for better demand forecasting, appropriate product modification, and territory management. Today's elitist marketing organisations might prove inadequate.

Second, the industrial relations milieu in marketing requires better monitoring today. Unionisation among marketing personnel is of relatively recent origin in Indian organisations. In the area of according legitimacy and bargaining status to it, the attitude of manaegment is somewhat ambiguous. Management of unionism in marketing could prove unwieldy, given the dispersion and far-flung nature of the operations. The lack of legitimisation, however, is.

5. For a discussion see Stagner (1965).

probably contributing to inter-group distrust and militancy. Field inspection and supervision of sales personnel is becoming increasingly difficult. Necessary organisational preparations for collective barganing appear overdue. Field-oriented diagnostic surveys incorporating both compensation and accountability issues would also be relevant for marketing productivity.

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Productivity Trends in Indian Automobile Industry

NPC Research Section

Despite its tremendous potential for generating employment, both direct and indirect, for building entrepreneurship, for stimulating the development and for introduction of modern and sophisticated technologies, the performance of Indian automobile industry could not be considered inspiring in recent years. This brief report on the productivity performance of the industry examines its record with respect to some of the vital parameters.

Prepared by a team of specialists consisting of N.K. Nair, Director (Research), A.K. Burman, Assistant Director (Research) from the National Productivity Council and K.D. Kohli, Consultant.

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Automobile Industry is an important segment of the coutry's engineering industry. It has a tremendous potential for generating employment, both direct and indirect, for promoting high grade skills, for building entrepreneurship and for stimulating the development and introduction of modern and sophisticated technologies. It also plays a vital role in the economic development of the country besides being of strategic importance for the country's defence and security needs.

The crucial role played by the automobile industry in the overall economic development of a country has led to its faster growth in almost all countries of the world-both developing and developed. Rapidly rising production of passenger cars and commercial vehicles in some of the world's major automobile producing countries (Annexure-I) is a clear evidence of the fact that a strong and viable automobile industry is considered a prime nacessity by almost every nation. That the importance of the automobile industry is well recognized all ever the world is further supported by the fact that some of the major automobile units in the USA, Japan and West Germany are currently counted amongst the world's top fifty industrial groupings, e.g. General Motors of USA is ranked 4th, Toyota of Japan is ranked 13th and Daimler of West Germany is ranked 17th (Times, 1000-1987-88).

Importance of Automobile Industry in India

In this vast country with greatly varying terrain and large inaccessible areas, road transpart naturally comes to acquire considerable importance. It is at

present the second most important means of transport for goods and passengers next to the railways (Table 1).

TABLE 1 Estimated Traffic Carried by Road

Year	Passengers (BPKM)[1]	Freight (BTKM)[2]
1951	40.4	12.1
1960	90.5	26.3
1970	233.8	62.5
1980	528.0	139.0
1982	724.4	183.0
1985	918.7	243.0
2000	3000 Plus	735 Plus

Note : 1. BPKM: Billion Passenger Kilometer
2. BTKM: Billion Tonnes Kilometers

Source : Kadiyali (1987).

In 1984 the road density in India was 0.45 kms per square kilometer. With a phased programme of road development, the road network is expected to expand to 27,00000 kms. by the end of the 20 century. The road density will then marginally increase to 0.57 kms/sq.km. The 7th Plan outlay for road development under the central and state sectors has been placed at Rs. 1819.75 crores and 4180.37 crores respectively. Considering the resource constraints and the past plan achievements, the projected targets of road development may not be fully achieved. However, even at the rate of past achievement (4.5 per cent per year), there is bound to be a further increase in the total road length and improvement in the percentage of all weather roads. This should bring about a substatial shift of traffic, both passenger & freight, from rail to road and, thus, provide the much needed fillip to the automobile industry, particularly to the commercial vehicle sectors.

Development & Growth of Indian Automobile Industry

In India the automabile industry took its birth as far back as 1942, although the assembly of vehicles from CKD packs had commenced much earlier, in 1928. In 1953 when the automobile assembly plants of GMC and Ford Motors were closed down, only five of the then existing automobile firms were recognised as actual manufactures. These were HML, SMPIL, PAL, APIL and Ashok Motors. Later, they were joined by TELCO, M&M and BTL and a few others. In the initial stages HML, PAL and SMPIL assembled vechicles from 50-60 per cent imported components and sub-assemblies obtained from their foreign principals. However, during the plan era, indigenisation received considerable emphasis and most of the automobile units began to emerge as fullfledged vechicle producers. Their scale of operations, however, remained at very low uneconomic levels (Annexure II)

The total vehicle production in India (for all manufactures) till 1980 was just a little more than 1 lakh per annum and reached a modest total of 2,51,919 in 1987-88 (AIAM, 1987) whereas the estimated economic annual output for a single automated plant is in the range of 2 to 4 lakh units. The Development Council for Automobiles & Allied Industries has estimated the minium annual economic capacity of a single unit at 50,000 for cars/jeeps and 30,000 for commercial vechicles.

The industry due to its small volume of output may continue to operate the component and assembly lines without automation, until such time, the demand for vehicles picks up sufficiently and it becomes feasible for individual plants to change over to automation and more modern technologies for their manufacturing and assembly lines. With a low per capita GNP of Rs. 3,640 and an equally poor disposable income, it seems unlikely that there will be any spectacular rise in the demand for automobiles to induce the existing automobile producers to opt for high level automation or sophisticated technologies in the near furture. It appears that the existing automobile units may, by and large, remain low output and high cost units for several yeai to come.

Export Possibilities

Exports are an important indicator of the development and maturity of an industry. While India was

importing assembled vehicles to a large extent until 1954 besides CKD packs and components, exports of vehicles began on a modest scale only in the Sixties. The extent of export of commercial vehicles from 1960 onwards is shown in Annexure-III.

The Indian auto industry came up primarily as an import substitute and began operations on a low key. Even today it has a limited variety of models and quantities to market. In the international market India is, therefore, still a marginal exporter. For example, in 1984 India's share of CV exports in relation to the total exports of all market economies was barely 0.09 per cent, the lowest among the developing countries except Singapore, Argentina & Ireland. In the face of stiff competition, from US, Japanese, German and face of automobile manufactures, it is unlikely that the exports will improve much, until the industry achieves economies of scale and is able to compete in the world market in equal terms.

In a study on Automotive Industry in Developing Countries, undertaken by the World Bank, it was brought out that "production costs for passenger cars ran about 2.2 times those in Europe. This was for a Fiat-type vechicle at very low volume (about 5,700 vechiles per year) and with a high domestic content. The Indian plant also maufactured two models of small and medium size trucks with a total output of just over 12,000 units annually". The then ex-factory prices for the case quoted in the Study were :

Ex-fy. price of passenger car	*India*	*Europe*	*Ratio*
Before 1966 devaluation	Rs 11,320	Rs 5,118	2.2
After 1966 devaluation	Rs 12,664	Rs 8,064	1.6

Citing the case of another manufacture of heavy (8-ton) truck the Study observed "The Indian export prices was actually six percent below the comparable European product immediately following devaluation, as compared to 23 per cent above, prior to devaluation. This was due to the fact that the volume of production was much closer to European standards i.e. about 19,000 in India as compared to 30,000 in Europe". The paper gave the following ex-factory prices for this type of vehicle :

Ex. fy. price	*India*	*Europe*	*Ratio*
Before 1966 devaluation	Rs 30,000	Rs 24,800	1.23
After 1966 devaluation	Rs 35,000	Rs 37,600	0.94

Dwelling on the reasons for the wide disparity of costs, the Study pointed out that there were two basic causes for the high cost structure in India :

(a) a much smaller scale of production relative to internationally competitive plants, and

(b) high procurement cost of materials and parts also produced by small scale plants under a protective regime.

Even though the World Bank Study was carried out scveral years back, position regarding the competitiveness of our automabile industry remains somewhat similar even today. A recent EMF Report ranks India at the bottom of the list of 9 industrializing countries in competitiveness (EMF, 1986).

Dispite lower wage rates, the production cost of automobiles continues to be high for various reasons. For determining efficiency in this capital intensive industry, the scale-of-economies and technology, thus, play a decisive role. It seems that the Indian auto manufactures will find it extremely difficult to establish themselves as exporters of any significance in the near future.

Productivity Trends

We have employed the following measures for assessing the overall performance of an enterprise :

(a) Total earnings to conversion cost ratio
(b) Capacity Utilization
(c) Profits to conversion cost ratio
(d) Ratio of Wages/Salaries to Sales
(e) Rates of stock turn to Sales
(f) Profit to sales ratio
(g) Sales & Earnings to employee ratio.

However, before examining the available data on capacity utilization and productivity, a look at the overall financial performance of the industry may be worthwhile. Table-2 gives a summary of some important financial statistics for the past three years of eight major Indian automobile companies. The figures reveal declining profits and rising costs, suggesting low efficiency of operations. Even though, the net sales have been going up every year, the profits have been coming down.

TABLE 2 **Financial Performance of Some Major Automobile Companies**

(Rs. crores)

	1984	1985	1986
Net Sales	1863.04	2309.70	2646.20
Operating Profit	191.59	213.28	237.29
Depreciation	65.91	81.90	75.53
Interest	99.49	113.74	161.32
Profits before tax	92.10	99.44	75.97
Tax	20.68	23.27	17.12
Profits after tax	71.42	76.17	58.85
Tax as percent of Profit before tax	22.50	23.40	22.60
Dividend	21.24	20.70	25.86
Retained Profits	50.18	55.47	32.99
Net Worth	622.01	750.11	817.13
Gross fixed assets	1160.16	1481.49	1919.39
Profit after tax as percent of Networth	6.10	5.10	3.10

Note : Total companies covered are 8.

Source: The Centre for Monitoring Indian Economy, Key Financial Data on Larger Business Units, May 1988 & November 1987.

Capacity Utilization

As mentioned earlier, a common feature of all Indian automobile manufactures is their relatively smaller scale of operations. Although the first plant came into being sometime in 1942, the actual automobile manufacturing began only some times after 1953. The capacity build up has been rather slow for various reasons, and took an upward trend only from 1980 onwards. Commensurate with changes in capacity and rise and fall in the market demand for cars, Jeeps and commercial vehicles within the country the production of automobiles has been fluctuating from year to year.

As an indicator of the health of an industry, capacity utilisation is important. Table-3 shows the trends in installed capacity production and capacity utilisation for 3 major products of the automobile industry from 1970 onwards.

During the period 1970-75 there was little growth in capacity or production. In fact there was a general fall in the production of all types of vehicles which is attributable, largely, to the energy crisis of the early Seventies and the general economic recession that followed. With the pick-up of eccnomic activity from 1977 onwards the production began to improve once again. The period from 1981 witnessed hectic activity with an unprecedented rise in both capacity and production of cars, LCVs, HCVs and jeeps. Thereafter, once again, a stagnant trend emerged, particularly in the CV & Jeep sectors which seemed to be still continuing. While the CV sector is characterised by over capacity, the demand for jeeps is limited by the fact that the defence requirements are largely being met from the ordnance factories, civil demand being confined largely to survey teams and other field operations in the rural areas. High petrol prices and increased vehicle maintenance costs are some of the other factors which have also contributed to this general stagnation in the automobile indstry.

There has been a steep fall in the overall capacity utilisation from 1984 onwards (figuer 1) which continued till last year (expect for passenger cars). While the trend in production has been on the rise during the period, vastly excess capacity created in the boom period of 1980s has led to a fall in capacity utilisation from 1985 onwards mainly because of the demand not coming up to the anticipated levels. Table 4 shows individual capacity utilisation

TABLE 3 **Installed Capacity, Production and Capacity Utilisation**

	1970	1975	1980	1981	1982	1983	1984	1985	1986	1987
Installed Capacity (000)										
Cars	47.4	47.4	53.0	53.4	53.4	53.4	53.4	131.0	170.6	n.a.
Jeeps	10.0	13.0	18.8	20.0	20.0	20.0	20.0	30.0	40.0	n.a.
CVs	62.4	64.0	89.5	103.0	103.0	103.0	103.0	212.0	264.5	n.a.
Production (000)										
Cars	35.8	23.3	30.5	42.1	42.6	44.9	64.1	88.7	101.5	124.7
Jeeps	9.3	8.2	17.3	17.0	21.4	29.4	24.1	28.5	28.6	28.8
CVS	40.6	38.0	65.9	89.7	88.4	88.7	93.5	105.3	95.0	99.0
Capacity Utilisation (Percent)										
Cars	76	50	58	79	80	84	120	68	60	73*
Jeeps	93	63	92	85	107	147	121	95	72	72*
CVs	65	59	74	87	86	86	91	50	36	37*

Note : * Capacity has been assumed to have remained at 1986 level.

Source : 1. The Centre for Monitoring Indian Economy, Production & Capacity Utilisation in 600 industries, 1986.
2. Kothari's yearbook on Business and Industry—1987.

TABLE 4 **Capacity Utilisation among Automobile Manufacturers**

Company	Installed Capacity (000)	Production (000)			Capacity Utilisation %		
		1985	1986	1986	1985	1986	1987
Ashok Layland	23.0	15.9	15.3	16.4	69.1	66.5	71.0
Hindustan Motors	45.0	26.9	25.7	25.0	59.8	57.1	55.6
Mahindra & Mahindra	35.0	33.5	32.7	34.6	95.5	93.4	99.0
Maruti Udyog	40.0 (1985-86) 100.0 (1986-87)	51.6	80.2	92.6	129.0	80.2	92.6
Premier Automobile	54.5	29.4	30.2	27.4	53.9	55.4	50.3
Standard Motors	7.5	5.8	5.5	55.1	77.5	73.5	73.4
TELCO	58.5	47.3	46.9	49.2	81.0	88.2	84.2
DCM Toyota	15.0	—	2.5	2.8	—	16.7	18.6
Bajaj Tempo	20.0	13.8	13.2	15.7	69.0	66.0	78.5

percentages for some of the major automobile enterprises in the country.

The average capacity utilisation for a selected group of 164 Indian manufacturing industries for the period 1970 to 1986 is around 76 per cent (CMIE, 1986). Compared to this, both Mahindra & Mahindra and TELCO as also Maruti Udyog can be said to have performed quite well. However, the average capacity utilisation of the automobile manufacturing units in the world is between 83 and 86% (United Nations, World Economic Statiatics). Compared to this, it would seem that even TELCO & M&M have yet to go a long way to reach the international standard. The low capacity utilisation by the industry as a whole arises largely from the insufficient domestic demand and poor offtake due to technical, operational and market related factors such as :—

(a) Low per capita income which places passenger cars beyond the reach of a overwhelmingly large majority of the country's population.

(b) Poor export prospects due to high manufacturing costs and stiff market competition both in variety and quality.

(c) High excise duties and taxes which push up prices.

(d) Heavy maintenance & running costs of all vechicles.

(e) Technical constraints and lack of worthwhile R & D.

(f) Non-availability of certain critical raw materials at times.

(g) Irregular power supply and frequent breakdowns.

Earnings-Conversion Cost Ratio

The ratio of total earings to conversion costs being an overall indicator of productivity, is also a general measure of conversion efficiency of an enterprise. The figures in Annexure-IV reveal an unstable trend for the industry as a whole, although from 1984 onwards there has been a gradual decline year after year. There was some improvement in 1987 but it remained much below the 1984 achivement. Amongst the individual companies BTL showed an exceptionally high ratio for the four years.

Other Indicators

The ratio of profits to total conversion cost (Annexure-IV) is closely linked to earnigs-conversion costs ratio. Here again the pattern of performance is almost similar to what is indicated by the ratio of earings to conversion costs.

The ratio of wages and salaries to sales (Annexure-IV) shows what the employees cost the company to achieve the specified sales. Some companies show consistently better performance than the others throughout the six year period. The performance of such companies in other collateral areas of productivity also appears to be equally good. Rate of stock turn (ROST) indicates how many times a company turns its inventory (Annexure-IV). This measurement is normally done on a monthly basis but in the absence of required data, the figures shown are for the whole year. More or less all companies seemed to have operated close to the industry's average rate of stock turn for each year.

Profit performance can be monitored through two main indicators (i) Profits to cost ratio (PC) and (ii) Profit to Sales ratio (PS). PC is expressed in rupees and shows the ratio of profit to total cost and PS the amount of profit per rupee of total earnings. It is closely linked to the ratio of earnings to conversion costs. The trend in the ratios, as shown by the above two indicators (Annexure-IV) reveales a gradual decline in the performance of the industry as a whole during the six year period, although some individual companies showed some improvement occasionally. The trends generally conform to the picture presented by the financial data shown in Table-2.

Purchased Services to earnings ratio indicates how much purchased services cost a company for every rupee of a total earnings. The figures for the past 4 years (Annexure-IV) show a fair amount of uniformity in the ratios, though, a slight fall below the average level is shown by one or two companies

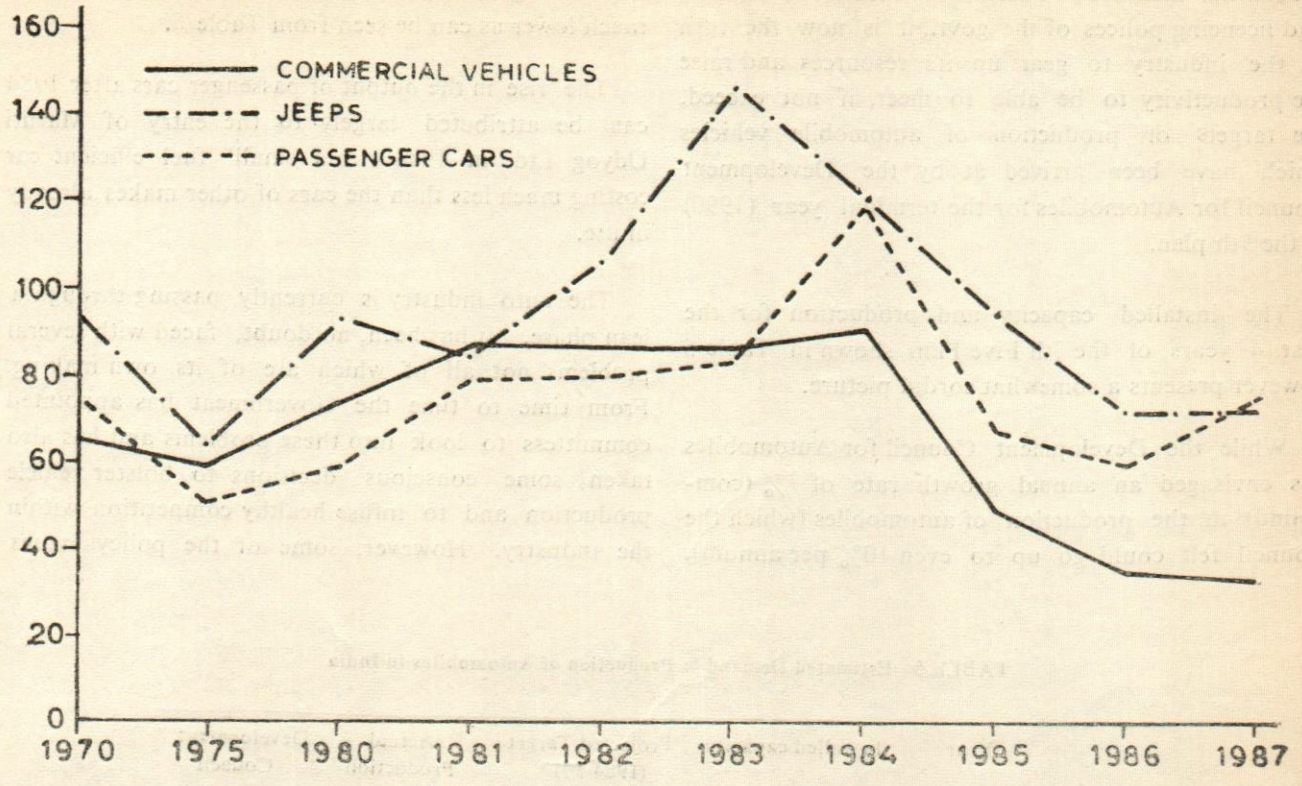

Fig. 1 Trends in Capacity Utilisation : 1970-1987

with occasional spurts. Such uniformity in the ratios may be due to the fact that the costs of most of the purchased services such as fuel and electricity, telephones, rent etc. do not change too freqently and that the consumption of these services moves in sympaty with production and sales, generally.

Labour Productivity

Labour productivity is measured through (i) sales per employee (SPE) (ii) earnings per employee (EPE) and (iii) Wages & Salaries to sales (WS) (Annexure-IV). While SPE and WS indicators are similar in nature, EPE is a more reliable indicator as the influence of mark up is removed. Labour productivity is one area which has always been the centre of attention of the industry as well as the Govt. The rising share of labour over the years has led to a low share of added value going to profits. If this trend continues, overall productivity performance may get a further setback. The ratios shown in Annexure IV may at a first glance give an impression that, by and large; all is well with the industry. This is far from being so. While a comparison between the productivity ratios of the Indian automobile industry and those of other established units in foreign countries may not be valid because of the palpable differences in technology, scale of operations, market conditions, state of the economy etc., an inter unit comparison should be quite in order. Such a comparision, however, seems to indicate that in some cases, the productivity ratios are from satisfactory, being much below the average for the auto industry.

Future Outlook

Indian automobile industry has now entered the maturity phase although it has still to go a long way way to approach the international standards. Of late, some of the leading companies, particularly in the LCV sector have been forced to cut back on their production. The commercial vehicle sector has, therefore, been pressing for change in govt. policy which will help stimulate domestic demand for automobiles especially for the light and medium commercial vehicles. After securing a

substantial measure of liberalization from the taxation and licencing polices of the govt., it is now the turn of the industry to gear up its resources and raise the productivity to be able to meet, if not exceed, the targets of production of automobile vehicles which have been arrived at by the Development Council for Automobiles for the terminal year (1990) of the 7th plan.

The installed capacity and production for the first 4 years of the 7th Five Plan shown in Table 5 however presents a somewhat sordid picture.

While the Development Council for Automobiles has envisaged an annual growth rate of 7% (compound) in the production of automobiles (which the Council felt could go up to even 10% per annum), the actual growth (except in the case of cars) has been, much lower as can be seen from Table 6.

The rise in the output of passenger cars after 1984 can be attributed largely to the entry of Maruti Udyog Ltd. in 1984 with a 'small' fuel efficient car costing much less than the cars of other makes already in use.

The auto industry is currently passing through a lean phase. It has been, no doubt, faced with several problems not all of which are of its own making. From time to time the Government has appointed committess to look into these problems and has also taken some conscious decisions to bolster vehicle production and to infuse healthy competition within the industry. However, some of the policy issues

TABLE 5 **Estimated Demand & Production of Automobiles in India**

	Year	Installed capacity	Projected Target (1984-87)	Actual Production	Development Council Target (1990)
Cars	1984	53,400	80,000	64,100	
	1985	1,31,000	91,000	88,700	1,54,000
	1986	1,70,000	1,04,000	1,01,500	
	1987*	2,25,000	1,18,000	1,24,700	
Jeeps	1984	20,000	28,000	24,100	
	1985	30,000	31,000	28,500	45,000
	1986	35,000	34,000	28,600	
	1987*	35,000	38,000	28,800	
CVs	1984	1,03,000	1,06,000	93,500	HCV
	1985	2,12,000	1,19,000	1,05,300	1,20,000
	1986	2,64,000	1,35,000	95,000	LCV
	1987*	1,46,480	1,52,000	99,000	75,000

Note : *As per the scheme of broad banding permitted by by the government the available installed capacities are composite figures. We have, therefore, assumed the 1986 figures of installed capacity for calculation of capacity utilisation percentages.

Source : Drawn from different sources, a major portion being from (a) The Centre for Monitoring Indian Economy, Production & Capacity utilisation in 600 industries and AIAM Publications.

TABLE 6 Growth Trends in Production of all Vehicles

	1984 %	Growth 83/84 %	1985	Growth 84/85 %	1986	Growth 85/86 %	1987	Growth 86/87 %
Jeaps	24,100	18%	28,500	18%	28,600	0 35%	28,800	0.7%
Cars	64,100	42%	88,700	38%	1,01,500	14%	1,24,700	22.8%
CVs	93,500	5.4%	1,05,300	12.6%	95,000	9.8%	99,000	4%

Source : Association of Indian Automobile Manufacturers, (1985).

like levels of indigenisation, selling prices of vehicles, quality/durability standards, economy of operation, technology up-gradation, excise & taxes etc. which have been raised again and again over the past few years still remain unresolved. These have also featured in the terms of reference of the Tariff Commissions and Development Council for Automobiles appointed by the Government. These are indications of the government's concern for the industry's problems, but clear cut policies have yet to emerge.

In view of the huge investments made in the automobile industry particularly in the LCV sector during the last few years, mainly with foreign collaboration, the problem of unused manufacturing capacity and regular outgo of foreign exchange has assumed great importance from the national angle.

According to indudstry sources (AIAM-1988) high and rising cost of inputs and heavy tax burdens are two of the major contributory factors which have led to the current slump in the demand for commercial vahicles. Tardy efforts at indigenisation, low productivity, poor fuel efficiency and indifferent vehicle quality are some of the other factors which have further aggravated the problem of sluggish demand.

Efforts to export of vehicles have proved equally unrewarding because of the lack of competitiveness of our vehicles in the international market both in quality, price and after sale service arrangements. These are some of the problems and issues which stand out for urgent review and solution to help the industry to strengthen its growth and stabilize its operations.

Conclusion

The automobile industry is of strategic importance in the context of the country's economic development and its defence and security needs. Its importance has grown over the years and from a simple CKD assembler, it has now acquired the status of a full fledged automobile producer. The scale of operation has, however, remained small which has seriously handicapped its efforts to compete in the world market.

Despite continuous, *albeit* slow, expansion of road network in the country, the growth of the automobile industry has not come to the expected levels, The quality and cost of its products are still below the international standards primarily because of uneconomic scale of operations which preclude the possibility of introducing automation in its assembly and manufacturing units.

Though India has been exporting automobile for the past three decades or so, it still remains a marginal exporter. The position is unlikely to change very much in the near future as most of the automobile manufactuers continue to be low output high cost units and cannot stand in competition with the long established automobile manufacture elsewhere in the world.

There has been a steep fall in capacity utilisation from 1984 onwards in almost all sectors of the auto industry. The entry of Maruti Udyog with a small fuel efficient car has provided some respite to the car sector but the situation in the auto industry as a whole

remains somewhat unsatisfuetory. The vehicle market has now turned into a buyer's market and unless the industry becomes resource efficient and brings the sales price dawn and also raises the quality of its products, the demand for its product may remain sluggish.

Productivity in the industry, in general, is on the low side. Some individual units have, however, performed better than the others. To reach international standards, the industry has yet to go a long way. The automobile industry, for long, has been used to a protected market and has been unfamiliar with campetition within its own ranks. It will now have to gear up its resources and managerial talents to improve productivity, reduce costs and tone up the quality of its products, if it has to survive. There are no soft options available now or later.

Abbreviations

AIAM—Association of Indian Automobile Manufactures
APIL Automabilc Products of India Limited
AL Ashok Leyland
ALL Allwyn Nissan Limited
BTL Bajaj Tempo Limited
CMIE Centre for Monitoring Indian Economy
DCM DCM Toyota
HCV Heavy Commercial Vehicles
HML Hindustan Motors Ltd
LCV Light Commercial Vehicles
M & M Mahindra and Mahindra
PAL Premier Automobiles Ltd.
SAL Sipani Automobiles Ltd.
SMPIT Standard Motor Products of India Ltd.
SCL Simpson and Company Ltd.
TELCO Tata Engineering & Locomotive Company

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ANNEXURE—1 **Vehicle Production in Some Industrialized Countries 1982-1985 (000)**

Country	1982	1983	1984	1985
Canada	1276.0	1525.4	1841.8	1930.6
Mexico	476.5	284.0	347.0	424.1
USA	6902.3	9109.2	10697.0	11359.0
Brazil	840.1	1723.0	848.7	955.0
Japan	10811.8	11105.3	11453.5	12080.2
Korea	137.4	204.6	256.8	361.3
France	3543.2	3631.8	3324.3	3082.3
W. Germany	4051.6	4157.3	4029.9	4442.4
Itally	1448.4	1569.1	1596.1	1562.5
Holland	99.2	114.3	117.1	116.5
UK	1150.0	1283.6	1128.6	1305.1
Sweden	375.7	424.1	442.1	468.0
Czechoslovakia	220.2	220.0	226.4	232.5
GDR	224.2	229.2	246.3	257.3
Poland	275.9	321.0	333.2	340.2
Spain	1063.4	1229.1	1258.2	1371.3
Yugoslavia	177.8	188.8	206.4	197.2
USSR	175.2	162.0	166.0	168.0
India	135.9	130.8	157.5	194.3
World Total	36210.7	39728.6	41657.6	44165.0

Note : 1. Break up total does not tally with world total.

2. Figures include passenger road transport vehicles seating more than nine persons and road transport vecheles designed for conveyance of goods including vehicles for special purposes, and passenger cars, three or four wheelers designed for carrying passengers.

Source : United Nations Industrial Statistics—1985.



ANNEXURE—II **Annual Output of Vehicles By Manufactures (Nos)**

Year	Jeeps			Passenger Cars					Commercial Vehicles								
	M & M	MUL	BTL	PAL	MUL	SM	SAL	Total	TELCO	AL	PAL	HML	BTL	M&M	SM	SCL	Total
1977	9594	..	20256	17481	..	111	171	38019	23419	8083	1881	969	4770	953	1627	..	41702
1978	11010	..	20987	2931	..	117	331	34366	29108	10947	1264	2383	6507	1354	1907	..	53470
1979	12340	..	17523	11550	..	56	106	29235	31685	12315	1079	2599	6509	3084	2425	..	59696
1980	15068	..	21752	9729	..	6	51	30538	31768	12928	1235	4880	9801	3617	3491	591	68311
1981	17029	..	23197	18874	..	4	31	42106	45034	15031	3282	5303	8589	7234	4459	820	89752
1982	19660	..	21836	2077	..	1	126	42674	43097	16363	2797	2496	11708	9034	4751	..	90246
1983	21660	..	23683	20929	175	1	302	45090	46074	13411	1293	1908	9626	9658	5395	..	87365
1984	20130	n.a.*	24376	26620	12087	..	930	74298	46740	14430	952	2307	12906	11515	5810	..	94660
1985	21755	n.a.*	24064	29223	48635	185	954	103079	46904	15938	856	302	13757	11701	n.a.	..	101228
1986	21405	6387	22387	28501	63504	1476	399	116267	49242	15265	855	4	13136	11297	n.a.	..	94885
1987	29120	n.a.*	25561	31191	90909	744	18	148423	56662	16347	n.a.	n.a.	15664	5522	n.a.	..	105500

Note : 1. Some production figures are for the financial years e.g. HML, AL, PAL, MUL, etc.
2. Break-up total may not add to World Total.
* Included in the production figure for cars/vans etc.

Source: (i) Association of Indian Automobile Manufactures, The Automobile Industry Statistical Profile, 1985.
(ii) Annual Reports of Companies concerned.
(iii) Hindu Sept. 22, 1988.

ANNEXURE-III **Export of Commercial Vehicles 1960-1987**

		1960	1964-64	1969-70	1974-75	1979-80	1981-82	1983-84	1985-86	1987-88
Vechiles for Transport of goods materials etc.	No.	13	208	1557	2271	4419	4841	1614	n.a	3858
Buses and CV Chasis etc.	Rs. (Lacs)	2.44	53.3	581.0	1758.2	4294.4	5300.0	3325.0	5400.0	6851.0

Source : DGCI & S Monthly statistics of Forgein Trade.

ANNEXURE-IV Productivity Indicators for Indian Automobile Industry

Productivity Indicator	Year	Industry Average	AL	BTL	HM	M&M	MUL	PAL	SM	TELCO	DCM	ALL	Aver-age	High-est	Low-est	Remarks
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Total earnings	1982	1.19	1.18	..	..	..	..	..	1.23	...	..					
to conversion	1983	1.55	1.78	3.6	1.48	1.29	..	1.33	1.26	1.53	..					
cost ratio	1984	1.85	1.36	6.0	1.47	1.28	1.14	2.63	1.20	1.23	..	..				
(T/C) (Rs)	1985	1.29	0.92	8.2	1.33	0.93	0.31	1.27	1.17	1.26	..	..				(a) Some aberr-
	1986	1.20	1.42	6.4	1.25	1.36	0.14	1.96	0.79	1.03	0.32	0.55				ations have
	1987	1.22	1.22	..	1.19	1.35	1.15	1.09	..	1.31	0.55	1.05	1.38	8.21	0.14	been intro-
Profits to conversion	1982	0.21	0.20	..	..	..	..	...	0.26	..	..	..				duced in the
cost ratio	1983	0.17	0.11	0.65	0.31	0.18	..	0.11	0.14	0.13	..	..				results due
(P/C) (Rs.)	1984	0.16	0.10	0.81	0.24	0.17	0.31	0 09	0.13	0.07	..	..				to the
	1985	0.12	0.06	0.68	0.21	0.11	0.04	0.14	0.09	0.08	..	..				inclusion
	1986	0.08	0.08	0.68	0.17	0.07	0.09	0.14	−0.26	0.09	0.43	−0.78				of data of
	1987	0.04	0.09	..	0.01	6.08	0.13	(negl.)	..	0.01	−0.47	−0.75	0.13	0.61	0.78	some new
Ratio of Wages and	1982	12.2	8.7	..	..	..	..	..	15.4	..	..	..				companies
Salaries to	1983	13.2	8.7	4.04	13.6	13.0	..	19.5	14.0	12.6	..	..				whose per-
Sales (%)	1984	13.7	9.7	3.5	14.4	14.0	18.6	23.8	15.1	14.0	..	..				formance
	1985	13.5	10.7	3.0	15.2	15.4	3.6	22.6	16.7	13.8	..	..				has yet to
	1986	13.0	9.7	3.0	16.4	15.6	0.8	23.2	20.8	14.4	4.4	3.0				stabilize.
	1987	12.6	10.7	..	15.5	15.2	1.9	25.0	..	14.9	2.9	7.4	13.0	25.0	0.86	(b) Some figures
Rate of Stock	1982	0.32	0.34	0.26	..	..	..	0.33	0.23	..	..	...				refer to
turn to sales (I/S)	1983	0.29	0.26	0.30	0.38	0.23	..	0.31	0.26	0.30	..	..				financial
	1984	0.27	0.25	0.29	0.33	0.24	..	0.22	0.23	0.27	..	..				years.
	1985	0.28	0.30	0.20	0.35	0.33	..	0.27	0.33	0.25	..	..				
	1986	0.32	0.25	..	0.42	0.33	..	0.27	..	0.34	..	..				
	1987	0.29	0.27	..	0.41	0.27	..	0.32	..	0.27	..	..	0.29	0.42	0.20	
Profit to sales ratio	1982	5.1	3.8	0.9	..	..	..	..	5.7	..	..	..				
(P/S) (%)	1983	4.4	2.4	9.0	5.2	4.3	..	3.7	3.1	3.7	..	..				
	1984	3.6	2.2	8.7	5.7	4.2	0.11	3.4	2.9	2.2	..	..				
	1985	3.3	1.4	5.8	5.8	3.8	1.10	4.7	2.2	2.9	..	..				
	1986	2.2	1.7	6.5	5.9	1.8	1.26	5.1	−0.1	1.6	10.0	−15.2				
	1987	1.2	2.2	..	2.1	2.0	2.0	5.8	..	0.5	−8.8	−24.6	3.3	10.0	−24.6	

(Contd.)

ANNEXURE-IV (Contd.)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Ratio of Purchased	1982	0.30	0.32	..	..	..	..	..	0.13	..	..	..				
Services to Total	1983	0.26	0.21	0.19	0.24	0.25	..	0.24	0.14	0.29	..	..				
Earnings	1984	0.25	0.29	0.11	0.24	2.26	3.40	0.10	0.15	0.35	..	..				
	1985	0.30	0.43	0.10	0.27	0.36	1.84	0.20	0.17	0.33	..	..				
	1986	0.33	0.29	0.08	0.29	0.24	4.32	0.22	0.30	0.41	1.80	1.10				
	1987	0.33	0.32	..	0.28	0.24	0.62	0.27	..	0.31	0.93	0.38	0.29	4.32	0.08	—
Total Earnings per	1982		58.4			..	..	..	..	..	..	..				
employee	1983		91.9			..	..	55.46	..	84.6	..	..				
(Rs. 000)	1984		73.0			323.7	5.97	128.6		77.5	..	..				
	1985		61.2			218.7	24.46	74.5		89.0	..	..				
	1986		95.9			254.2	16.20	77.1		76.9	..	..				
	1987		95.7			224.9	267.6	79.3		104.2	..	..	..	323.7	61.2	—
Sales per employee	1982		260.1			..	..	..		..	..	..				
(Rs 000)	1983		252.6			..	..	129.3		193.7	..	..				
	1984		242.3			999.0	39.0	134.9		205.3	..	..				
	1985		277.6			842.5	521.7	171.0		226.9	..	..				
	1986		320.1			714.8	900.8	179.9		238.3	..	..				
	1987		333.8			632.8	1513.0	183.0		276.2	..	..	..	999.0	3.20	—

Note : 1. The above calculations are based on the published financial data contained in

(i) CMIE publications Key Financial Data on Large Business Units, for Various Years.

(ii) Kothari's Year book on Business and Industry-1987.

(iii) Annual Reports of the Companies concerned.

Grievance Handling System in Tata Steel

Any progressive industrial organisation should have a sound grievance handling system as a key component of its industrial relations management strategy. This may seem fairly obvious, but the key to a successful strategy lies in a mechanism which can take note of grievances as and when they arise, instead of allowing the dissatisfaction, which is the starting point of the grievance, to simmer on without finding expression in forums created for this purpose. Here it might be mentioned that a grievance may be real or imaginary but has to be tackled nevertheless. If the grievance is real, the need for curative action is obvious; if it is imaginary, the need to explain and clear up the atmosphere is all the more imperative.

Tata Steel has an enviable record in the area of industrial relations and this has been due, in a large measure, to the committees set up for the handling of grievances. The first Works Committee was set up as early as 1919. For a while it remained dormant because of the internecine rivalry among various trade union factions. It was revived in 1946 in the form of the West Plant Joint Committee and the East Plant Joint Committee for departments in the Western and Eastern zones of the Works respectively.

In 1956 an agreement was signed between the management and the Tata Workers' Union for a programme towards closer cooperation. An important clause pertained to the introduction of a grievance handling procedure for all departments, in consultation with the Unions. It was also agreed to review the working of the Works Committees in this light. Following this, the Committees were divided into its zonal counterparts. The idea was to decentralise the grievance handling procedure so that grievances originating at a particular department can be tackled in that department itself, in the shortest possible time and at the lowest possible level. It is a three stage procedure with an appropriate form for each stage.

Individual grievances and complaints are not discussed at any level other than that specified in this procedure, except that if the Union so desires, such cases may be put up for discussion at the Central Works Committee.

Policy matters and their interpretations are not discussed at any level except with the top management. The Union, however, can take up such matters at the Central Works Committee.

It should be noted here that the system is designed to ensure that the Works Committees serve the purpose for which they came into being, and do not become toothless bodies. For this reason, representations for the redressing of grievances from employees to the various authorities either directly or through the Union, are not entertained, at least until the case has been either disposed of or withdrawn from the Works Committee.

However, in exceptional cases, like those involving the grievances of a number of workmen, or on questions of principle or policy or any other important matter where immediate action is necessary, the

Union may directly take up the matter with the appropriate level of mananement. In important cases, the President or the General Secretary of the Union may ask the management for a joint inquiry. The following subjects come under the purview of this procedure :

Action
Amenities and/or facilities
Continuity of service
Compensation
Discharge/dismissal
Fines
Increment
Leave
Medical
Misconduct
Nature of job
Promotion (excluding selection by interview)
Safety appliances
Suspension
Transfer
Victimisation
Warning letter

What follows are the steps involved in the grievance handling procedures outlined in some detail. This may help in bringing out the decentralised nature of the whole system.

Stage One

(a) If any employee has a grievence, he meets his shift-in-charge or equivalent and talks it over with him. In cases of appeal against punishments excluding suspension, discharge or dismissal, the employee can meet his General Foreman or equivalent. If necessary, he can obtain a copy of Grievance Form-1. He has to fill in the form and submit it within one week of the date on which the facts on the basis of which the grievance has arisen, became known to him, except that in the case of promotions, a time limit of six weeks from the date of promotion in question is allowed.

(b) The grievance form is handed over to the shift-in-charge, General Foreman, or equivalent, as the case may be, who arranges to issue an acknowledgement receipt. He makes necessary enquiries, and returns the form to the employee concerned with his remarks in the space provided for this purpose or, with the remarks of the head of the department (where the matter is beyond the jurisdiction of the General Foreman or the shift-in-charge or equivalent) within the next two working days from the receipt of the form. In cases requiring reference to higher authorities, this time limit is relaxed. If necessary, the employee can discuss the case further with the supervisor concerned in the light of his remarks. The employee can also take the help of the Union representative in presenting or discussing the case at this and/or the next stage.

Stage Two

(a) If the employee is still is not satisfied with the reply at the stage one, he may obtain from the General Foreman or the shift-in-charge or equivalent, as the case may be, a copy of Grievance Form-II, enter there in the reasons for reconsideration of the case, and submit the form to the head of his department within three working days of the receipt of the reply at stage one; he is given an acknowledgement receipt.

(b) Appeals against suspension can be sent to the head of the department on Grievance Form-II or on ordinary paper, within seven days of the receipt of orders or after the last date of suspension, whichever is later. Appeals in such cases need not go through stage-I of the grievance handling system.

(c) The head of the department discusses the issue with the employees and the supervisor concerned and returns this Form with his remarks within three working days of receipt of the Form. In cases requiring reference to higher authorities or to another department, this time limit is relaxed.

Stage Three

(a) If the employee is still not satisfied with the reply, he may appeal to the Chairman of the Zonal Works Committee concerned, on Grievance Form-III,

within seven working days of the receipt of the reply at stage II.

(b) Appeals against orders of discharge or dismissals are addressed to the Chairman of the zonal works committee concerned, on Grievance Form-III (copies of which are made available at the Employment Bureau) or on ordinary paper, and these are considered at Stage III, in the first instance. The employee should appeal within six weeks of the receipt of the orders, except that in cases, where the employees discharged or dismissed are out of Jamshedpur at the time when the orders are issued, the time limit is three months from the date of issue of such orders.

(c) The decision reached by management, after due consideration of the recommendations of the zonal works committee is communicated to the employee on Grievance Form-III through the proper channel. The zonal works committee's unanimous recommendations are considered final when no objection is raised by either the management or the Union within 10 days of the receipt of such recommendations.

(d) Where such recommendations are not unanimous or have not been accepted by the management or the Union, the zonal works committee refers the case to the Central Works Committee for consideration.

Both the Management and the Union are free to raise objections on the unanimous recommendations of the committee, though generally unanimous recommendations are accepted *in toto*. Objections are raised only when the recommendations contravene any laid-down policy. A time limit of 10 days is set for raising objections. If no objection is raised within this period, the management takes necessary action to implement the recommendations. This is communicated as the management's decision to the departmental head concerned who in turn communicates the decision to the employee on Grievance Form-III.

At the Central Works Committee (CWC), which normally meets every Friday afternoon, the General Manager (Works) and the Deputy Director of Personnel (Works) discuss many pressing problems with Union officials. The cases referred by the zonal works committees are also considered there besides others on the agenda of that committee. The decision taken there is communicated in the same fashion to the employee concerned. Similarly, the Special CWC at its periodic meetings disposes off the cases referred by the Non-Factory Employees Works Committee. Tables 1—3 show the performance of the

TABLE 1 : **Performance of Zonal Works Committees and Central Works Committees**

Number of grievances (subjectwise) handled by various ZWCs from 1982-83 to 1986-87

	1982-83	1983-84	1984-85	1985-86	1986-87
Acting/Seniority	23	33	42	53	28
Promotion	30	41	37	52	29
Warning	9	1	8	11	4
Suspension	40	39	34	35	30
Discharge/Dismissal	83	66	53	61	64
Miscellaneous	25	46	37	46	33
Total	210	226	211	258	188

TABLE 2 : **Number of ZWC Meetings held during last 5 years**

1982-83	120
1983-84	128
1984-85	95
1985-86	113
1986-87	101

TABLE 3 : **Performance of CWC/Spl. CWC**

	No. of meetings held of CWC/ Spl. CWC	No. uf cases handled by CWC/Spl. CWC
1982-83	26	173
1983-84	23	299
1984-85	21	152
1985-86	17	179
1986-87	16	97
Total	103	900

Zonal Works Committees and Central Works Committee.

The workers by and large have a lot of faith in this system. The strength of the procedure lies in :

1. Its sticking to the time schedule rather strictly.
2. Management's credibility which has been built over the years.
3. Officers who are involved, directly or indirectly, because of whom a worker puts a grievance, do not hold it personally against the worker.
4. Scope of jurisdiction is well defined.
5. Matters relating to wages, hours of work, bonuses and also matters falling within the purview of the other joint committees such as JDC and other ancillary joint committees are excluded from the purview of the zonal works committees. In other words, the terms of reference, functions and jurisdiction of the committee are clearly enunciated and accepted by all concerned and adhered to.
6. Support by a stable trade union.
7. Codification of the Company's rules and practices and the availability of the copies at different levels of management.
8. Participation of the aggrieved employee, his Union representative and his supervisor at different levels of discussions.
9. Every effort is made in the meetings of the Works Committees to keep the discussions "fact-oriented" instead of "employee-oriented".
10. Conventions are respected, e.g. publication of seniority list of employees, acting and promotion charts are made known to all and followed strictly; unanimous recommendations of the works committees are implemented unless they are contrary to the Company's policies.
11. It is always borne in mind by the members of the works committees that they are not instruments of the collective bargaining but are designed to make a joint review of employees grievance and make appropriate recommendations.

Tata Steel, thus, not only recognises the grievances of workers, actual or perceived, but also takes pains to solve them. Besides, the management also takes preventive action in areas where there is likelihood of grievances coming up.

S.N. Pandey
Executive Director
Tata Steels
Jamshedpur

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BOOK REVIEW

THE GOOD AND BAD NEWS ABOUT QUALITY, By Edward M. Schrock and Henry L. Lefevre, Marcel Dekker, Inc., New York and Basel, 1988, 264p, $54.00

The good news is that we know how to economically manufacture high quality products. The bad news is that many manufacturing companies have not learned the good news. Now Japan has a better reputation for quality than the land of its tutors. The ability of the United States to produce complex and sophisticated products is still outstanding, but this is not enough. The products must be safe, reliable and strong enough to withstand abuse without hurting anybody. Customers must also feel that they are getting their money's worth.

This is the central message contained in this volume. The book discusses the organisational principles and administrative procedures, for the top management to follow in order to understand the language of quality control, recognise the tools of quality professionals and maximise the product quality at minimum cost. The book was conceived by Edward M. Schrock, a pioneer in the field of quality control. He, however, did not live to see it published. Henry L. Lefevre completed the book.

The uniqueness of this book is in two factors: one, that the authors have approached the subject as managers, not as statisticians. And secondly, the fundamental concepts as well as the methodology, technology and procedures are discussed at the leading edge of the discipline.

The modern approach to quality and reliability concerns excellence, argue the authors. Excellence when the product is designed, excellence when the product is made, excellence as the product is used and excellence throughout its lifetime. But excellence does not result without effort and products and services of superior quality and reliability require an appropriate combination of statistical, engineering, managerial and motivational efforts.

Edward and Henry had the advantage of working as managers and consultants. Within this volume, the reader will, therefore, find the means to create, control, and improve quality and reliability in ways that are cost effective, that enhance productivity and that create a motivational atmosphere that is harmonious and constructive.

Emphasis on the customer as the ultimate judge of quality serves as the catalyst to bring about the integration of techniques, methods and managerial effort for quality. Schrock has rightly broadened the concept of inspection from the emphasis and detection and correction of defective materials to the control of quality through analysis and prevention of quality problems.

The author introduces the concepts under seven characteristics calling them the fearful dragons. Some of them are very important such as 'Quality Control doesn't Need High-level managers', 'Quality is a Departmental function', etc. The next chapter rightly concentrates on Myths and Realities, followed by Keys to Managing Quality.

The operators are now the 'master craftsmen'. No one else really knows the details of what's going on in

the shop. In order to capitalize on the operator's closeness to the work, many companies are training shop personnel in statistical techniques. This helps them to participate in the correction of quality problems. The importance of quality improvement is, therefore, through participation in such forums as quality circles.

According to the author, the most important key to quality is the knowledge of customer requirements. Who are your customers? Men? Women? Senior citizens? Teenagers? Southerners? Easterners? Under privileged? The affluent? Each group has different expectations. One thing customers normally want is reliability. Customers are a company's greatest resource. Organisations that understand and provide for their needs, wants and desires will be rewarded.

Schrock observes that quality starts with the suppliers. If their quality is poor, the product quality will be poor. Do your purchasing, quality and design departments visit your suppliers? They should work as a team, evaluating the vendor's ability and willingness to provide quality products. The author advises the development of good lines of communication between the firms quality representative and the vendor's; and to ensure the use of the same equipment and procedures, when inspecting parts and materials by the firm and the vendor.

The authors have devoted one chapter to management of controlable defects and another to worker controllable defects. This clarifies their respective roles in defects prevention.

Due coverage has been given to process capability, and other techniques. The proverb, "one picture is worth more than a thousand words" is relevant here. Frequency distribution charts, control charts and other techniques are just as useful. Regression analysis being an important statistical tool is covered in detail to determine the effect one variable has on another. Now, that they are computerised, these analyses can be run by the average clerk.

The book is intended for those in manufacturing, engineering, marketing and management, as will as the consuming public, all of whom have an interest and stake in the improvement and maintenance of quality and reliability in the products and services. I trust that the reader will benefit from the disasters and successes that have been described.

Ajit Singh
Director
National Productivity Council
New Delhi

MODERN SMALL INDUSTRY IN INDIA, By Ram K. Vepa, Sage Publications, New Delhi, 1988, 193p, Rs. 175.00.

A publication of this type by a former member of the Indian Administrative Service who had held several responsible positions in the government will certainly be read with great interest. The matter presented in the publication also acquires considerable authenticity as Dr. Vepa himself headed for quite sometime the Small Industry Development Organisation as Development Commissioner for Small Scale Industries.

Chapters 1, 2 and 3, Introduction, Growth of Small-Scale Industry and Organisational Structure respectively present detailed information about the growth of small industries and the organisational structure of modern small industry and 'village and small industries sector'. Most of the statistical data and structural as well as policy aspects will, naturally, acquire historical importance only. But these chapters provide a good link with the past as the Modern Small Industry movement is a very significant post-independence development in the Indian economy. The remaining four chapters which discuss the key issues, field planning for small industry development and prospects for 1990 as also the conclusions are of great interest because they contain views and reflections of the author on this Modern Small Industry sector such as aberrations in planning and implementation of the programmes, achievements, its great potentialities as a bridge between the medium and large industries and traditional industries. The Appendix Chapter deals with the comparative position of Indian Small Industry movement vis-a-vis small

industry development in Japan and China with different political systems, strategies and socio-economic and cultural backgrounds. These differences will explain the relevance or otherwise of such comparisons.

In India, Modern Small Industry includes the manufacturing activity, although there is some evidence in recent years of broad-banding the concept to include servicing and maintenance and more importantly, the business enterprises as in Japan. It is not enough until we accept in totality and change even the description from small industry to small enterprises, the emphasis being on enterprise. The author has rightly touched the core of the problem when he has questioned the lack of conceptual clarity. The author's suggestion to set up a separate department of small industry in the Ministry of Industry to cover all small industries of different descriptions, no matter whether they are traditional, rural or tiny, has come no sooner. 'Fragmentation of the decentralised small industries sector between several agencies spread into different Ministries' to use the author's language, 'has lead to problems of coordination, although in actual practice, this is achieved through frequent meetings of the officials of the agencies concerned'. These meetings are certainly not a substitute for an umbrella organisation.

The author has also suggested a Small Industry Commission to be set up to advise the Small Scale Industry Development Commissioner periodically. While there can be several organizational innovations that can tried, the fact remains that it is the Planning Commission and the administrative ministry which have to apply their minds constantly on policy issues and take initiatives to correct the imbalances that come to surface in the growth of this sector from time to time. For instance, the modern small industries are highly urban oriented and our expectation that they would act as a bridge between the traditional industries and large and medium industries and also remove certain regional imbalances in the growth of agriculture and industry together have been belied. Further, it is also a fact that over 80 to 90 per cent of the registered small industries are tiny industries by their size of investment and even employment. Therefore, it is apprehended that these smaller of the small industries are not getting enough attention from the authorities. In this respect, most of them share the disadvantages of traditional industries. The dichotomy between the small industries and the tiny industries is very sharp and the SIDO and Small Industries Associations appear to protect the conspicuously big but pass for small industries.

The author has dealt at the length with the harm that can possibly be done by unqualified and time-bound policy of reservation, but the data on the progress made in some reserved items in Table 22 show decidedly that the policy of reservation has helped the growth of this sector. In situations like ours,it has to be admitted that a policy of reservation has an important place in the development of such industries. Modernisation is an important key area and the book does not deal with the quantitative and qualitative achievements under this programme.

The chapter on prospects for the nineties, largely, is author's own vision. He says that 'this is the challenge of the nineties to the small industry sector—to be in the vanguard of industry, and not its trailing edge; to be a pace-setter rather than a follower; and to make it the dynamic component of industrial economy'. The vision of the author seems to be a very fantastic one if only it materialises putting the small industry in the centre of the industrial scene of the country. However, as stated earlier, in the absence of any strong lobby for the traditonal rural and tiny industries, the gap between these segments of industries is everwidening. This is in fact a most disquieting trend of the post-independence Indian planning for industrial development.

The small industries sector in India, although has made several strides in terms of diversification of production including the most sophisticated electronic goods like colour televisions, measuring equipments, etc., cannot be described that it is 'walking on two legs'. It, however, continues to be of great interest to economists and planners because of its great potential in a developing country. There are a several non-quantifiable advantages of a

decentralised production which the country has inherited from the past, peaceful harmonious cottage production, absence of trade unionism, involvement of inter-family members and above all, creating self-employment to name a few, which do not find adquate place in the book. In fact, the small industries movement in India is trying to imitate the so-called Western pattern. The fault perhaps lies in our obsession with what is good and relevant for the West which is not necessarily so in our conditions. A reader would look for more durable solutions which are typically Indian, no matter howsoever they are unpalatable.

C.S. Rao
Joint Director
Ministry of Industry
Govt. of India
New Delhi

BANK AND CUSTOMERS—A BEHAVIOURAL ANALYSIS, By Sushila Singal, Shri Ram Centre, New Delhi, 1987, 233p, Rs 125.00.

Banks in India, public sector or other wise, have made rapid strides in terms of business gains but as far as customer service and satisfaction are concerned they have miles to go.

Dr. Singhal has chosen a significant institutionalised customer service sector for her research; the study, moreover, comes at appropriate time. Her effort to probe into the behavioural dynamics of bank-customer interface is commendable especially in the context of the limited amount of literature on the subject.

Customer service for any service industry is the hallmark of its success or failure; but is one of the most neglected areas, nonetheless. In fact, we have not been able to develop a work culture which is geared to customer satisfaction; banks being no exception. Theoretically, any organisation—industrial, commercial, service or professional—has to exist primarily for customer service and satisfaction but the existing scenario proves otherwise.

The research design of the study is quite exhaustive and incorporates the correlation between the perceptions of employees' job-behaviour and customer service. It is quite valid to hold that ultimately what the position incumbent thinks of his job and how he accordingly sets to work gets translated in his job-behaviour vis-a-vis his clientele. Dr. Singhal has also worked out that howsoever good the infrastructural facilities a bank may provide to its employees, it makes them very little effective unless they really want to work. In other words, employees' own perception of their work-place determine the quality of their output to a very large extent. Bank employees are qualified and well equipped people but not motivated enough and therefore the resultant is poor customer service.

Some of the issues raised by the author are relevant to the question of excellence in the banking industry in terms of organisational control, interface relationships, management of industrial relations, customer service and further research. One of the issues is a direct offshoot of nationalisation, which has added the dimension of political control over bank management. Political control has created different 'clouts' within and outside the banks. An off-shoot of this is unionization. An oridnary employee does not trust the management but the union, howsoever inefficient the latter may be. Employee unions in particular have been the beneficiary of the political pressure which erodes managements' power position and credibility.

Another issue is the growing incidence of frauds in banks which reflects two things—the incapacity of management to lay down appropriate operational procedures and the loyalty of the personnel involved in such cases.

The insights provided by the author realistically reflect the working dynamics of banks in India in the post nationalisation period. These insights would also provide analogical reference data to understand the work-behaviour of other public sector organisations.

Banks are in theory accountable to the nation and society; this research has broken this myth. Customers are taken for a ride many a time. The research by

the author has done a great service to the banking industry by giving them data based feedback. The sponsor's must be congratulated for promoting the study. Finally, I must confess to being disinclined towards serving the flaws in this work since the author has brought out what rampantly exists but has been evading our knowledge.

Rahul Bhatnagar
Management Consultant
New Delhi

PRODUCTIVITY, INNOVATION, MANAGEMENT AND DEVELOPMENT, By P.N. Rastogi, Sage Publications, New Delhi, 1988. 263p, Rs. 185.00, (hard cover)

The book deals with the "why" and the "wherefore" of productivity. Concepts of culture and values provide the basis of productivity analysis. The quest for productivity is linked with man's search for meaning/purpose of life and without a strong spiritual support system a durable culture of productivity cannot be sustained. Work reported in this book adopts a cross-cultural perspective. Productivity differentials among nations are due to variations in productivity norms which may be viewed in terms of the variability in productivity culture.

A productivity approach views an organization as an instrument for the production of goods and services for the society. If organizations prosper by causing damages to society—the author calls them social parasites. If they are wasteful they are social delinquents. If their work is disrupted due to internal disharmony they are socially irresponsible. Even governments can cause damage to the productivity culture. The strength of the productivity culture depends on the strength of mutually supportive relationships among the social actors involved.

The author differentiates between creativity and innovation as the former denotes the 'thinking' of new things and the latter denotes the 'doing' new things. A multi-feedback loop representation of innovation process permits a number of analytical inferences to be drawn from the model, apart from their depiction of the multilateral interaction relationships within the system.

The author has very forcefully argued that the HR theories, though insightful, fail to address a number of issues such as goals bereft of social and moral significance, limited number of incentives, participation without substance autonomy devoid of authentic relationships. He identifies certain 'missing' factors in the pursuit of productivity-such as the linkage of organizational goals with larger social purposes, elevation of moral basis of work etc. Chapter V identifies the culture of productivity. Productivity culture of the nation and the organization together with the cultural configuration is very effectively brought out. The description is original and thought provoking. Feedback linkages between basal values, productivity norms, culture and economy of a nation are depicted. Basal values of Japanese, American and Indian cultures are presented which according to the author would cover a whole spectrum of scenarios. Productivity is viewed as a socio-cultural phenomenon. Logic employed in this chapter is very sound, though, at times one gets the impression that the author holds very strong views/opinions on basal values of various cultures.

The author has attempted a chapter-wise elaboration of the productivity cultures of Japanese, American and Indian societies respectively. The author identifies core norms of societies, their basal values, management systems and interorganisation cooperation. Attention has been paid to the spiritual support system of Japanese society, quest for spiritualism in American society as well as facets of the weak productivity culture in Indian Society. Issues raised by the author are relevant and important. He has, moreover, been rather forthright and candid about expressing them, though, one may want these to be substantiated.

Chapter IX presents a new thesis of S-Productivity culture, exploring spiritual options for plural societies. Spiritual basis for common indentity is thought to provide the necessary motivation for higher productivity. The superordinate and superrational framework of truth, love, inner serenity and righteous action constitute the essence of human life. He

describes ethico-legal problems of management in this context. Chapter X describes restructuring of behavioural processes in organizations under the S-Productivity Culture. Chapter XI identifies the role of S-Productivity culture in eliminating poverty, unemployment and inflation, It provides a morphological map of rural poverty and depicts the interrelationship between moral norms, economic development and social problems. The last Chapter provides a rationale from S-Productivity culture and its cascading effect.

Though one may feel that many of the views expressed in the book are yet to be validated and hence are at best opinions or propositions, yet the contents of the book are revealing and thought provoking and very forcefully introduce a spiritual dimension to the concept of productivity. One hopes for more specific case studies to validate these concepts to come up in future. This book is nevertheless a welcome addition to productivity literature.

Prem Vrat
Professor
Indian Institute of Technology
New Delhi

ENVIRONMENTAL CHALLENGES OF DEVELOPMENTAL PROCESS, "Environment Management in India," By R.K. Sapru, Ashish Publishing House, 1988, 595p, Rs. 500.00 (two volumes).

Environment management is often misunderstood as the mere management of resources of an ecosystem. It should actually be considered as the sound management of all activities which have an impact on the environment. It is an essential tool to meet the basic human needs of the population on a sustainable basis. In practice, the environmental management techniques put great emphasis on the planning of new or modified activities to prevent or mitigate their harmful impact on the environment. Dr. Sapru, who hails from the faculty of public administration at Punjab University has made an attempt to focus on the environmental management techniques pursued by the Government. Views of a large number of experts, specialised in diverse fields, on these issues, have been edited and presented in two volumes.

The author has tried to give an overview of the environmental challenges faced by today's modern society with a focus on the public response to these challenges. In all, there are 48 presentations covering three major issues—(a) rapid urbanisation & it's impact on environment (b) ever increasing denudation of forests and afforestation programmes launched by the Government and (c) the legal aspects of environmental protection in India.

India has the third largest urban population in the world after USA and USSR. As per 1981 Census, the urban population in India was estimated at around 167 million, representing about 24% of the total population. It is estimated that by the year 2000 AD., about 65% of the population in India will live in cities with 100,000 or more population. The impact of this urbanisation on the environment and the resulting complex and interlinked, problems like housing, transportation, water supply, sewerage, sanitation etc. are discussed. The experts have also reviewed possible approches to overcome these challenges and the strategies to provide a better quality of urban life.

It is wellknown that denudation of forest cover will ultimately result in increasing water shortage, recurrent land slides, increasing incidents of woods in the plains, high sedimentation load in flowing water, shortage of fuel etc. In fact some of these effects are already being experienced in the ecologically sensitive Himalayan region. Current national forest policy emphasises social forestry including afforestation of wasteland, apart from conservation and protection of existing forests cover. While, discussing details of various social forestry schemes launched by the Government and their envisaged positive impacts on environment, a word of caution is given on the possible negative environmental impacts like excessive use of fertilisers, pesticides replacement of ecosystem by an artificial monoculture, etc.

A Number of issues on the existing constitutional and legal provisions for environmental protection in India have been included in these two volumes. Specific cases where the Municipal and other Acts have been used from time to time for dealing with pollution

problems have been cited. The need for enacting additional comprehensive legislation for controlling noise pollution in India has also been emphasised. In fact 25% of the total presentations are on legal aspects and in the process, several authors have repeatedly quoted the Supreme Court's decision on Ratlam Municipality Case of 1980.

In addition, there are presentations on specific and lesser known issues like the Bioenvironmental control of malaria, fisheries development and environment, foreign trade and environment, politico-adninistrative aspects of environment protection, etc. It would however have been more useful if the author had edited these presentations and classified them subsector wise to avoid repetitions.

L. Paneersalvam
Joint Director
Ganga Project Directorate, New Delhi

CAPITAL BUDGETING DECISION UNDER RISK AND UNCERTAINTY, by J.D. Agarwal, Indian Institute of Finance, New Delhi, 168p, Rs. 150.00

Capital budgeting is one of the the important areas of financial management, on which a lot of attention has been devoted during the post world II era.

Ever since the work of Joel Dean, the literature on capital budgeting has grown so rapidly that it has tended to diverge from rather than converge to a unified whole. Agarwal's book on capital budgeting decision under risk and uncertainty is not just another addition to the existing literature but another brick on the theories and techniques which have been developed, over a period of time. The book opens up newer frontiers and vistas by challenging the existing techniques as outdated and far from reality.

The book in all has nine chapters. In the first three chapters the author explains in an analytical manner the nature and meaning of capital budgeting decisions besides giving a brief background of the literature. These three chapters present a complete picture of capital budgeting decisions in a summarised form.

In the next three chapters the author presents the findings of his own research based upon an empirical investigation, to establish that firms in general pursue multiple objectives. The author has also attempted to prove that the techniques which help evaluate capital budgeting decision assuming a single objective do not give an optimal solution. The author not only makes a case of evaluating projects keeping in view the multiple objectives but also presents a model suggesting how to rank various multiple objectives in order of their priority.

In chapters 7 & 8 the author suggests two models : A Goal Programming Model and A Stochastic Goal Programming Model for evaluating capital projects under conditions of certainty, risk and uncertainty. Although an application of goal programming model has been presented and a computerised solution is given, no such attempt has been made by the author for the stochastic goal programming model which according to the author has been developed to incorporate risk and uncertainty.

The author's goal programming model which has several advantages, opens up the whole approach of capital budgeting and adds a new dimension. Besisdes the weakness of providing the solution in fractions, the goal programming approach suffers from it, would be helpful in decision-making. Of course the author suggests in the last chapter that an integer goal programming model can take care of this weakness. The author also spells out a number of areas on which further research may be carried out.

The book would be immensely useful for executives of financial institutions, companies, Government, policy making bodies, bankers and management consultants in evaluating the projects thoroughly. The book would also be useful to teachers, researchers and students of finance, economics, business management, commerce and operations research.

K.L. Handa
Professor of Financial Management
Indian Institute of Public Administration, New Delhi

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BOOKS IN BRIEF

Advanced Information Technology in the New Industrial Society : The Kingston Seminars

By Arthur Cotterell, Oxford, Oxford University Press, 1988, 144p, £7.95

This book is a collection of papers presented at a seminar at the Kingston College of Further Education, UK, in Autumn 1986, on the role of information technology in the future economic development in Britain. The papers discuss the impact of current revolution in information technology on industry, on education and training for industry and on society.

Automatic Control—1987

By R. Isermann, Oxford, Pergamon Press, 1988, 10 volume set, £ 1000

Automatic Control 1987 is the proceedings of the 10th IFAC World Congress. In an area of continuing development and research, and with the ever increasing importance of automation and technology within industry, this publication provides information on the state-of-the-art and future developments in automatic control.

Labour Administration : Profile on Pakistan

By International Labour Organisation. Bangkok, ARPLA, 1988, 213p, £8.00

The profile on Pakistan reviews the organisational structure and functions of the Ministry of Labour, Manpower and Overseas Pakistanis and provides the budget and the organisation charts of the various services in the labour administration system. It is the fourth in a series of profiles, the earlier ones being on Hong Kong, Bangladesh and Thailand.

Labour Administration : Profile on the Philippines

By International Labour Organisation, Bangkok, ARPLA, 1988, 85p, $6.00

The profile traces, in a historical and developmental perspective, the growth of labour administration. The historical background of the Department of Labour and Employment emphasises both its role as a major institution in labour administration and its growth in terms of organisational structure and responsibilities as it contributes to national development. The creation of the department affected the institutional and substantive involvement of labour administration in national development/work. This is a fifth in a series of profiles, the earlier ones being on Hong Kong, Bangladesh, Thailand and Pakistan.

Management's Hidden Enemy : And What Can be Done About it

By David S. Brown, Mt.Airy, Lomond Publications, 1988,123p. $ 29.50

This book is concerned with some of the most wasteful, costly and debiliting aspects of present day administration systems and suggests what can done about them. The enemy is dysfunctionalism, a pervasive evil the author says, which has received too little attention. It is an analysis of dysfunctional problems with practical suggestions of how to deal with them.

Marketing Eonvironment and Practices in Nepal

By Y.S. Vermand, M.P. Dhal, New Delhi, Sterling Publishers, 1988, 176p, Rs. 150

This volume presents the proceedings of a Seminar-cum-Workshop organised by the Institute of Management, Nepal. There are articles by distinguished authors on the marketing practices of four of the leading undertakings of Nepal. The contents have been arranged in four sections (i) Marketing System and Environment; (ii) Marketing Environment of Nepal; (iii) Marketing Practices in Nepal; and (iv) Marketing Practices as Interaction between Marketing Principles and Environment.

Modern Small Industry in India : Problems and Prospects

By Ram K. Vepa, New Delhi, Sage Publications, 1988, 193p, Rs. 175 (HB), Rs. 75 (PB)

This book outlines the progress made over the last thirty years in the small industry sector. It identifies some key areas which need greater attention on the part of policy makers if the small industry sector is going to successfully meet the challenges posed by modern technology. It also identifies thrust areas which are likely to gain in importance.

Office Management : An introductory Text Book

By Mrityunjoy Banerjee, Calcutta, Book Syndicate, 1987, 230p, Rs. 20

An attempt has been made to present the important aspects of modern office management in this publication which is designed as a text book at the undergraduate level. It conforms to the syllabuses of the few leading universities and institutions that have incorporated office management as a paper in thier courses.

Personnel Selection and Productivity

By Mark Cook, Chichester, John Wiley & Sons, 1988, 276p, $ 49.95

This volume emphasizes that personnel selection must lie at the heart of any consideration of how psychology can relate to working productivity. The author describes the value of good employers, the importance of job description and job analysis in the process of personnel selection. He reviews the major selection methods and discusses technical issues of validity tests.

Planning at The Gross Roots

By Kamta Prasad, New Delhi, Sterling Publishers, 1988, 200p, Rs. 125

This book deals with the rational methodology, data requirements, problems of integration and coordination, planning machinery etc. It also reviewed the past attempts made in this direction and in the process has analysed the causes of slow progress of this scheme. The book discusses in detail the three important schemes of poverty allevation programme namely IRDP, NREP and RLEGP and based upon some field studies in states of Gujarat and Bihar, highlights the weakness and implementation problems at the district level.

Planning for Coal Sector

By Gopal K. Kadekodi, Delhi, B.R. Publishing Corpn., 198p, Rs. 125

It is a publication sponsored by the Institute of Economic Growth, Delhi. This book examines the issues based on extensive field data from coal mines, coking units and project areas, exhaustibility, cost of mining, pricing of coal, technological options, coal beneficiation, soft and beehive cokes, exploring more coal and environmental effects. It has a focus on planning and policy options econometric models of cost and productivity. Cost-benefiit analysis of coal mine projects and optimisation models of choice of techniques form the basic facets of enquiry into the nature of this important energy sector.

Planning for Rural Development : Issues and Case Studies

By Ravindra H. Dholakia and Sundershan Iyengar, Bombay, Himalaya Publishing House, 1988, 133p, Rs. 100

This study is based on author's first-hand experience of action-research carried out in the Gujarat

State. It presents five specific case studies of different schemes/projects covering different aspects of micro-level planning for rural development. The book highlights issues and problems one is likely to face while planning any intervention for rural development under the present circumstances. It provides useful insights into the planning process that would countribute towards improving management of special programmes for rural development.

Productivity and Value: The Political Economy of Measuring Progress

By Folke Dovring, Wesport, Greenwood Press, 1987

This book takes a critical look at the "generic" concepts of productivity as they are used in most of the conventional literature. In particular, the author challenges the concept of "total-factor" productivity as a vaild indicator of successes or failures in economic policy and in the economy generally. Economists, business leaders, economic journalists, and politicians will find this book useful in explaining the current controversies in productivity research, and by what means they are likely to be resolved.

Productivity, Investment and Import Substitution in Indian Industries

By N.C. Gupta, New Delhi, Radha Publications, 1987, 162p, Rs. 120

The present study is a modest attempt to examine three specific aspects of non-ferrous basic metals industries, namely productivity, investment and import substitution. The measurement of import substitution is confined to primary non-ferrous metals, namely aluminium, copper, lead and zinc. The book presents estimates of different indices of productivity, such as partial productivity ratios, total factor productivity indices; estimates based on production function for the two periods ie 1948 to 1958 and 1960 to 1970.

Productivity Plus

By Jahn G. Belcher Jr., Houston, Gulf Publishing Co. 1987, 237p, $ 24.95.

This book offers key management strategies for obtaining and sustaining peak performance in any company or organisation. This is not a "Shot-in-the-arm" programme or a dose of short-term motivation. Productivity Plus offers proven techniques to integrate high productivity and competitiveness into the organisation as constant, clear-cut objectives. It covers all aspects of productivity, including how to get top-management commitment, involve and reinforce employee, and measure productivity, the role of the union; and the quality/productivity connection.

Putting the Just-In-Time Philosophy into Practice

By P.J. O'grady, London, Kogan, Page, 1988, 138 p, $ 16.95

This book describes the essential features of Just-In-Time (JIT) approaches to manufacturing and how JIT can be successfully implemented. JIT marks a significant departure from previous western approaches to manufacturing management and aims to improve quality levels and customer service while decreasing lead times and inventory levels. The use of simple though effective methods can, with proper management, lead to continuous improvements in the manufacturing operation. The book is aimed at production, operations and manufacturing managers.

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

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

This book is a comprehensive, practical, clearly written explanation of the JIT (Just-In-Time) concept and its relationship to quality, vendors, management, systems and technology. Examples from actual companies illustrate the technical and managerial problems involved in changing to JIT, and how to address them. The book tells why the JIT approach makes sense, explains the managerial implications and then, tells how to go about implementing it.

Transnational Corporations in a Developing Country: The Indian Experience

By Johri Martinussen, New Delhi, Sage Publications, 1988, 228 p. Rs. 150

This volume is a comprehensive assessment and analysis of India's policies towards transnational corporations (TNCs) since the late sixties. It also reviews the most important acts and rules governing TNCs in India and, then, investigates the administration and implementation of the policies contained therein. It analyses the implementation of the Foreign Exchange Regulation Act and the functioning of the industrial approval system.

Understanding Computers

By Dinesh Kumar, New Delhi, BPB, 1988, 400p, Rs. 36

The book is written for laymen and provides essential information about computers and other various components, how they function and what they can do. It also helps a prospective buyer in making sound selection from the plethora of computers and application packages available in the market.

Worker Consciousness and Trade Union Response

By E.A. Ramaswamy, New Delhi, Oxford University Press, 1988, 242p, Rs. 150

This book is a comparative study of trade unionism in four major industrial centers of Bombay, Calcutta, Madras and Bangalore. It portrays the contemporary scene by examining broad trends in the labour movement and the individual styles of prominent leaders and assessing specific unions against this back drop.

Compiled by :

S.N. VIG
Documentation Officer
National Productivity Council
New Delhi

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S.N. VIG
Documentation Officer
National Productivity Council
New Delhi

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All business correspondence to be addressed to the Business Management Section, National Productivity Council, Utpadakta Bhavan, Lodi Road, New Delhi-110 003 (INDIA)

Trade Unions and Productivity : A Theoretical Construct

Ramjas

The author argues that the traditional notion of trade unions as forums for collective bargaining does not reflect the full range of functions they perform. In particular, their role in providing a collective 'Voice' which looks into all aspects of worker-welfare is very important. This article is a review of the extensive literature dealing with this aspect.

Ramjas is a Lecturer in Commerce at the Shaheed Bhagat Singh College, Delhi University, Kalkaji, New Delhi.

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Trade unions wield considerable influence at the national level as they command the loyalties of millions of workers. The behaviour of trade unions and employers as economic agents and the interplay of forces associated with them, determines the allocation of resources, the reward to factors of production and the welfare levels of the labour force.

The traditional line of argument about the impact of unions on productivity is that with an increase in the wages of unionized workers through collective bargaining, labour becomes relatively costly. In response to a rise in the relative wage, firms seek to raise the marginal product of labour by factor substitution i.e. by raising the capital-labour ratio. The effect is an increase in measured labour productivity; also an increase in the unit cost of the product and a misallocation of resources. With a relative increase in the pay of the workers, employers are compelled to adjust the quality of labour hired. The employer will recruit higher quality workers as a response to union induced pay increases. So over a period of time as incumbents are replaced, the average quality of the enterprise's labour force will improve (Ashenfelter and Johnson, 1972). There is no rigorous way to measure the independent effect of collective bargaining on the quality of the work force. The effects are clearly not the same in all managements and unions. Bok and Dunlop (1970) contend that there is a reason to believe that the net effect of collective bargaining is to increase productivity through a higher quality of the labour force. The traditional economic reasoning, therefore, limits the influence of the union on productivity through a rise in the capital labour ratio and

recruitment of higher quality labour induced by the union wage effect.

Negative Effects on Productivity

In the popular mind unions are not usually thought of as raising productivity; at best they are thought of as keeping the pace down to acceptable levels. Even unorganised labour force is supposed to withhold labour. At the turn of the century, F.W. Taylor emphasised the existence of a systematic tendency to withhold effort : "The greater part of the systematic soldering, however, is done by the man with the deliberate object of keeping his employers ignorant of how fast work can be done. So universal is soldering for this purpose that hardly a competent workman can be found in a large establishment, whether he works by the day or by piece work, contract work or under any of the ordinary systems of compensating labour, who does not devote a considerable part of his time to studying how slowly he can work and still convince his employer that he is going at a good pace" (Taylor, 1947, p. 33).

The impact of the organized work force is perceptibly distinct at the work place. Its collective power has the potential of affecting diverse aspects of the production environment viz., work rules, regulation of machinery, work stoppages, managerial decisions on technological changes, promotions and lay off. Unionization also brings about beneficial changes in the compensation packages (i.e. wages and fringe benefits) of employees over and above the prevalent market rates of compensation, leading to a misallocation of resources. Unions are supposed to stifle enterprising management, constricting its operations with enormous work rules and engaging in immoral behaviour often characterised as 'featherbedding' (Bok and Dunlop 1970, p. 261). Featherbedding is defined as a labour working rule which causes the firms to hire more of labour units of a particular type than it would at the existing wage, assuming technology and social norms to be given. Social norms are included in the definition to cover such items as vacations, rest periods etc. which are in the category of reasonable union rules (Weinstein, 1960, p. 379).

There is a subtle difference between featherbedding and work restriction. Examples of the former are : limits on the board handled by workers, restrictions on the tasks performed by employees in given occupations, requirements that work be done twice or that unnecessary work be done, requirements for unnecessary standby crews or crews of excessive size, enforcement of loose production standards or limits on work pace and interference with technological changes sought by management (Brown and Medoff, 1978, p. 359). The consequences of such type of practices will be to force management to hire more labour than it would otherwise choose, the wage bill will be normally increased and resources will be used less productively than what management would prefer. Unions are also seen as an interference in hiring the most able workers, seniority as blocking the promotion of best qualified employees and worker solidarity as a force turned against management and production (Brown and Medoff, 1978, p. 360). So far as the empirical evidence of non-wage inefficiencies introduced by trade unions are concerned, systematic empirical evidence is sparse, the bulk of the material taking the from of case studies of establishments (Slichter, et al, 1960).

Positive Effects of Unions

The conventional approaches to the study of the impact of unions on productivity through wage effects assume wagerelated implications like factor substitution and better quality of workers but do not allow for the possibility of more dynamic effects.

But there exists an alternative view which holds that the introduction of unions and collective bargaining invovles fundamental changes in the enterprise and its surrounding product and labour markets. The introduction of unionism typically involves a wholesale transformation. According to this view, unions are both economic and social institutions firmly embedded in the large fabric of a constantly changing and evolving society. Unions belong to a class of institutions—families, firms, schools and the like—having decision-making characteristics distinct from the individuals who belong to them. Groups of

individuals within a union when they make decisions about wages collectively, do so differently from what they would individually. According to this broader view, the existence of unions is not simply a matter of economic costs and benefits. "Unions may be concerned with the distribution as well as the level of economic benefits achieved through bargaining, their economic policies may induce a wide range of adjustments and innovations at the work place and they may devise economic policies to alter the market context within which they bargain" (Doeringer, 1984, p. 316).

Recently some empirical work has challenged the conventional view by arguing that unions produce X-efficiencies through the expression of 'collective voice'. This new view associated with the work of Freeman and Medoff, and their students at Harvard, while not denying the monopolistic role of labour unions, maintains that the monopoly view of unions (i.e. an organisation whose main function is to raise wages) is seriously misleading. Unions, according to this view, have significant non-wage effects that influence diverse aspects of modern industrial life. By providing workers with a 'voice' at the work place, unions can and do affect positively the functioning of the economic system. The central idea of this new view is that unions have the potential to more than offset via enhanced productivity, the cost increases that result from wage and non-wage inefficiencies.

The essence of the Harvard view is contained in Freeman (1976), Freeman and Medoff (1979) and Freeman and Medoff (1984). This analysis draws heavily on the exit-voice paradigm of Hirschman (1970). According to this, societies have two basic mechanisms for dealing with social and economic problems. The first is the classic market mechanism of exit and entry, in which individuals respond to a divergence between desired and actual social conditions by exercising freedom of choice or mobility. In the labour market, exit is synonymous with quitting while entry consists of new hirers by the firm.

The second mode of adjustment is the political mechanism that is called 'voice'. This refers to the use of a direct communication to bring actual and desired conditions close together. For example, if a customer is not satisfied with his shopkeeper, according to the first mode, he will quit and go to the other. According to the second mode, the customer, instead of quitting the first one, will complain and explain his desired quality of the product or behaviour.

Out of these two modes of adjustment, Freeman contends, the 'voice' is the efficient one. The advantages claimed by the 'collective voice' mechanism can be the following. First, unions can induce managers to alter the methods of production and adopt more efficient policies. Second, unions collect information about the preferences of workers, thus, permitting the firm to choose a better (i.e. more efficient) mix of wage and personnel policies. Third, unions improve the communication between the two sides leading to improved decisionmaking. Finally, unions improve morale and cooperation among the workers.

Information about the conditions and preferences of workers can be collected through free market 'exit' consisting of 'quits' and related behaviour and/or by 'voice' consisting of the collective bargaining system by which workers elect union leaders to represent them in collective bargaining. Employers can learn about worker preferences and the causes of discontent from individual quits either inferentially or by exit interviews. Inferences about the preferences of workers who quit, may, because of 'selectivity bias', yield incorrect information about average evaluation or evaluations of the possible quitters (Freeman, 1976, p. 362).

Exit interviews run into a different difficulty because it is difficult to motivate the worker who leaves to detail work place conditions. There is no gain to quitters by providing management with desired information about dissatisfaction and there may be possible losses via bad references. On the other hand, collective rather than individual bargaining with an employer is necessary for effective voice at the work place for two reasons : first, many important aspects of industrial settings are 'public good' that is, good which will affect the well being (positively or negatively) of every

employee in such a way that one individual's partaking of the good does not preclude someone else from doing so i.e., the consumption of many of the working conditions is non-rival. Thus, safety conditions, lighting, heating and the firm's policies on lay off and promotions etc. are shared by all the workers. Individuals connot bargain over plantwide conditions (Freeman and Medoff, 1984, p. 8). Second, collective action is necessary because workers who are tied to the firm are unlikely to reveal true preferences to an employer, for fear of victimisation. The danger of job loss makes expression of voice by an individual risky.

The collective nature of trade unionism fundamentally alters the operations of the labour market. In a non-union setting the predominant form of adjustment by firms depends on the preferences of the 'marginal' workers whereas in the case of unionized settings, the union takes account of all workers in determining its demands at the bargaining table. It is likely to respond to a different set of preferences from those that prevail in a non-unionized setting. In sum, taking account of all workers and appropriately considering the sum of preferences for work conditions that are common to all workers, can be economically more efficient than the contract that would result in the absence of unions.

Workers, prior to their organisation into unions, tend to establish job control and output restrictions through 'informal groups'. These workers use crude methods of job control as they have no direct channels of expressing complaints. When union organisation supersedes informal groups (i.e. institutionalise) they allow for complaints and grievances to be directed against the causes of discontent. The result may be less attention to restrictive attitudes, unless the grievance mechanism is unavailing. "Trade unions do not create conflict between employer and his employees. Conflict is inherent in the situation. They merely give an institutional expression to the conflict which would assume chaotic proportions in their absence" (Sinha, 1981, p. 12).

Trade unions institutionalise the system of determination of acceptable bargaining packages and the elicitation of preferences of the common worker. These are the major tasks of the trade unions and critical components in the successful operation of collective bargaining.

The major advantages of unionization are that it provides a direct channel of communication between workers and management and an alternative mode of expressing discontent than quitting, with consequent reductions in turn-over costs and increases in firm—specific training. In a large enterprise, the union 'voice' provides central management with information about local conditions and operations that is likely to differ from that obtained from the organisational hierarchy. Collective voice is also likely to yield a better mix of wages, working conditions, rules of the work place and increased firm-specific human capital than otherwise.

Why No 'Voice' in Non-Union Settings?

Can the 'voice' mechanism work and its advantages be availed of in the absence of unions ? If this were so the firm will be able to keep itself aloof from the inefficiencies caused by unionization. Is it possible that the need for unions will disappear if human relations techniques like profit sharing, employees' representation, formation of small groups and cultural centres are introduced? In such a scenario, even if unions come into being, they may be made to become an integral part of a programme of team work, communication and participation.

The reason for the general absence of 'voice' or industrial jurisprudence practices in the non-union sector is that the essence of 'voice' is to reduce managerial power and create a dual authority channel within the firm. Such a change in power is difficult to obtain in the absence of an independent union. During the 1920s many firms experimented with the so-called 'employee representation' plans designed to provide a non-union 'voice' mechanism for workers. Freeman (1980), observed that many of these plans ended in failure, despite their best intentions, as workers were unwilling to express their views for fear of retaliation by the management and because of their own lack of power to affect decisions.

This is not to say that no non-union firm will have a grievance or arbitration system; some may have such systems, in part to reduce workers' desire for unions. The point is that it is more difficult to institute an effective system in the absence of unions. Freeman and Medoff (1984) have offered a very apt analogy. The problem, they say, is akin to that of operating a democratic parliament in a monarchical or dictatorial regime. As long as the monarch or dictator has the final word, the parliament cannot truly function. Free expression just cannot be there in a dictatorial regime even if the regime desires it on certain issues.

Shock Effect

The presence of unions stimulates rational and productive use of labour and other resources. This is true even in the context of management as a resource (Slichter, et. al, 1960). Unionism can improve efficiency by putting pressure on management to institute more efficient methods in the utilization of labour, improve the training and methods of assignments and work measurement and better supervision, This pressure on management or 'shock effect' can improve efficiency by tightening job production standards and accountability in order to preserve profits in the face of higher wages. This plainly means that a union-shocked management is able to extract more output from a given amount of inputs than a management which is not confronted with the union stimulus (Brown and Medoff, 1986, p. 359).

The thesis of shock effects is based on the assumption that there are opportunities within the firm for removing slack and inefficiency i.e. X-inefficiency. The implications of X-efficiency are that firms maximise profits and minimise costs only as a special case. "Firms do not operate on an outer bound production possibility surface consistent with their resources. Rather they actually work on a production surface that is well within that outer bound and, thus, the amount to be gained by increasing X-efficiency is significant" (Leibenstein, 1966, p. 413).

Given that there is, in most situations, vast potential for X-efficiency, the question of motivation and woker morale assumes significance. Workers can be 'induced', 'energised' or 'motivated' even in non-union settings. It is possible that the costs of avoiding the union are more (considering the covert benefits of unionization) than in the event of a compromise with the existence of unions. Unionized workers, because of better pay, fringe benefits and the 'voice' factor develop 'interest' in the firm which attaches them to it for a comparatively longer duration. This is dispite the finding that unionized workers may be more dissatisfied than non-unionised workers (Freeman and Medoff, 1984). Workers in unionized firms can be better 'activated' than in non-unionized firms.

Gellerman points out that a union might discover that its strongest lever in bargaining with management is the maintenance of discipline over its members (monitoring services) in exchange for concessions on wages, fringe benefits and other financial gains. Thereafter, the union will attempt to take over the enforcement of work standards, attendance and punctuality requirements and above all to prevent slowdown and work stoppages. It can accomplish these functions far more effectively than management can. For this reason, management will probably learn to appreciate the union despite its militancy. A bargain is, thus, struck between the two sides (Gellerman, 1970, p. 280).

The other behavioural variables viz. morale and job satisfaction are also influenced to a great extent by unionization. With better pay and other material rewards, promotion and layoff through seniority and other voice-based transformations of the work place relations, morale of the workers is expected to be high. And it is possible that high morale may lead to an increase in worker productivity.[1]

Herzberg, Mausner & Synderman (1959) have developed a distinction between motivation and what they call hygienic factors. 'Motivations' are those which are intrinsic to the job such as achievement, recognition, the nature of work, responsibility, advancement and growth. 'Hygienic' factors are not job-

1. But the evidence of the relationship between morale and productivity is not always positive. With high morale the productivity can be lower or vice-versa; see Vroom and Deci (1970).

related, but comprise such variations as company policies, salary, co-worker relations and supervisory style. They argue that eliminating the causes of dissatisfaction (through hygiene factors) will not always result in a state of satisfaction. Instead it will result in a neutral state (i.e. passive acquiescence). Satisfaction and motivation would occur only as a result of the use of 'motivators'. It is highly controversial that the so-called 'hygienic' factors will not motivate. Individual perceptions of the significance of these factors differ to a great extent. However, it should be the business of management, according to this theory, not to try to sell employees on the beauty of benefits they already take forgranted but to anticipate where their needs become strongest and to plan an active programme of harnessing the motives that these needs will ignite (Gellerman, 1970, p. 54).

So far as the anticipation of the needs of the workers by the management is concerned, it can more conveniently be determined in a unionised setting than in a non-unionized one, considering the diversity of industrial perceptions. The union will help in determining such average needs after considering the perceptions and priorities of its members.

The impact of 'voice' on enhancing labour productivity is summarised in Fig. 1; it also illustrates that the other 'route' to higher productivity, which along with increasing wages, leads to a misallocation of resources.

Conclusion

In brief, the positive effects of unions on productivity are the following :

1. Reduced turnover and consequently higher human capital retention by the firm. Training costs are reduced.
2. High morale and motivation.
3. Shock effect on management.
4. Better informal relations amongst the workmen, less rivalry through introduction of seniority and higher informal training of workers.
5. Improved and effective channel of communication between workers and management.

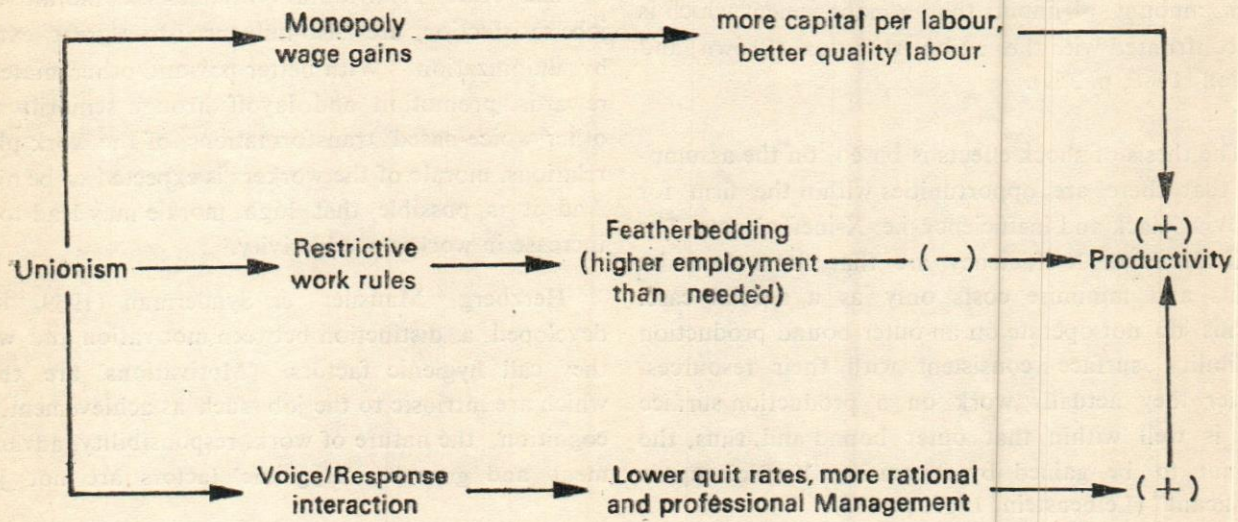

Fig. 1 Impact of 'Voice' on Productivity

Source : Freeman & Medoff (1984, p. 163).

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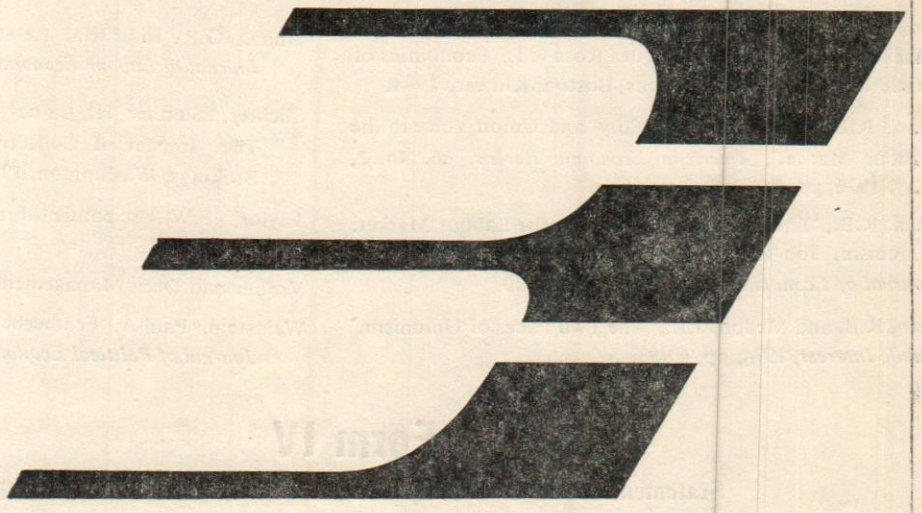

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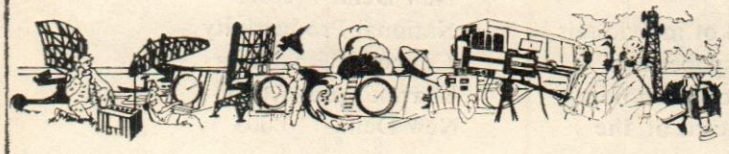

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Status of Quality Circles in India

Ajit Singh

Quality Circles have been employed in Japan since the early 1960s but in India they have a much shorter history, and it is only in recent times that interest in them has intensified and become widespread. Quality Circles are, sometimes, seen as the fashionable quick-fix solution to shop floor problems and there have been many failures in practice because of a lack of understanding of "What quality circles are about". The attitudes, expectations and experiences of companies that have employed quality circles, are examined in this study and results are presented on the basis of a survey of Indian organisations.

Ajit Singh is Director (Industrial Engineering), in the National Productivity Council, Lodi Road, New Delhi-110 003.

Productivity, Vol. 29, No. 4, January-March 1989, 381-386

The development of quality control in Japan since the 1950s has relied heavily on absorbing, adapting and refining methods and concepts such as statistical quality control (SQC), Zero Defects (ZD) and "Right-first-time" developed in the west, principally in USA. Though SQC was a success in many ways in Japan, apparently the onus of quality rested with the Quality Control Department during the early days (Chu, 1987). To resolve this problem, the Japanese developed Total Quality Control (TQC) which meant that every employee in the organisation had a responsibility for quality. Quality Circles were employed as a part of Total Quality Control system (Pacific Information Digest, 1984). The first quality circle were registered with the Union of Japanese Scientists and Engineers (JUSE) in May 1962, which established a special organisation to promote and coordinate quality circle activities. The quality circle has been defined by the Union of Japanese Engineers and Scientists (JUSE) as :

> "A small group to voluntarily perform quality control activities within the workshop to which they belong. This small group with every member participating to the full carries on, continuously, as part of company wide quality control activities, self-development and mutual development, control and improvement within the workshop utilising quality control techniques." (International QC Circle Proceedings, 1981).

The basic philosophy, attitude and the way of operating Quality Circles are now well-established. These activities have been proved successful in Japan to upgrade quality and to secure improvements in products or services. Initially, it was believed that Quality

Circle activities could not possibly be implemented outside Japan unless considerable modifications were made. However, attempts made in Taiwan and South Korea were successful and implementation was extended to American, Asian and European Countries (Mohrman, 1983).

In India, about 158 companies are registered with Quality Circle Forum of India (QCFI) and an equal number of companies are practising Qrality Circles though they are not yet registered with QCFI. The results presented here are based on a survey carried out by the author and responses received from 112 companies registered with QCFI. A semi-structured questionnaire was circulated to collect data and a few visits to four selected companies were made. The survey included engineering industries, heavy machinery, shipyards, port trusts, process industries, rubber and automobiles.

Survey Results

The bulk of the quality circles have been introduced during 1984 and later (Figure 1). The growth of quality circles indicates the increasing participation rates which doubled in three years and is expected to be six times in 1988 as compared to 1984. It is interesting to note that 56% of the companies reported their Quality Circle programmes as successful and only 12% reported failures. However, 32% of the companies reported that they could not yet say anything about the outcome. There was no evidence to suggest that success or failure was in any way related to the type of industry which the company was engaged in.

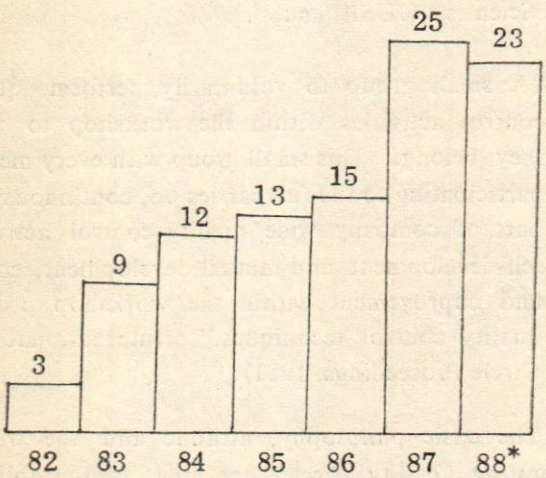

Fig. 1 Year wise Percentages of Quality Circles introduced by companies in the survey

*Figures for 1988 are upto April only (4 months)

The problems or factors that were assessed as having impeded the implementation of quality circles programmes are shown in Figure 2.

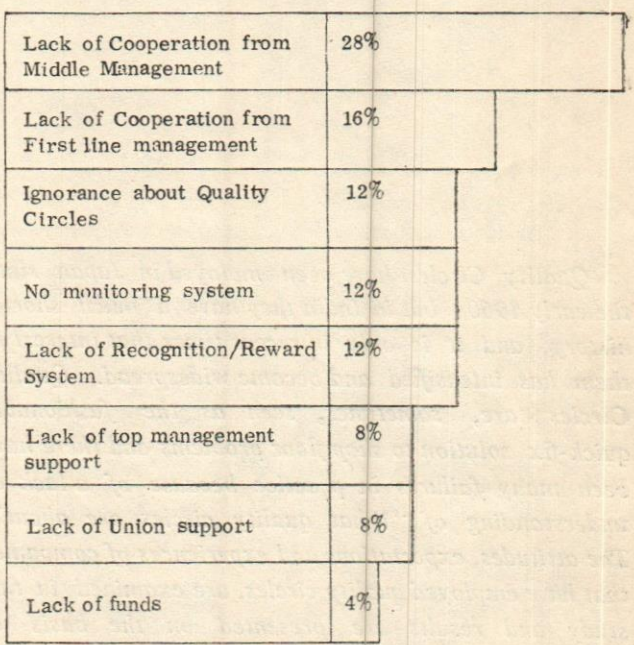

Fig. 2 Problems or factors that impeded the implementation of Quality Circle programmes in unsuccessful companies

For the unsuccessful companies lack of cooperation from middle management was considered to be of overriding importance. Lack of cooperation from first line management, although the next most important issue, was seen as being of much less significance. Ignorance about quality circles, absence of monitoring systems and lack of recognition/reward systems were considered comparatively of less importance. Neither lack of top management support nor the lack of union support was thought to be a major obstacle to the introduction of quality circles and the question of lack of funds was hardly considered a problem at all.

It will be worthwhile to mention here that the

survey carried out by King and Tan on Quality Circles (1986) also showed lack of cooperation from middle management' and first line management, as the two topmost reasons for failures.

For the successful companies, the factors which contributed to the effective introduction of quality circles, are given in Figure 3.

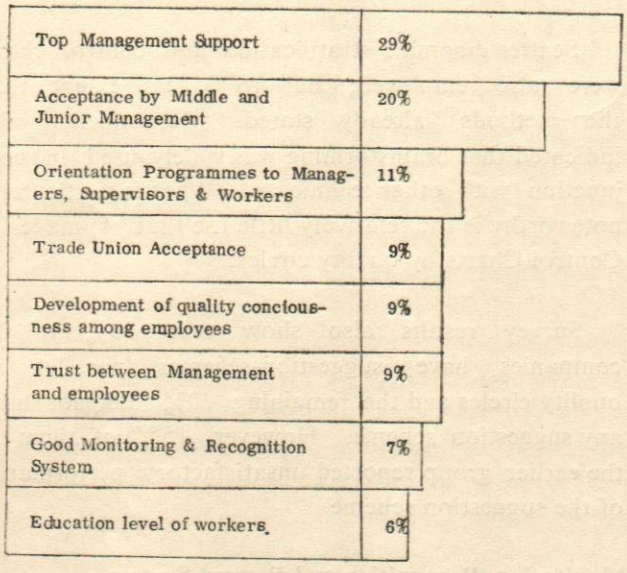

Fig. 3 Factors contributed to the success of Quality Circles in successful companies

A very interesting inference can be drawn from Figure 2 and Figure 3. For those companies which are successful, the top-ranking factor for success is "Top Management Support" and for those companies which have failed the top-ranking reason of failure is "Lack of Cooperation from Middle Management". This is typical of Indian organisations.

The reasons for adopting quality circles were examined for both successful and unsuccessful companies together and the results are presented in Figure 4.

The need to develop problem solving attitudes and improve employees' motivation have been ranked as the two most important objectives/reasons for introducing quality circles. The third in ranking was the requirement to develop quality consciousness. Both the need to improve productivity or output and the need

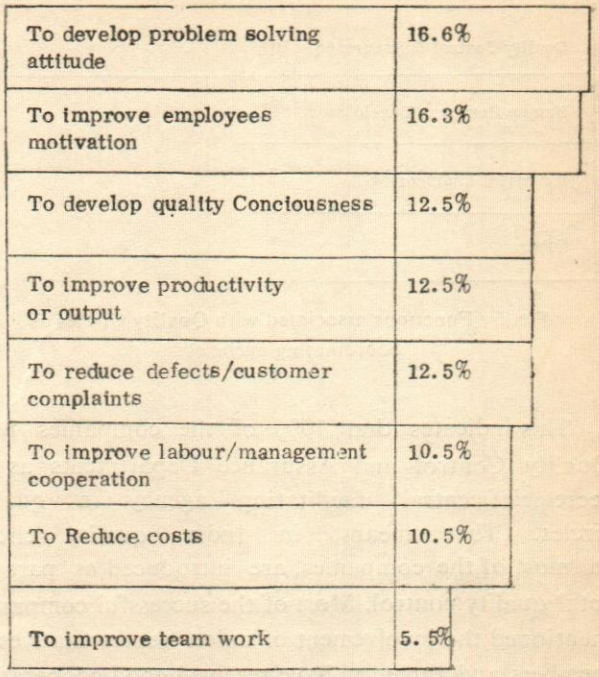

Fig. 4 Reasons for adopting Quality Circles

to reduce defects/customer complaints were also ranked equally. This may be regarded as the important and measureable consequences that could be expected to flow from improvements brought about by quality circles. The expectations of companies to improve labour/management cooperation and to reduce costs ranked next. This means that managements in general do not expect a direct reduction in costs through quality circles, though they hope to achieve it indirectly. Surprisingly the improvement in team work has been ranked the last. Most of the successful companies reported that the objectives as envisaged in the introduction of the quality circle programme have been achieved to the extent of 50% to 80%.

All the successful companies indicated a continuing future commitment to the employment of quality circles. The unsuccessful companies were yet undecided about the continuance of the QC programme.

Out of the total companies surveyed, 6% did not have any formal Steering Committee and no formal QC coordinator. Full-time coordinators were employed by 14% of the companies while 80% utilised part-time coordinators. The part-time coordinators belonged to the functions as mentioned in Figure 5.

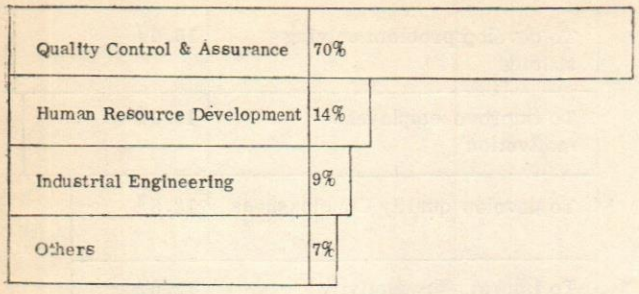

Fig. 5 Functions associated with Quality Circles as coordinating agencies

This indicates that 70% of the companies used Quality Control and Assurance Departments as the secretariat/central facilitating agency in quality circles. That means, in India, quality circles in most of the companies, are introduced as part of total quality control. Most of the successful companies mentioned the involvement of union representatives as members and agreed to have received good cooperation from trade unions. However, none had any union representatives on the Steering Committee.

There were mixed views about the role of the facilitator; the most prevalent view being that of coordinator. Some viewed them as trainers/counsellors and change-agents. Figure 6 gives the role as perceived by the companies.

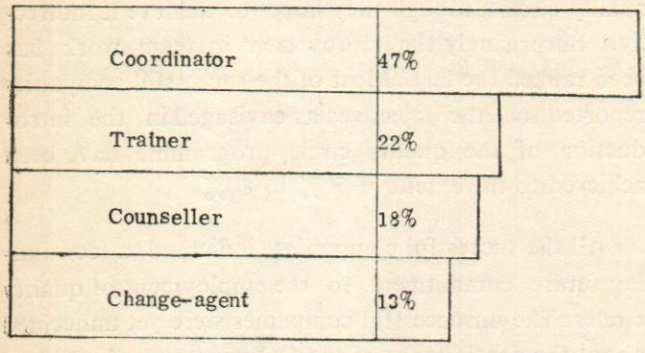

Fig. 6 Role of Facilitator as perceived by surveyed companies

Quality circle leaders were chosen in a variety of ways which ranged from being elected by the circle members to being appointed by the management. About 84% of the companies surveyed reported that the members elected their leaders, in 10% of the companies they were chosen by consensus and in another 6% they were appointed by the management.

Figure 7 shows the ranking based on the frequency of usage of quality aids/techniques employed by quality circles in the successful companies. The most used teehniques are, as may be seen, the cause-effect or fishbone diagram, check sheet, Pareto chart and histogram.

Scatter diagram, stratification and control charts were also employed; but to a less extent than the methods already stated. Respondents also indicated that brainstorming was widely used in conjunction with other techniques. What is particularly noteworthy is the relatively little use that is made of Control Charts by quality circles.

Survey results also show that 80% of the companies have suggestion-schemes parallel to quality circles and the remaining 20% did not have any suggestion scheme. However, 15% of them in the earlier group reported unsatisfactory performance of the suggestion scheme.

Monitoring, Recognition and Reward System

Many companies have developed an effective system of monitoring progress to sustain quality circles activities on a long term basis. One of the successful companies reported that the management constantly monitored the activities and gave Blue colour to circles rated as good, Green to satisfactory, Yellow to fair and Red to those circles which needed attention.

Most of the companies monitor the number of meetings held, the number of suggestions put forward and the number of presentations and their implementation, the total number of circles and other such parameters.

The recognition system consists of monetary rewards and non-monetary rewards. For example, one company has linked the monetary rewards directly to the savings as a result of implementation of suggestions. It varies from 10% to 15% of the

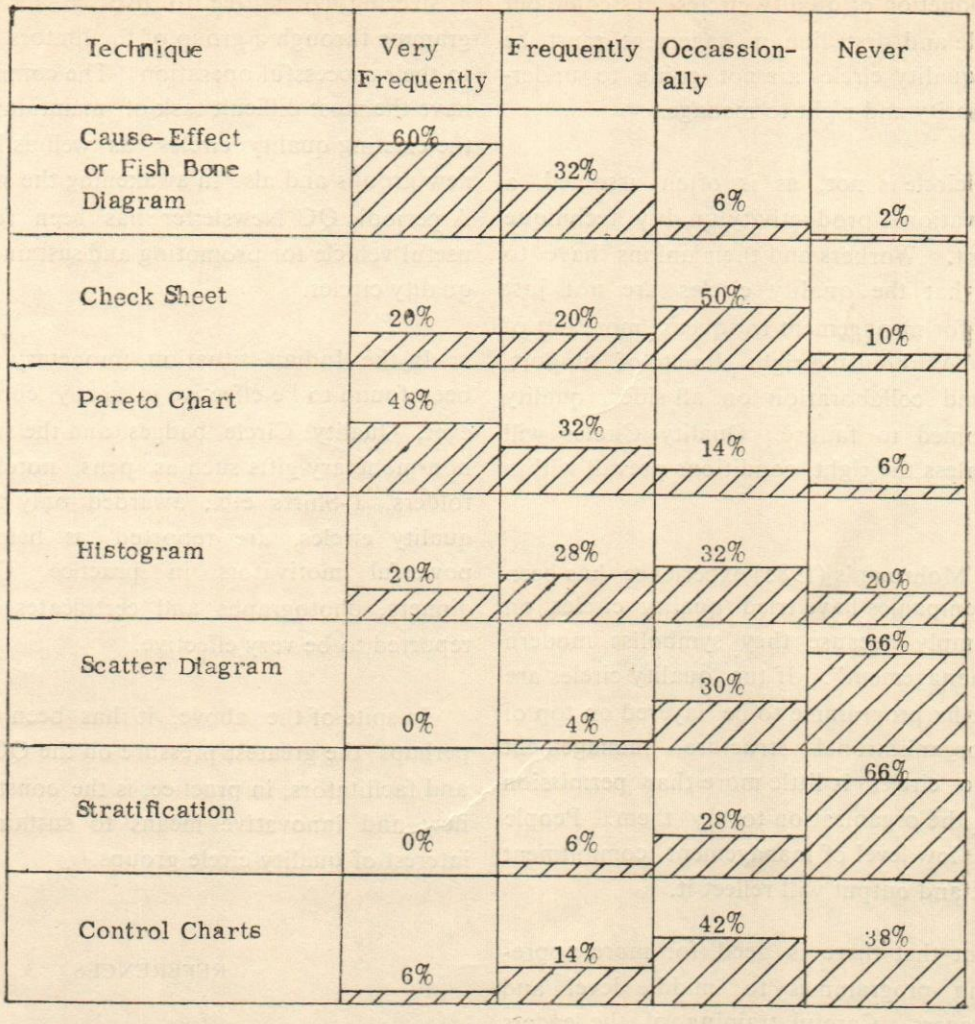

Fig. 7 Frequency of usage of aids/techniques by Quality Circles in surveyed companies

savings. Others have worked out different non-monetary methods which are mentioned in brief as under:

* A rosewood plaque with brass plate names of all members of a circle for outstanding circles
* Certificates to members with their names
* Rolling Trophy/Shield for best circle in the company
* Best Facilitator award
* Inter-unit competitions and complimentary gifts
* Photograph of members in House Journal/News Letter of the Company
* Publishing of the Case Studies
* Participating in seminars/conventions
* Sending the best circle to tourist places
* Sending the best circle to international conventions

Conclusions

It has become clear from the study that quality circles can be successfully employed in every kind of industry. The QC activities are not always successful; failures may be due to various causes, the principal one being, as already discussed, the lack of cooperation from various levels of management and to a lesser extent, union opposition.

The importance of middle management in the

successful introduction of quality circles has come out clearly. Middle and first line management must be reassured that quality circles are not going to undermine their authority and right to manage.

The quality circle is not, as is often assumed, a quick-fix motivational/productivity/quality technique for improvement. Workers and their unions have to be convinced that the quality circles are not just another device for management to squeeze more out of the workforce. Without the right climate of support, commitment and collaboration on all sides, quality circles are doomed to failure. Quality Circles will not succeed unless the right conditions prevail within the company.

Lawler and Mohrman's (1985) experience has been that : "some companies have tried quality circles on a trial basis simply because they symbolise modern participative management". If the quality circles are seen as a quick-fix programme to be layered on top of the existing organisational structure, management commitment to circles is little more than permission for someone in the organisation to try them. People will sense the low level of management commitment and their effort and output will reflect it.

It is evident that there is need for more appreciation training programmes to middle level and front-line managers. Careful training of the leaders is important, as well as that of the members, for quality circles to succeed and become a way of life in Indian organisations.

The results from the survey also indicate that there are variations in the successful employment of quality circles. There are instances where quality circles are successful without either a steering committee or even facilitator. But how long these companies will sustain quality circles is open to question. The majority of the companies found that a steering committee to oversee and direct the programme through a group of facilitators is fundamental to their successful operation. The committee members have the most difficult task of maintaining interest in the existing quality circles, as well as in encouraging new groups and also in awakening the sleeping circles. A periodic QC Newsletter has been found to be a useful vehicle for promoting and sustaining interest in quality circles.

In the Indian situation, monetary rewards have been found to be effective in many companies. However, Quality Circle badges and the small, inscribed, non-monetary gifts such as pens, notebooks, diaries, folders, T-Shirts etc., awarded only to members of quality circles, are reported as being surprisingly powerful motivators in practice. Quality circles dinners, photographs and certificates have also been reported to be very effective.

In spite of the above, it has been observed that perhaps the greatest pressure on the QC Coordinators and facilitators, in practice, is the constant search for new and innovative means to sustain or revive the interest of quality circle groups.

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Productivity Measurement in a Multiproduct Multiplant Engineering Company

G.D. Sardana
Prem Vrat

This paper demonstrates through the case study of a multiproduct, multiplant engineering industry in India that the conventional productivity measurement models such as Kendrick-Creamer, Craig-Harris and Taylor-Davis which are based on output-input type relationships are inadequate and inappropriate for measurement of productivity based on the published balance-sheets or annual accounts. The paper makes a plea for using a more appropriate model for productivity measurement based on a systems approach such as PO-P approach.

G.D. Sardana is Executive Director (Mfg) of the Indian Sewing Machine Co. Ltd. and Prem Vrat is Professor of Industrial Engineering at the Indian Institute of Technology, Delhi.

Productivity, Vol. 29, No. 4, January-March 1989, 387-397

Productivity, as an indicator of the overall efficiency of an organization, helps in setting goals for improvement. A large number of concepts and models to measure productivity have been evolved; yet productivity measurement remains beset with several problems. There are inadequacies, inconsistencies and fallacies inherent in the approaches proposed as pointed out by Sardana & Vrat (1987) and Sink (1983). Non-availability of suitable and appropriate data complicates the issue further. Kendrick-Creamer (K-C), Craig-Harris (C-H) and Taylor-Davis (T-D) models are among the three major contributions in the literature on productivity measurement. This paper attempts to critically examine the applicability of these three models to measure the productivity of an Indian company by restricting the source of data and information only to the published annual accounts of the Company. The objective is to investigate whether the annual report is a useful measure of productivity. The paper, then, highlights the inadequacies inherent in the application of these approaches.

The Company Profile

Heavy Electro-Mechanicals Ltd. (HEML),[1] chosen as the company for the case study, is an affiliate of a multinational and has several plants located at various places in the country, but publishes one common companywide Annual Report and Balance Sheet. It is

1. The actual name is not disclosed in the paper.

a large organization employing over 3000 persons and is engaged in the design and development, manufacturing and marketing of heavy electro-mechanical equipment for use by public utilities, industries and bulk consumers of electrical energy. The company is known for its professional outlook, quality of products, precision engineering and public image and has a sustained growth-oriented performance. For the study, the period of analysis is 1980-81 through 1984-85. The year 1980-81 has been considered as the base year.

For purposes of the present study, all needed information from the Profit and Loss Account statements has been tabulated in Annexure-I. This includes information on Income and Expenditure and Profits before taxation. Information on total funds employed and their application on fixed assets, inventories, current assets etc., as obtainable from the Balance Sheet statements has been summarized in Annexure-II. Annexure-III provides detailed information on various classes of inventories such as raw-materials, components, finished goods, work-in-progress etc., as noted from the explanatory schedules of the Annual Report.

All the three models recommended that the output and inputs be corrected to base year values through the use of deflators. As the balance sheet does not furnish the deflators, recourse has been taken to the use of "Index Numbers of Wholesale Prices in India" valid for electrical machinery for deflating the output and inputs of materials and capital. "Consumer Price Index Numbers for Industrial Workers" has been used to correct the labour input. These indices as detailed by Nair and Burman (1988) are reproduced in Annexure-IV.

Kendrick-Creamer (K-C) Model

Three types of indices have been recommended by Kendrick and Creamer (1961) :

1. Total Productivity Index $= \frac{\text{Output}}{\text{Input}}$

where Output = Measured-period output in base-period prices

Input = Measured-period input in base-period prices.

2. Total Factor Productivity Index

$$= \frac{\text{Net Output}}{\text{Total Factor Input}}$$

where Net Output = Output — Intermediate goods and services, Total Factor Input = Labour Input + Capital Input.

3. Partial Productivity Index

$$= \frac{\text{Output}}{\text{Input of Labour or Capital or Materials}}$$

Depending upon the use of the input factor, the productivity index is referred to as the productivity of labour or capital or materials. Kendrick and Creamer (1961) have demonstrated the computation of productivity indices through five case studies. It is only in the case study of Mideast Manufacturing Company that the computation of Total Productivity Measurement has been demonstrated. This particular case study is followed while computing the productivity indices of HEML. The individual components are defined and used as shown in the following paras.

Output The output is taken as the deflated value of "net sales and other operating revenue". Dividend and interest income from portfolio holdings of stocks and bonds has not been included. The value of the change in semifinished and finished goods inventories does not form a part of the sales. On the other hand, the "amounts attributable to production for inventory" are to be excluded from the inputs. The model has suggested use of a "chain index procedure" to arrive at a price deflator for sales.

Labour Input This is the total labour compensation allowable to production of goods sold, deflated by an index of average hourly compensation. The model recommends that compensation on account of non-production activities such as construction workers, long range research and development etc should be excluded. Similarly, deduction should also

be made for the portion of labour compensation spent on semifinished goods, work-in-progress and inventories of finished stock. The annual report of HEML does not furnish any information about the extent of completion of work-in-progress, labour content in other inventories, the extent of manufacturing effort in the component inventory and also the actual labour hours worked to generate output. Certain assumptions have therefore, been made. Work-in-progress has been considered to be 50% complete; component inventory has been counted as 100% manufactured inhouse; 100% labour compensation has been assumed on components and finished goods inventory and no labour compensation on inventories of raw materials and stores-spares, being assumed as 100% purchases. No deductions have been made for non-production work.

Purchased Materials and Services This represents the cost of materials and services responsible for sale of goods. In the context of the Mideast Manufacturing Company, the K-C model treats the above components as "residual", i.e., the figure arrived at by deducting the labour compensation, depreciation, federal taxes etc. This information is available under the heading "Cost of Material and Erection Services" in Annexure-I. This requires to be deflated to base year prices. The model recommends the use of weighted average of prices of all quantitatively significant types of materials used for deflating to the base year.

Capital Input It has been proposed that the total value of capital assets in constant dollars be estimated and the capital input be arrived at by applying the base period gross rate of return on invested capital at replacement value to the real stock estimate. Cash and other securities are to be deflated by 'Cash Use' index; accounts receivables are to be deflated by 'Sales Price Index'; materials by 'Index of purchased materials prices' etc. The output, inputs and productivity indices so arrived are summarised in Table 1.

Craig and Harris (C-H) Model

Craig and Harris (1973) considers productivity as the efficiency with which outputs are produced. The indiscriminate use of partial productivity measures is discouraged. The model defines Total Productivity

TABLE 1 **Productivity Indices Under K-C Model**

	1984-85	1983-84	1982-83	1981-82	1980-81
Output					
Net Sales (Rs '000)	656,068	403,810	384,904	489,656	424,514
Input					
Labour (Rs '000)	46,824	48,860	41,673	48,685	44,076
Materials (Rs '000)	443,371	237,253	235,712	292,914	244,082
Capital (Rs '000)	53,041	46,794	47,432	44,682	38,874
Total input (Rs '000)	543,236	332,907	324,817	386,281	327,032
Total Productivity	1.21	1.21	1.18	1.26	1.29
Factor Output (Rs '000)	212,697	166,557	149,192	196,742	180,432
Factor Input (Rs '000)	99,865	95,654	89,105	93,367	82,950
Factor Productivity	2.13	1.74	1.67	2.11	2.18
Labour Productivity	14.01	8.26	9.24	10.06	9.63
Material Productivity	1.48	1.70	1.63	1.67	1.74
Capital Productivity	12.37	8.63	8.11	10.96	10.92

(P_t) of a company as :

$$P_t = \frac{O_t}{L_t + C_t + R_t + Q_t}$$

where L_t = Labour input factor

C_t = Capital input factor

R_t = Raw material and purchased parts input factor

Q_t = Other Miscellaneous goods and Services input factor

O_t = Total Output

The model has been described as a service flow model. The model is elaborated and its application to HEML explained in the following paras.

Output The C-H model recommends that all outputs should be weighted so that these can be added together. The selling price has been suggested as the most suitable weighting unit. The emphasis is on units "produced" and not units "sold" since productivity has been viewed to be concerned with efficiency of converting inputs to outputs. Following this rationale, work-in-progress inventory suitably weighted with percentage completion, as measured in cost terms, is also required to be included in the computation of output. The model also brings out that the output value should be arrived in base year terms. New products are to be valued using an adjustment method based on the ratios of established costs of new and old products. As a "short-cut", it is also recommended that value of output in any year after the base year can be corrected by deflating (or inflating) the same by a suitable price index. The model also recommends that income derived from other sources (except windfall profits) should be included in the output as it is the outcome of a portion of the input factors. As in the case of K-C model, it is assumed that work-in-progress and component inventory is manufactured totally inhouse; the raw materials and stores-spares are totally purchased inventories.

Labour The labour input is calculated by summing up the wages/salaries and the fringe benefits. The model recommends that the manhours worked times an appropriate wage rate (per hour) of the base year provides the labour input. In case of HEML, data pertaining to wage rate of each job classification and number of hours worked by each labour classification are not available in the annual accounts. The total personnel compensation comprising wages, salaries and benefits is, therefore, taken as the labour input.

Raw Materials and Purchased Parts All purchases of production material after adjustment for inventory changes times base year material prices represent the input. The C-H model also stipulates that appropriate price indices can be used to adjust the current year prices in case the base year material purchase prices are not available. Components and work-in-progress inventory are assumed to have been produced totally inhouse, whereas raw materials and stores-spares are considered as totally purchased inventories.

Miscellaneous Goods and Services This category covers all other input resources (except labour, capital and materials) such as utilities, advertising, office supplies etc. These are also required to be adjusted to base year prices. Interest payments are not counted as inputs. The basic expense data under this category are given under the head "Other Expenses" in Annexure-I.

Capital The C-H model views that the "service value of capital" represents capital input. It is assumed that the stockholders and debtors lease out the land, buildings and equipment and supply current assets and therefore, expect a return. The required rate of return is the cost of capital in the base year. The model recommends that the current year costs of buildings and equipment should be first deflated to base year. The contribution of the assets is calculated by multiplying the base year value of the assets by the cost of capital, which has been assumed to be 15%, being the current bank rate for borrowings from financial institutions. The output, inputs and the productivity indices are detailed in Table 2.

Taylor and Davis (T-D) Model

Taylor and Davis (1977) Model measures "Total Factor" Productivity. The model lays emphasis on output as value-added and therefore, recommends the exclusion of raw-materials as input.

TABLE 2 **Productivity Index Under C-H Model**

	1984-85	1983-84	1982-83	1981-82	1980-81
Output (Rs '000)	781,943	544,450	523,378	610,331	514,553
Input					
Capital (Rs. '000)	45,963	40,550	41,102	38,726	33,692
Material (Rs '000)	453,362	225,025	231,073	317,048	391,218
Labour (Rs '000)	55,363	56,757	51,897	58,592	51,694
Others (Rs '000)	99,587	87,286	75,352	91,645	83,950
Total Input (Rs '000)	654,275	409,618	399,424	506,011	560,554
Productivity	1.20	1.33	1.31	1.21	0.92

The model differs from K-C and C-H variants in its treatment of working and fixed capital. The total factor productivity model is formulated as follows :

$$TEP = \frac{(S+C+MP)-E}{(W+B)+[(Kw+Kf).\ Fb.\ df]}$$

where S = Sales
C = Inventory Change
MP = Manufacturing Plant
E = Exclusions
W = Wages & Salaries
B = Benefits
Kw = Working Capital
Kf = Fixed Capital
Fb = Investor Contribution Adjustment
df = Price Deflator Factor

The explanation and computation of each component of output and input is detailed as follows.

Output It is a value added measure. It covers sales, manufacturing plant, adjusted inventory but excludes purchased materials, services and rentals. The exclusions are, supposed to be the output of other firms and fruits of someone else's labour and not a direct outcome of ones own efforts. The sales figures of the company are represented under the head "Sales and Services" in Annexure-1.

Inventory Change The T-D model emphasises that the output should reflect total production efforts of a firm. As inventories are also the result of the efforts of an organization, any increase or decrease in net inventory should be added or subtracted respectively from the output. The company has categorised its inventories under the head of rawmaterials, components, finished goods and work-in-progress which get added to the output for conversion to sales and hence only inventory change of these categories are to be added or subtracted. Furthermore, the productive efforts of the company are only reflected in the inventory categories of finished goods, components and work-in-progress where certain value-additions has already taken place. It is assumed that the entire component inventory has been manufactured in-house. The inventory change is arrived at by subtracting the opening inventory from the closing inventory. The closing inventory of the previous year is the opening inventory for the current year.

Manufacturing Plant This includes items which could be purchased from outside sources but are produced internally. This encompasses items such as components, spares, equipment produced for maintenance, repairs, research and development, trials, development of process, technology of product, tool trials, jigs, fixtures etc. Only a limited information is available under the head "Repairs : Building, Plant & Machinery and others" of HEML's annual accounts. In the absence of information as to what

extent the same have been carried out internally, it is assumed that one-half might have been done internally.

Exclusions The model recommends that factors which do not represent results of production efforts must be subtracted from total output. The items include externally purchased materials and supplies, depreciation on buildings, machinery and equipment and rentals. In HEML Annual Accounts, depreciation and rentals do not appear in the sales figures. It is therefore, only the value of purchased materials deflated to the base year which is to be subtracted.

Labour Input Wages and Benefits cover the compensations to all classes of employees in any form including wages, salaries, incentives, bonuses, overtime payments, vacation benefits, insurance and all types of allowances such as dearness, house, dress, medical etc. For HEML, the labour input is taken as "Personnel Expenses" in Annexure-I.

Working Capital and Fixed Capital Working capital includes cash, notes, accounts receivables, inventories and prepaid taxes. Fixed capital covers investments in land, buildings, machinery, equipment and deferred charges. Both working and fixed capital (except portfolio investment) are available for generation of output.

Investor Contribution The concept introduced in this model is to "annualize" capital. Investor contribution has been defined as "real net capital", that is, capital after depreciation for each year weighted by the rate of return in the base year. For HEML, profit before tax as detailed in Annexure-I has been computed as a percent of the total assets for the base year. Using this as a weightage factor, the investor contribution has been computed for each succeeding year. The output, inputs and productivity indices as computed are given in Table 3.

K-C, C-H, T-D Models : A Comparison

All the three variants are essentially output-input models. These are based on the hypothesis that an input results in output or a change in input leads to a change in output on a proportionate basis. Yet, there are differences in the approaches followed and in the interpretation of the outputs and the inputs. Under the K-C model output is "Sales and other operating revenues". The unsold finished stock is not a part of the output. C-H model, on the other hand, considers output as total units produced irrespective of whether these are sold or remain as inventory. The model recommends that even the work-in-progress inventory weighted appropriately, should be added to output. T-D model, as a major departure, recommends output as value added to be arrived at by the exclusion of all purchases. All categories such as sales, changes in inventory, production of maintenance spares, tools etc. are required to be included in output as these are the results of productive efforts. There are also marked differences in the definition of inputs. Under the K-C model, labour, materials and capital as related to the production of goods sold form the inputs for

TABLE 3 **Productivity Index Under T-D Model**

	1984-85	1983-84	1982-83	1981-82	1980-81
Net Output (Rs. '000)	231,216	154,557	175,027	236,536	209,232
Input (Rs. '000)					
Labour	55,364	56,757	51,897	58,592	51,694
Total Capital Input	53,041	46,794	47,432	44,682	38,874
Total Input	108,404	103,551	99,329	103,274	90,568
Productivity	2.13	1.49	1.76	2.29	2.31

arriving at the total productivity index. In the case of the C-H model, besides labour, material and capital, other input resources such as utilities, advertising expense, office suaplies etc. are also included. Besides, all inputs are related to the production. Inputs under the T-D model cover only labour compensation and capital; the materials as inputs are excluded. Labour and capital as inputs are to be related to the total production, inclusive of work in-progress.

Similarly the treatment, interpretation and computation of capital as an input factor is found to follow different methodologies in the three models. The K-C model recommends the criteria of return on invested capital at replacement value to be deflated by a suitable index. The C-H model, on the other hand, compares the same to the available rate of return as if the capital inputs were leased out by stock holders. The T-D methodology has introduced the concept of annualising the capital as investor contribution. The techniques suggested for the computations are quite complex.

It is very interesting to note that the resultant productivity indices are quite at variance in the case of HEML. 1983-84 is the year of lowest productivity using T-D model whereas 1980-81 and 1982-83 are the years of the lowest productivity respectively when C-H and K-C models are applied. It is often said that the models are particularly useful when these are used to ascertain the trends in productivity. In this context also the three models provide results at variance with each other. The T-D model shows rising productivity from 1983-84 onwards. The K-C model however, depicts declining trends in productivity. The C-H model depicts declining productivity for one year followed by an increase in productivity in the following year.

K-C, C-H, T-D Models : Limitations and Inadequacies

The three output-input models have basic conceptual inadequacies making it difficult to apply them to real life situations. In addition, there are problems of measuring inputs and outputs. The models imply reliance on a stimulus-response model of causality, that an input causes an output. It is presumed that the organisation is a simple, static and mechanistic system and its output is regulated by inputs. The K-C model has also advocated the use of factor productivity and partial productivity indices mainly to meet objectives of diagnostic analysis for productivity improvement. This approach has serious shortcomings and may lead to misinterpretations and misleading analysis. In a complex system, inputs interact and impinge on each other. A change in output because of one input can sometimes be at the cost of output from another input factor. It is known for example that output per labour hour can be increased through a capital intensive hi-tech plant or through the use of materials with higher technical inputs; but increase in labour productivity would be at the cost of material or capital productivity.

Gold (1983) points out that the intended use of such an index is to measure changes in efficiency level, the ratio of deflated total revenue to deflated total cost and product price indices relative to factor price indices. However, changes in these ratios can be on account of several reasons, such as variations in quantity or price, shifts in input factor proportion, differential changes between factor and product prices etc., so that total productivity index is hard to interpret. It hardly meets the objective of developing productivity indices for identification of areas to bring about improved performance.

The focus on output-input ratio has a bias towards the production function. As a matter of fact, C-H and T-D models have advocated inclusion of unsold finished stocks or products and work-in-progress in output on the ground that these represent the efforts of production and should not be excluded. But there can be several other outputs besides production of goods and transactions of sales.

These models have restricted the input to labour, materials and capital. Similarly, outputs considered are essentially goods manufactured or sold. Mali (1978) has dealt with the issue of inputs and outputs in a detailed way and it is pointed out that input variables also encompass budgets, space, land, payroll, costs, time, supplies, work-orders, rent and equipment. Management attitudes, organisational ingenuity and

creativity are the other inputs. Similarly, output variables also comprise services rendered, cost benefits reports completed, failures generated, deliveries made, tasks completed, responsibilities met, machine utilization standards reached, work completion etc. Besides, as Mohanty (1983) points out, there can be intangible outputs such as service to clients, free repairs, service to society etc. and also negative value outputs such as effluents, pollutants, wastes etc., which must be accounted for as these are also generated by the same efforts of an organization responsible for positive outputs.

All the three models have proposed that the output be measured in terms of sale value of the products sold or produced/value added. Selling price itself is a function of several variables such as cost of production, market environment, demand and supply and other company objectives such as achievement of a specified market share of a product or a minimum return on sales in a specified territory, strategic selling at low sales value etc. In a market oriented economic system, a customer chooses a product which satisfies his requirement of "fitness for use" and is not concerned as to the efforts spent by the organization. In a free economy the selling price of the same product may vary depending on the status of demand and supply, thus, projecting different "output" though efforts of production remain unchanged. Similarly, sale value of different products need not be in proportion to the efforts spent in their production.

In the case of measurement of inputs, there is an additional problem of integration of inputs. For measurement of labour alone, it calls for integration of efforts, skills, time, and machine plant and equipment. The qualitative aspects of the inputs do not find a place in these models. This issue becomes more complex where inputs of heterogenous nature are required to be integrated. Besides, productivity is a synergetic process and the basic phenomena related to synergy are interdependence and interaction. The inputs interact with each other; the concept of equivalent conversion implies that the interaction is predetermined and follows a linear relationship. This is a basic incongruity. Another problem lies in arriving at the "deflator factors". The approaches suggested are complex and deflator factor arrived for one organisation is not applicable to another.

Limitation of Annual Accounts

The inadequacy of the Annual Accounts of HEML for productivity measurement is reflected in several ways. It is apparent in non-availability of information as well as in the improper definition or interpretation of the data available. Many assumptions had to be made in the application of the conventional output-input models.

In the case of application of the K-C model, certain assumptions became necessary for want of information on: change in semi-finished and finished goods inventories attributable to production; state of completion of semi-finished (work-in-process) inventory; price-deflator for sales; extent of labour spent on semi-finished goods, work-in-progress; actual labour hours worked; average hourly rate of labour compensation; weighted average prices of all quantitatively significant types of materials; price index for purchases; replacement value of invested capital; real stock estimate; "cash use index", "sales price index", and "purchased materials price index".

Non-availability of following information from Annual Accounts led to assumptions while applying C-H model; selling price per unit of each product, state of completion (percentage) of work-in-progress, established costs of new and old products, base year selection, index of inflation, wage rate of the base year, manhours worked, base year material prices, price index for purchases, expense on office supplies, advertising, cost of capital (annuity), cost of capital (liquid assets), and lease value.

In the case of application of T-D model, the following information is not available in Annual Accounts : deflator factor for sales correction, degree of completion of work-in-progress, extent of manufactured plant produced, price inflation rate, inventory change on account of production efforts, rate of return in the base year and price deflators.

These models have referred to productivity as the

conversion efficiency of inputs to outputs. The only "output" which the Annual Accounts refer to are the realised sale value or the profits; the other outputs are not mentioned. Even information on goods unsold or work-in-progress is not detailed enough so as to know the productwise status in terms of percentage completion. The detailed and accurate impact of inflationary trends in prices, change in product mix, changing market profile or change in product pricing policy cannot be ascertained from the Annual Account statements. *The Annual Account statements are indeed meant for objectives other than that of productivity measurement.* The principal objective of these statements is to project the financial health of the company to shareholders and other investors. With this objective, the profit and loss statement proceeds to establish profit. The shareholder has little desire to know if the profits have resulted from the production efforts or from other means (such as marketing strategy). The balance sheet lists down the liabilities and the assets again with a view to generate confidence amongst investors on sources and disposals. In case the principal objective of productivity measurement is to identify areas for improvements to bring about increased effectiveness, the published accounts serve only a very limited purpose. The data available for the exercise of productivity measurement are incomplete with reference to both inputs and the outputs.

Concluding Remarks

The statements of Annual Accounts of the company pose serious limitations in carrying out the exercise of productivity measurement. The data available are inadequate and suffer from definitional and interpretation problems. Data on a number of vital items are not listed under any statement of explanatory schedule. Any subjective interpretation of this data make the exercise unscientific. The output-input models therefore have a very limited scope of application if only the data from the Annual Accounts are to be used. Besides, the output-input models have severe limitations in concept as well as in application. These include: defining the concepts of productivity, outputs and the inputs, measurement of output and the inputs and selection of deflator factors to account for inflation or conversion to base period values. This establishes the need for interpreting productivity in a broader perspective and the development of a more general model to measure the productivity of an organization. System-based productivity models such as PO-P by Sardana & Vrat (1983, 1984, 1987) may be more appropriate for measurement of productivity, since the balance sheet is not a very appropriate tool.

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ANNEXURE I **Data from Profit & Loss Account**

(Rs. '000)

	1984-85	1983-84	1982-83	1981-82	1980-81
Income					
Sales & Services	795,234	489,467	424,370	518,703	424,514
Other Income	9,800	11,164	14,138	16,975	15,435
	805,034	500,631	438,508	535,678	439,949
Expenditure					
Cost of Materials & Erection Services	537,420	272,391	259,881	310,291	244,082
Personnel Expenses	77,215	75,374	62,003	63,756	51,694
Other Expenses	120,712	100,214	83,078	96,521	83,950
Depreciation	10,965	8,792	7,561	5,469	4,360
Interest (on Debentures & Fixed Loans)	13,076	14,784	12,172	9,908	6,075
Others	26,417	22,892	21,472	15,489	11,361
	785,805	494,447	446,167	501,434	401,522
Less Overheads Capitalised	1,023	1,273	853	709	477
	784,782	493,174	445,314	500,725	401,075
Profit Before Taxation	20,252	7,457	6,806	34,953	38,874

ANNEXURE II **Data from the Balance Sheet**

	1984-85	1983-84	1982-83	1981-82	1980-81
Total Funds Employed	375,045	313,572	305,306	276,458	226,169
Fixed Assets					
Gross Block	161,058	141,737	124,422	115,369	94,718
Less : Depreciation	69,816	59,406	50,877	43,363	38,097
Net Block	91,242	82,331	73.545	72,007	56,621
Capital Work-in-Progress & Advances for Capital Expenditure	2,268	13,207	13,603	7,227	10,530
	93,510	95,538	87,148	79,234	67,151
Investments	3,628	3,198	3,198	2,969	1,555
Current Assets, Loans & Advances					
Inventories	205,426	179,377	199,214	185,171	136,325
Sundry Debtors	318,071	219,153	161,796	198,170	161,786
Cash & Bank Balances	6,248	4,384	8,628	8,660	3,294
Other Current Assets	3,082	3,789	4,760	2,717	2,105
Loans & Advances	40,841	39,832	23,186	28,157	36,327
	573,668	446,535	397,584	422,875	339,837
Current Liabilities & Provisions					
Current Liabilities	281,541	220,349	171,651	196,578	148,527
Provisions	14,220	11,350	10,973	32,043	33,847
	295,761	231,699	182,624	228,621	182,374
Net Current Assets	277,907	214,836	214,960	194,255	157,463

ANNEXURE III **Data on Inventories**

	1984-85	1983-84	1982-83	1981-82	1980-81
Stores & Maintenance Spares	9,386	8,494	8,104	9,544	6,717
Raw Materials	43,464	35,264	38,437	47,793	39,569
Components	81,205	69,632	87,597	68,883	51,464
Finished Goods	11,807	11,004	11,613	25,562	15,554
Work-in-Progress	59,564	54,983	53,463	33,389	23,021
	205,426	179,377	199,214	185,171	136,325

ANNEXURE IV **Price Index Numbers**

	1984-85	1983-84	1982-83	1981-82	1980-81
Index Numbers of Wholesale Prices	253.2	239.6	230.3	221.1	208.8
Consumer Price Index Numbers for Industrial Workers	586	558	502	457	420

Fight TUBERCULOSIS

1. If you are having continuous cough for more than two weeks or if you notice blood in sputum, may be, you are suffering from T.B. of lungs.

2. Get yourself examined especially your sputum at the nearest Primary Health Centre, Dispensary or T.B. Centre.



3. T.B. can be cured provided medicines as advised by the doctor are taken regularly for the prescribed period.

4 Prevention is always better than cure. So get your child vaccinated with B.C.G.

Central Health Education Bureau (D.G.H.S.)
Min. of Health and Family Welfare, Kotla Road,
New Delhi-110002.

davp 88/729

The R&D Process and Productivity—An Enquiry into the Critical Factors

S. Suresh Kumar
A.D. Damodaran

The R & D Process is responsive to a number of psychological, social, organizational and structural factors. This has been borne out by many studies. Significant differences may exist among the countries as regards R & D management practices, organizational settings, work climate etc. Nevertheless, the relation between these factors and performances of research tend to show the same directional pattern, as proven by comparative studies. This finding is of considerable importance in science policy formulation. The paper enquires into these patterns and the critical factors influencing productivity in research.

S. Suresh Kumar and A.D. Damodaran are from the Regional Research Laboratory, (CSIR), Trivandrum-695 019.

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It is often said that in research one should not emphasise output measurement; it nevertheless becomes essential to have a productive research group so that the heavy investments are justified in the long run. Just as definite factors, qualitative and quantitative, contribute to industrial productivity, so do certain elements to research effectiveness. Creativity and innovativeness are the bases of productivity in research; though creativity cannot be made to order, it can be fostered by appropriate measures and institutional mechanisms. This paper dwells on these elements and their linkages with productivity in a research unit and is culled from the findings of some of the recent studies in this field (Andrews, 1979 & Nag Paul, Krishnaiah and Chawla, 1987). Wherever deemed necessary quantitative indices to perceptive or subjective factors are indicated so as to correlate with measures of research efficiency. It has also been observed that more than objective factors, it is the subjective factors that influence productivity in the R & D process.

Factors of Effectiveness

There is a fallacious faith in the linkage between material endowment and the quality of research performance. However, it has been observed in studies that there is no significant relationship between indicators of economic and physical resources and research unit efficiency (Nag Paul, Krishnaiah, and Chawla, 1987). Once the resource base is sufficient to keep a research unit viable, there need be no such linkages. R & D effectiveness is not a continuous

linear function of capital input. A rich unit can be ineffective whereas a poor unit can make great contributions. This has great implications for science policy in that it reveals that financial resources are not to be reckoned as number one in the national investment in R & D. In fact socially relevant research is more effectively undertaken by a relatively poor unit. Needless to say that this excepts such high funded basic research areas as high energy particle physics or similar sophisticated equipment-based frontier areas.

However certain other factors do show a notable relationship to various aspects of effectiveness. These include characteristics like (1) position of the research group leader in the social system of the R & D unit (social factor), (2) size of research group (organizational factor), (3) communication among scientists (socio-psychological), (4) morale, motivation and statisfaction with supervision and resources (psychological), (5) work plan, configuration and research methods (technical). Of these, the psychological and technical factors are of primary importance as corroborated by some of the recent studies (Andrews, 1979 and Ginn, 1986). According to Ginn (1986) organic forms of management systems contribute a positive psychological environment as against mechanistic forms the characteristics of which are as below.

Organic	*Mechanistic*
Employees contribute as colleagues.	Sub-tasks are distinct from larger tasks.
Tasks are adjustible and can be interactively redefined (flexibility).	Tasks are rigidly defined.
There is a low level of hierarchical structure and rules are few.	There is emphasis on formal authority and rules are many.
Project control is by adhocracy.	Project control is by top-down management.
Lateral and informal communication is common.	Vertical communication prevails.

It is further observed that an organic structure is more conducive to innovation and creativity. An overwhelming body of research evidence indicates that apart from an organic structure the most direct route to increasing R & D productivity is through developing good technical communication within the R & D organization. This ensures that the scientific and engineering staff of a project remain current. This contributes to improved work plan, configuration and research methods. Organic forms positively influence internal technical communication (Allen, 1986). Summary findings of the various studies are as given below.

Study	*Results*
Allen (1964)	Positive correlation between internal technical communication and technical quality of proposals.
Baker, N.R., Siegmann, J. and, Rubenstein, A.H. (1967)	Successful ideas for new products originated primarily within the organization.
Goldhar, J.D., Bragan, L.K. and Schwartz, J.J. (1979)	Award winning innovation cited most important source of information in developing innovation as communication with colleagues within the organization.

The dynamics of R & D leadership have been explored by IRI's research-on research committee where a majority of the research managers agreed that leadership is a very important factor. As far as technological science groups involved in applied and development activities are concerned, the managing and integrating functions of the leader is an important variable (Wolff, 1986). The IRI expert panel identified the key tasks of an R & D leader as below:

- —create an environment that allows for freedom of action and openness in technical discussions
- —encourage researchers to have internal and external professional contacts
- —stress the importance of cross-discipline interaction

—avoid excessive paper work and unnecessary presentations to management

—be willing to accept high risks.

The psychological factors pertain to perception rather than reality. Subjective perceptions need not always concur with objective reality. This cognitive dissonance between the two can significantly affect performance. A research unit should have enough resources in the form of material, men, and information to undertake its functions effectively. But it is not the actual quantum that is important but the perceived adequacy and the degree of satisfaction with these resources.

An objective measure of the material resources can be obtained by considering items like funds and space on a per unit basis, equipment and raw material inputs for the group, delay in procurement etc. The number of research scientists per project, academic training and experience of scientists and technical staff etc. all objective measures of human resources. The objective measure on information as a resource is derived from data on visits to and from other units, library and documentation inputs and facilities, group meetings within the research unit and the number and frequency of innovative ideas or modifications suggested.

Subjective measures for resources are based on a five-point scale rating of the level of satisfaction with the availability of resources. The level of satisfaction with human resources (subjective measure), actual delays in the procurement of low cost equipment (objective count) and the level of contacts of the unit (subjective measure) are the three factors having the strongest relationship to research unit efficiency (Patchen, 1970 and Andrews, 1979).

Communication

Communication in science and technology may be looked at from the point of view of negentropy. Communication can be recorded as a signal or as a channel. Communication as a signal is represented by the composite output measure which is developed from counts on :

(1) published written products

(2) patents, prototypes, instrumental techniques/ new devices etc.

(3) reports and programmes.

Qualitative measures on channels of communication are based on perceptions regarding the following, by unit heads as well as staff scientists : (a) Contacts between units (b) Contacts within the unit with respect to frequency of meetings, (c) Participation of supporting staff, (d) Acceptance of ideas from junior staff, etc. Countable measures are based on the number of science and technology visits, number of papers prasented or published, number of unit members providing useful information like novel ideas or administrative help, etc. An index is developed representing the average ratings by the head and the staff scientists and this is reckoned along with the countable measures to derive a composite index for communication effectiveness.

A comprehensive measure for signal communication (index for R & D effectiveness) can also be derived based on a combination of quantitative and qualitative counts. In addition to the quantitative measure, it is essential to have a measure based on the qualitative aspects. In an R & D laboratory, the usual measures of output are quantitative in nature. The quantitative measures are:

(i) Publications

(a) No. of books published in the country or abroad

(b) No. of papers in Indian journals or foreign journals

(ii) Patents (within the country or abroad)

(iii) New devices, prototyes, instrumental techniques etc.

(iv) Reports, reviews, algorithms and programmes

However, these quantitative measures do not reflect the quality dimensions, there being no standards or generally acceptable yardstick to differentially rank the output measures or compare the quality. Hence,

in addition to a measure based on the above factors it is also important to index the qualitative dimensions of effectiveness. It is possible for these quality factors to be quantified by obtaining ratings on a 5-point Likert Scale (1-Low, 5-High). Each of the performance criteria (outlined below) is rated by all or a few of the relevant decision-making centres in an R & D organisation. These centres correspond to four hierarchic levels as below:

(a) Scientist or engineer working in the unit or group (Core members who are working in the unit/project for more than 50% of their time including supporting officers)

(b) Leader of the group or the unit

(c) Organisational Management which includes, besides Director and the Scientific Committee, other important internal advisory committees and the planning and monitoring group (internal evaluators)

(d) External evaluators consisting of consultants, outside agencies with whom the laboratory has interaction and user agencies. The rating for each of the performance criteria (enumerated below) is derived from the median ratings of the decision centres.

The median ratings are combined to get an index on quality. This is coupled with the said output measure.

Needless to say that there is a relationship between channel communication and signal communication. The six critical channel communication parameters that could be identified as having the most profound mpact on research unit efficiency (signal communication) are:

1. Unit heads ratings regarding contacts among units
2. Contacts with the users as rated by the head and staff (average)
3. Contacts within the unit as rated by the staff scientists
4. Number of science and technology meetings and visits
5. Number of publications/presentations

Signal (Criteria of performance effectiveness)	*Evaluating levels or decision centres (most critical to the signal)*	*Signal (Criteria of performance effectiveness)*	*Evaluating levels or decision centres (most critical to the signal)*
1. General contribution to Science and Technology	(a, b, c & d)	7. Strategic importance	(c & d)
2. Recognition for the work	(a, b, c & d)	8. Social effectiveness (social value of the application of the work viz-a-viz ability or potential to solve some current social problems)	(c & d)
3. Level of (interdisciplinary) efforts	(a, b, c & d)		
4. R & D effectiveness (ability to fulfill laboratory charter and goals, degree of innovation in work and overall productivity of the group)	(a, b & c)	9. Training effectiveness (expertise build up, know-how gain and familiarity with methods in areas of sophistication or frontier areas)	(a, b & c)
5. Application effectiveness (the extent to which the results are utilized or followed up)	(a, b, c & d)	10. Administrative effectiveness (ability to meet plans and schedules and leadership in resolving conflicts and proper co-ordination)	(a & c)
6. Application potential (economic or industrial importance and market for the product)	(b, c, & d)		

6. Number of unit members actively participating in discussion and providing useful information.

It has also been noted that for units in applied settings, ratings on contacts among units as well as with users is very important or rather critical to unit performance whereas countable channel measures (Nos 4. 5 and 6 above) as well as ratings or contacts within the unit are of paramount significance to basic research groups.

Job involvement and diversity

Communication levels within the unit are conditioned by the innovative spirit, dedication to work and sense of cooperation among group members. These are in turn related to morale and job involvement. The concept of job involvement is very important to science and technology activities (Patchen, 1970). A person should be able to identify psychologically with his job and this is a measure of his strength of motivation. An atmosphere of great dedication to work as opposed to an attitude of 'working for a living' should prevail. Satisfactory perceptions about human and material resources significantly contribute to this. The involved team member will do a great deal of overtime work and that too interestingly. Further the motivation and dedication of scientists is more important to performance than that of technical supporting staff.

Dedication and job involvement are significantly enhanced by operation diversity (Pelz and Andrews, 1966). A scientist who spends his time among several R & D functions like basic research, applied research, development work, consultation, training and even administration is more productive revealing the importance of diversity. This could be explained in terms of the fallow periods or 'lows' that even the best of scientists and research groups experience, and diversity ensures survival. The following main factors contribute to diversity in a research unit. (a) Interdisciplinary orientation, (b) diversity of staff specialization, (c) diversity in the nature of projects, and (d) diversity in funding sources and project linkages.

Organization and Control

Productivity is intimately interlinked with organizational dynamics. In addition to communication and motivational factors, OD is also concerned with influence or control. Deriving from the studies on organization (Likert, 1967 and Tannenhaun, 1968) the recent trend is to define an organisation in terms of control and its distribution. Control graphs are plotted for this purpose. Such graphs show the degree of control on a Likert Scale [low (1) to high (5)] along the Y-axis and the decision or responsibility centres along the X-axis. The decision centres are, as already mentioned, (1) scientists and other core members in the project and related infrastructure, (2) project leader/group leader, (3) institute leaders, consisting of director advisory and management committees and monitoring groups, (4) external evaluators consisting of consultants and outside experts associated with the research unit.

Distribution of control among the four levels is determined for the following decisions (Nag Paul, Krishnaiah and Chawla, 1987):

1. Planning decisions

a. Determining general research themes
b. Preparing proposals for new projects
c. Choice of specific research tasks
d. Choice of methods in research

2. Operation decisions

a, Work allocation within the unit
b. Publication and circulation of results
c. Pursuing the application or utilization of research themes
d. Coordination/cooperation/interaction with other units

3. Logistic decisions

a. Use of training and career improvement facilities
b. Hiring or recruiting personnel for specific periods

c. Disciplinary action for non-performance

d. Acquisition of low cost and other essential equipment (low cost means equipment costing less than Rs. 50,000/-)

A control curve can be plotted on the ratings provided by the first three levels.

The control graph represents the structure and influence in an organization. The total control is indicated by the average height, and distribution by the slope of the curve. The slope of the curve is of less criticality vis-a-vis research efficiency as compared to the totality of influence. This implies that the difference in the influence exercised by the unit head and the staff scientists is irrelevant with respect to performance though it may be egoistically important to the unit leader. In the case of research units in applied settings the predominance of external centres of influence lead to enhanced performance whereas productivity in basic research or academic settings was better correlated with within-the-unit control predominance.

Conclusion

Productivity in research depends considerably on the level of creativity among the participants. A creative scientist is less affected in his performance by the organizational dynamics, though he may benefit or suffer from extreme situations as the case may be. Creativity has been found to be a sort of buffer against the vagaries of the environment as it would impinge upon his work situation. Studies in organizational psychology show this to be true. A creative individual profile is characterised by:

1. An impatient, aggressive and overcommitment-to-work type of behaviour.
2. A feeling that he is in control of the situation despite the odds against him.
3. A need for achievement which is positively correlated with a lack of desire for continual external feedback on project performance.

A creative profile to a great extent, thus, offsets the disadvantages of a handicapping organizational climate and communication pattern. Studies in organizational behaviour (Wanir, 1950) also point to the fact that 'motivators' (factors responsible for motivation) are related in general to job or work content, and hygiene factors (factors necessary for basic organizational health but which are not capable of inducing motivation as such) to the work context. For highly creative people the job context is of no concern and all that matters is the job content, and hence their prowess for motivated performance even in the relative absence of hygiene factors in the work context. But this is true only for highly creative people who are always in the very minority. For most of us productivity is a derivative of the combination of motivators and hygiene factors.

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Wages Criteria in Collective Agreements in India

Subratesh Ghosh

This paper examines the principal wage criteria which have influenced collective agreements and collective bargaining in India since the fifties. It shows that wage criteria in collective agreements in India have been dictated by multiple factors—political, social and economic as well as the relative strengths of the parties in the course of bargaining. In this sense, wage determination through collecntive agreements has been neither a predominantly political process nor an economic one, but an amalgam of both, mixed with social and ideological factors as well.

Subratesh Ghosh is Professor of Personnel Management and Industrial Relations in the Indian Institute of Management, Calcutta.

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Barring some exceptions, origanised sector wages are determined by mechanisms like collective bargaining, quasijudicial machinery for wage fixation and legislative bodies (Wooton, 1953). In this sense, wages in most areas of the organised sector have ceased to be market-determined costs and hence, are genuinely administered costs (Ghosh, 1975). The factors which are taken into account (of course, with varying weights by different participants in the wage-setting process) by the parties in collective bargaining and by other agencies like tribunals are what go by the name of "wage-criteria". These criteria are economic as well as non-economic. Market forces and the economic environment do influence the wage-criteria, but so do the non-economic factors to a considerate degree (Hicks, 1955). The present paper seeks to examine the prinicpal wage-criteria which have influenced the collective agreements signed in India since the fifties. The term "wage" is used here in a wider sense to refer to all components of employee compensation for work e.g., basic wages, dearness allowance, bonus, fringe benefits etc.

Criteria for Wage Determination in India

Wage-criteria have been classified in various ways. Jules Backman divided them into six categories : economic environment, wage comparisons, cost of living, workers' budgets, productivity and ability to pay (Backman, 1959).

Another classification identified five components : cost of living, productivity, the prevailing wages, ability to pay, attraction and retention of employees

(Lanham, 1963). By adding a few more items viz., comparable wages, cost of living, living wage (a wage level related to a pre-determined, or specified level of living standard for a family), ability to pay, productivity, labour supply and purchasing power, Belcher (1962) made it more comprehensive.

It is possible to identify, subject to terminological variations, some criteria common to these different classifications. Thus, wage-comparison, the cost of living, ability to pay and productivity are common to all of them. "Living Wage", as understood by Belcher, although not the same as the workers' budget mentioned by Backman, are closely conected concepts. In India, the term living wage has been used in a specific way to refer to the wage that would be payable to a worker to meet his and his family's subsistence need, together with a reasonable degree of comfort to maintain and improve his efficiency subject to his environment and culture (Fair Wage Committee, 1948). However, as the prevailing economic conditions may not always enable a company to pay its workers the living wage due to the limitations of its ability to pay, the concept of fair wage has been advocated by the Fair Wage Committee as a reasonable approximation between the minimum subsistence wages of the workers and the living wage. Thus, in the Indian context the 'living wage' criterion may be substituted by 'fair wage' as a reasonably realistic criterion for wage fixation.

In this context it is also useful to make a reference to the concept of "need based minimum wages" as enunciated in the 15th Indian Labour Conference. The "needbased minimum wages" sought to quantify the minimum wage which an average working class family consisting of three consumption units (husband, wife and two childern) would require to have for their physical subsistence on the basis of the minimum nutritional needs of 2700 calories per capita and 18 yds. clothing per head per year, along with some minimum comforts (e.g., housing space, fuel, lighting etc.). Although the exact estimates of need-based minimum wages in different industries and regions have been a matter of debate between labour and management, this concept has also been used frequently as a criterion for wage-fixation in India. In the wage-literature in advanced countries, however, for obvious reasons, the minimum wage criterion was hardly used in collective argeements and it yielded place to the living wage criterion, which naturally meant higher amounts than required under the minimum wages norm.

Lanham's criterion of "attraction and retention of employees" and Belcher's criterion of "labour supply", in a similar way may be treated as allied concepts, since the supply conditions in the labour market, including the competitive pulls from other units using similar categories of labour, is an important factor in attracting and retaining specific categories of labour for a particular organisation. As problems of retention and attraction in this sense have to be corrected often through wage adjustments by a particular concern, or several concerns, this factor naturally deserves inclusion as a wage-criterion. Of course, to some extent, the economic environment includes the labour market and is, thus, related to the supply factor mentioned above. But for the purpose of clarity we may treat them as separate criteria. While discussing economic environment Backman considered mainly factors connected with business cycle changes, local or regional economic conditions and the state of the industry and their impact on wages (Backman, 1959). In a broader way, we may refer to the 'economic environment' as consisting of all the contextual factors and influences operating at the national, regional, or the local level on the wages of a particular concern or industry excluding the lobour market influences operating through the labour supply. The latter may be then treated as a separate wage-criterion in itself.

Among the factors mentioned, the ability to pay and the productivity of labour are also related in the sense that the latter is an important factor affecting the ability to pay of an organisation. However, in view of the great significance attched to productivity as a determinant of the wages in theory as well as in practice (in the past and also at present), it may be treated as a separate wage-criterion by itself. This means that the capacity to pay or the ability to pay should be taken as being determined by other factors affecting it, e.g., the product price, cost and other

factors affecting profit, return on capital and the needs of reinvestment etc. In India, difierent tribunals and wage-boards have deliberated at length on the above factors in their determination of the capacity to pay (Subramanian, 1975).

On the basis of the above considerations we may, thus, identify the enterprise-level wage-criteria as the following: capacity to pay of the organisation, comparable wages in the industry or the region, average productivity of labour, cost of living changes, fair wage, labour market influences affecting the supply of labour, and the economic environment in which the organisation operates. In addition to these wage-criteria, the wage-rates and the level are also affected by the political, social and cultural environment, but they operate more as factors influencing the criteria mentioned above, rather than as separate yardsticks or criteria in themselves.

Among these political, social and cultural factors, the consideration of social justice works as an important influence in wage-fixation, both in the case of wage-adjudication by tribunals as well as in collective bargaining and wage-legislation. The fact that the Indian Constitution has mentioned Social Justice as a major objective of Indian polity has naturally influened judicial and quasi-judical processes affecting wage determination in India. This is also cited as a factor to support their arguments by the parties involved in collective bargaining. Thus, in such a context, social justice may work as a wage-criterion in itself instead of as an influence operating on other criteria.

In addition to the above mentioned criteria, which are used in almost all cases in India, some other wage-criteria have been used in some recent wage agreements, these will be referred to in the course of this paper.

Waegs Criteria and Collective Bargaining

Wages-criteria are used in collective bargaining by both the participants viz., employers as well as the union. They use one or more of the wage-criteria mentioned above, but the weights assigned to them vary according to the perception of the parties concerned. For example, during the public sector employees' strike in Bangalore in 1980-81, the trade unions attached lot of weightage to the wage-comparison argument and claimed that all public enterprises under the Central Government operating from Bangalore should have pay-scales similar to those introduced at the Bangalore plant of Bharat Heavy Electricals Ltd. This was contested by the Central Government as well as the managements of the public sector undertakings in Bangalore, who pointed to the higher profit and labour productivity at BHEL. But on other occasions the Central Government and the public enterprises under their control have, themselves, used the wage-comparison criterion. In fact, in 1982-83, the Bureau of Public Enterprises, (Govt. of India) expressed its displeasure over some concessions granted by a number of leading public enterprises with regard to the dearness allowance formula in their collective agreements, which exceeded the BPE norm of Rs. 1.30 per point rise in the cost of living index.

In reality, in the course of collective bargaining, trade unions and managements use whatever wage-criteria best serve their immediate objectives and interests. They do not deny any wage-criterion, but try to increase or reduce its weightage according to their own purpose. Sometimes they contest the other side's interpretation or presentation of the same criterion. Thus, while the management emphasising the capacity to pay criterion, may draw attention to the profits shown in the profit and loss account, the union may contest the authenticity of profit calculations and the accounting procedures used by the management.

While the use of the wage-criteria becomes quite conspicuous and visible in collective bargaining, the criteria used in reaching the agreed decisions are not always clearly stated in the collective agreement signed consequently. However, some of the criteria used can be inferred from the terms of the settlement itself. Thus, from the terms stating the exact neutralisation norms, one can easily infer that the cost-of-living criterion has been used in that connection. Similarly in the productivity agreements or those pertaining to incentive wages schemes, the use of productivity as the criterion becomes quite apparent. But in relation to

some other criteria like changes in economic environment or labour supply problems, while the agreed wage rates may really result from the use of such criteria, in reality these may not be formally stated or even hinted at in the collective agreement drawn up.

Wages-criteria used in some important Collective Agreements in India

The wage-criteria mentioned above have been used in a number of collective agreements signed in India, in the past as well as in the present. The agreements signed in the early years after the Second World War and Indian Independence mainly used the rise in the cost of living and the consequent fall in the real earnings of workers as the main wage criterion. The bonus disputes during this period as well as those following the Bonus Act (1965) often represented attempts to link directly the size of the bonus to the profits earned. Apart from profit, the trade unions also tried to link the magnitude of bonus to the social justice criterion by claiming that since most Indian enterprises could not afford to pay the living wage, or fair wage, the bonus should partly compensate the workers for the gap between the living wage and the actual wages paid. The social justice criterion also served as the basis on which the lumpsum ad hoc increases in wages were granted to low income workers. The wage-comparison criterion was also used in many cases of collective bargaining.

Among the earlier collective agreements signed in the fifties, a few successfully used productivity as a major wage criterion. Their number was not large, but having been signed in some leading industrial organisations, their significance was considerable. It was pointed out in the Labour Bureau's enquiry in 1956-57 that out of 57 units which provided details of their incentive schemes, 16 units had formulated incentive schemes on the basis of collective agreements. The leading instances of these collective agreements include those signed in Tata Iron & Steel Co., the Indian Aluminium Co., Belur, the Tata Engineering and Locomotive Co., etc. Productivity was used as a wage criterion in all these agreements.

The TISCO agreement signed in January 1956 is one of the early examples of the productivity bargaining-based collective agreements and covered measures for improvements in productivity, revision of wages and gratuity, job evaluation and wage structure, job security and also closer association of employees with management. The collective agreement signed in 1951 at the Indian Aluminium Co. introduced an incentive scheme based on output with a monthly and annual production bonus. The same organisation in another agreement signed in 1956 clearly mentioned that bonus payments made on the basis of profit were not satisfactory, and it categorically preferred linking bonus to productivity. Productivity as a leading wage criterion, was thus, successfully incorporated. However, inspite of the significance of these agreements and the attention they commanded, the use of productivity as a criterion for the determination of wages in Indian organisations has been used less frequently than other criteria based on cost of living (mainly governing agreements on fixation and revision of dearness allowance) and social justice.

Profit as a Criterion

The collective agreement in Mysore Iron and Steel Works, Bhadravati, (1956) linked the payment of bonus to profit on a sliding scale. No bonus was payable below a 5% profit-level, but between 5-9% profit, bonus was payable at the rate of 1/12 to 1/6 of total earnings excluding DA and other allowances. Above 9% profit level, the bonus would amount to 1/4th of earnings. It was also stipulated that no adult male worker covered by this agreement would receive less than Re. 1 per day as his wage, while the minimum daily wage of a woman-worker was fixed at 10 annas (0.62 paise). Thus, in addition to the profit criterion, a minimum wage was worked out obviously on the basis of the social justice criterion. The use of the social justice criterion was also indicated in the management's consent to raise the wage scales of all workers earning Rs. 300/- per month while for determining the number of increments for fitment purpose the length of service was used as the yardstick. The collective agreement signed between the Indian Tea Association and the Tea Garden Labour Association in Assam related the quantum of bonus payable to profit and mentioned that no bonus would be paid in gardens claiming no profit.

However, apart from the few agreements using productivity as mentioned above and the agreements on bonus using the profit criterion, the earlier agreements, signed in the fifties and sixties, appear to have been, generally, influenced by the criteria relating to the cost of living, social justice and improvement in the living standards of workers. The use of the cost of living criterion was prompted by the workers' interest in maintaining their real earnings in the face of mounting inflationary pressures—a demand which the employers could not deny, but could counteract with their emphasis on their capacity to pay. The social justice criterion, which is not conspicuously used in the collective agreements in the USA, and some western countries as a wage criterion, has been often cited in tripartite bargains and also in bipartite collective bargaining leading to wage revision in many collective agreements in India. The Report of the Fair Wage Committee (1949) and the recommendation made in the Report of the First Five Year Plan for wage increases granted for removing anamolies, and for raising wages when they were too low (Planning Commission, 1951) also worked as contributory factors,

In the collective agreement signed at the Tata Iron and Steel Co. Ltd., in 1959, cost of living rise had been recognised as the basis for the increase in dearness allowance. The same agreement followed the earlier agreement of 1956 and, this time, the extent of the wage rise amounted to 15 percent on average. Although no specific reason was mentioned in the body of the agreement this was obviously in response to the Union demand for higher wages in order to raise the level of living of workers. A flat increase of basic wages at the rate of 25 paise per day per worker was granted in the collective agreement signed in Hind Mercantile Corporation's manganese mines at Chicknayallana Hatti in Tumkur district in 1968. A similar flat increase in wages at the rate of 30 paise per day was also granted in the collective agreement (1968) in High Tension Insulator Factory, Ranchi. This agreement also provided for the fixation of the minimum basic wage of daily rated workers at Rs. 3 per day in response to the Fair Wage Committee Report and the consensus reached at the 15th Indian Labour Conference on need-based minimum wages. In the collective agreement signed in 1959 in Caltex (India) Ltd. the wage scales were revised upwards and, in addition, a special adjustment equal to two increments in the existing scale was permitted to each worker. The adjusting increments were subject to a minimum of Rs. 3. Apart from the apparent use of the standard improvement criterion mentioned above, this collective agreement also made use of the performance criterion, as the quantum of increment in this settlement was linked to the ability, work and merit of an individual employee.

The minimum basic wage fixation setting the floor of the wage level reflecting the social justice criterion was also incorporated in the region-wise collective agreement in the textile industry in Coimbatore (1956) between the textile mills and their workers. Here the minimum basic wage for the unskilled workers was fixed at Rs. 30.6 per month.

The collective agreements signed in India during the seventies and eighties have coutinued to use the criteria discussed above. In addition, the wage comparison criterion has been sought to be used with a greater force in certain cases of bargaining causing disputes between the labour and management.

In the seventies, collective agreements resulted in basic pay scales being revised upward, in several public and private sector organisations. In one case, viz., the collective agreement signed in the Indian Aluminium Co. Ltd., Hirakud Unit (1978) the objective of the pay-scale revision was clearly stated as payment of a fair wage to workers, reflecting the use of the social justice criterion as well as the criterion of improvement in the standard of living of workers. In other agreements, although not so explicitly stated, the same criteria appear to have influenced the union decision-making in choosing the items of demand and the managements' acceptance of the same. Apart from these, the relative bargaining forces of the two sides naturally also played a role in the agreement on this particular issue. Notable among the collective agreements providing for pay revision were those at the Indian Petrochemical Corpn. Ltd., Baroda (1979). Gujarat State Fertiliser Factory (1979), Indian Telephone Industries Ltd., Bangalore (1978), Second Coal Wage Agreement

(1978) and the National Steel Industry Agreements (1970, 1979) signed in the Seventies in the public sector. In the private sector, similar agreements on pay scale revision were signed in the Tata Engineering and Locomotive Co. Ltd., Pune (1979), Calcutta Electric Supply Corpn. Ltd., (1979), Hindusthan Lever Ltd., (1979), Indian Oxygen Co. Ltd. (1979), to name a few. Most of these organisations renewed these collective agreements in the eighties with an upward revision of wages and additional increments and fitment benefits. In addition, some of them provided for ad hoc lumpsum payments to workers under the terms of the collective agreements. For example, in the National Steel Agreement (1983), in addition to two annual increment being granted to each worker, a lumpsum fitment benefit of Rs. 91 was paid to every worker. The same benefit was paid in the National Coal Wage Agreement (1983) and in the next year the port workers insisted and obtained the same benefit based on the comparison criterion, steel and port workers having been employees of the public sector in both cases.

In the private sector, workers of Indian Oxygen Ltd., in their 1980 collective agreement obtained one additional increment each over the three steps increase in basic pay in the scales agreement to in the 1979 agreement. The same agreement provided for a lumpsum benefit of Rs. 350 in January 1980 and another Rs. 350 in November 1980 to each worker. The collective agreement in Indian Aluminium Co. Ltd., Hirakud (1978) granted 1.5 additional increments subject to a minimum rise of Rs. 15 to every permanent worker with 10 years' service or more. In fact, to pay additional increments and lumpsum benefits in addition to the fitment benefits has been quite a common feature in the collective agreements signed in the eighties. Apart from the progressive increase in the living standards of workers, the liberal revision of pay scales and substantial lumpsum benefits granted in some cases (e.g. Indian Oxygen Ltd. agreement in 1980) appear to have been also based on the capacity to pay criterion, with the impact of inflation on profits being taken note of. The insistence of the oil companies in the public sector, on exceeding the BPE guideline of a maximum 10 percent rise in the wage bill in the early eighties may be cited as a case in point.

The cost of living criterion continued to be used in many agreements signed in the '70s and '80s. Mention may be made of the collective agreement signed in ITC. Ltd., Bangalore (1980) providing for a variable DA linked to changes in the cost of living index at the rate of Rs. 1.30 per point rise in the All India working class consumer price index of 325 (Base : 1960 = 100). Similar agreements in the private sector (with lower or higher rates of neutralisation in some cases) were signed in many other enterprises e.g., Indian Oxygen Ltd. (1979), Indian Aluminium Co. Ltd., Hirakud (1978), Wage Agreement in Engineering Industry of West Bengal (1979) etc.

In some cases, instead of an escalated linkage of the variable DA with the consumer price index, dearness allowance had been increased by a flat rate. e.g., in Hindusthan Lever Ltd. (1979), TELCO (1979), etc. However, in the eighties the tendency has been more towards escalated cost of living linked DA at higher rates rather than a flat rate of increase in dearness allowance. In the public sector, this tendency was so strong that the Bureau of Public Enterprises tried to put a ceiling on the rate of neutralisation at Rs. 1.30 per point rise in the consumer price index in the early eighties, but this was resented by several public sector organisations and ultimately, many public enterprises have been permitted to sign collective agreements at the rate of Rs. 1.65 per point rise in the consumer price index.

In the private sector also a similar tendency is visible. The industry-wide settlement in the engineering industy (1983) and the industry-wide settlement in the jute industry (1984) raised the rate of neutralisation from Rs. 1.30 per point to Rs. 1.50 and again in the revisions of these two collective agreements in 1987 the neutralisation rates have been further raised to Rs. 1.65 per point.

Conflicting Interests

In this connection it is interesting to note that although, the capacity to pay argument was used by both sides, employers (as in the jute industry) trying to emphasise inability to pay and the unions (as in the oil sector) pointing to the higher level of revenue—the

result was the same viz., increase in the quantum of benefits granted to the workers. Partly this has been due to the growing bargaining strength of the unions concerned and partly due to the influence of political factors as reflected in the Government's role in tripartite bargains in such cases.

In collectivc bargaining in recent years wage comparisons have been used as the major criterion. It was sometimes reflected in the collective agreements signed, but on a few occasions failed to influence the final outcome. Illustrations of cases where the comparsion criterion affected the terms of collective agreements are, the minimum fitment benefits (Rs. 91) in public sector agreements signed around 1983 and 1984, in the aftermath of the National Agreement in Steel Industry (1983) (e.g. National Coal Wage agreement, 1983, All India agreement in Ports, 1984), or the same rate of neutralisation in dearness allowance at Rs. 1.30 per point rise in CPI in the agreements signed around 1979 and 1980. In collective agreements signed in 1983, 1984 and 1985, this rate went up to Rs. 1.50. On the other hand, the attempt of the trade unions of Bangalore-based public enterprises (December 1980—March 1981) to have the same pay scales and benefits as granted to BHEL, although forcefully placed as a bargaining argument, could not be sustained when the striking unions agreed to withdraw the strike on the basis of a lump sum benefit and a little additional emolument per worker (Chatterjee, 1983).

The attempt to use the productivity criterion have similarly been a mixed successs in several cases of collective bargaining in recent years. Although some recent collective agreements have provisions for wage-rises (or an incentive component of it) linked to rises in productivity or some other measure of employee efficiency, in most cases it finds no mention in the agreement although during the bargaining stage, at least, employers tried to argue for its use as a wage-fixing criterion.

The leading instance of the latter is found in the unsuccessful attempts by the jute mill owneres to make the rise in productivity a major basis for any wage improvement in 1984 as well as in 1987. Each time, the jute workers' unions rejected this criterion. In the ultimate collective settlements signed during both the times increases in monthly wages and consumer price-linked dearness allowance at higher rates were granted with-out any linkage of wages to productivity.

However, in some other cases of collective agreements, rise in workers' productivity (individual or overall performance) has been directly used as the criterion for the incentive component of earnings. Notable among them are the collective agreements signed at Hindustan Antibiotics Ltd. (1980), Hindustan Photo-films Ltd. (1980) and Indian Telephone Industries Ltd., Bangalore (Ghosh, 1986). A list of some important public sector companies which, through collective agreements, introduced or modified their incentive wage, on the basis of productivity or performance criterion in recent years is given Table I.

Conclusions

The use of wage criteria in collective bargaining and the agreements which resulted therefrom have not been uniform, consistent or even rationally worked out by the participants on the basis of long term interests or objectives. The differences in the use of and the weightages given to different criteria by the parties concerned viz., trade unions, employers or the Government, have been dictated more by short-run consderaitions, in particular the impressions regarding bargining advantages by each party. This shows why even in sick industries like jute or cotton textiles, the productivity criterion had not been given due importance; even though in recent years the competitive position of these industries in the international market has been found to be precarious and the survival of the many units is at state.

Apart from the perception of the parties concerned of their relative bargaing advantages, their reading of the national economic envienment also naturally affected the use of wage criteria, although such readings often lacked depth and were guided mainly by the relevance of the contextual factors to the short-run interests of the party concerned. The wide use of the cost of living criterion during inflationary times is one such example. If the economic environment has not been used more occasionally, it is due to the reluctance of

TABLE 1 Some Productivity Linked Wage Schemes in the Public Sector

Sl. No.	*Organisation*	*Type and Nature of the Scheme*	*How Introduced and When*	*Impact*
1.	Petrofils Cooperative Ltd. Baroda	Multi-factor Overall Performance Based Incentive Scheme	First unilaterally by management, later finalised through bipartite bargaining	Successful in improving capacity utilisation, reduction of waste, labour index (attendance), quality improvement
2.	Bharat Electronics Ltd. Gaziabad	Overall Performance Based Productivity Incentive Scheme	Not clear (1980)	Successful (details not available)
3.	M.A.M.C., Durgapur	Individual Incentive Schem	N.A. (appears to be through collective agreement)	N.A.
4.	Hindusthan Antibiotics Ltd., Pimpri	Overall Performance based scheme; multifactor	Collective agreement through conciliation (June '80)	N.A.
5.	Bengal Chemical & Pharmaceuticals Ltd.	Overall performance (department-wise) scheme	N.A.	N.A.
6.	Smith Stanistrict Pharmaceuticals Ltd.	Overall performance (department-wise) scheme	Bipartite negotiation (1977)	N.A.
7.	Kerala Soaps & Oils Ltd., Calicut	Overall performance (department-wise) scheme	Bipartite negotiation (1983)	Successful. Productlon increased
8.	Gun Carriage Factory, Jabalpur	(a) Individual incentives	(a) Unilaterally in production side (1941)	Not known
		(b) Productivity linked bonus	(b) Through Jt. consultation (1979)	Not known
9.	Filing Factory, Chanda, Maharashtra	(a) Individual Incentives	(a) By Govt. unilaterally (1941)	Not known
		(b) Productivity linked bonus	(b) Negotiation	Not known
10.	Electronics Corpn. of India Ltd.	Overall performance based (Corporate Division target fulfilment)	Through collective agreement (1975)	No improvement
11.	Hindusthan Insecticides Ltd.	Multi-factor overall performance based scheme	Bipartite collective agreement (1967-68; revised in 1981)	Successful; increase in production and sales revenue
12.	Hindusthan Photofilms Ltd.	Mrlti-factor overall performance based scheme	Collective agreement (1979)	Successful. Output and productivity improved
13.	Neyveli Lignite Corporation Ltd.	Overall performance based	First initiated in 1977 unilaterally by management. Reintroduced in 1981-82 by a collective agreement. Productivity bonus scheme introduced in 1981-82.	Successful. Production increased. Started earning profit from 1977 continuously

(Contd.)

Table 1 *Contd.*

Sl. No.	*Organisation*	*Type and Nature of the Scheme*	*How Introduced and When*	*Impact*
14.	Rourkela Steel Plant, SAIL	Overall performance based production incentive scheme and productivity bonus scheme. Basis of performance; meeting of capacity utilisation targets	First initiated by management (1961). Later on through collective agreement	Successful. Equipment productivity rose from less than 50% to 95% or around that; output increased
15.	Alloy Steel Plant, SAIL	Individual incentive wage-scheme (1973)	Bipartite negotiation (1973)	Successful. Saleable output per man-year increased

Source : Materials and data collected for the Research Project on "Management of Labour Productivity in Manufacturing Industries in the Public Sector" conducted by the author in 1982-84 (*Ghosh*, 1984).

trade unionists to get involved in spohisticated intellectual arguments and also to their ability to find the context in terms of the cost of living criterion and, when the situation permitted, with reference to industrial profits.

Collective bargaining being as much a "political" process, as economic or psychological, the political context in which bargains took place naturally affected the decisions and the terms that were evolved. In spite of the managements' opposition in many cases, the persistent use of the social justice criterion and the needbased minimum wage and the criterion of the standard of living of the workers has been dictated by the political leverage of the trade unions, often supported or passively helped by the Government. In its statement of Labour Policy in the plans and through active intervention in tripartite bargains, the grovenment has tried to give a better deal to the workers often with the aim of gaining political support.

In public setor bargaining and collective agreements, however, the Government has consciously tried to use, or obstruct, certain criteria, on the plea of national interest. This is reflected in the tough stance it adopted during the Bangalore strike (1980-81) and also in the Bureau of Public Enterprises', to attempt to set maximum rates of increase in the wage bill and the neutralisation rate. Although not completely successful, this clearly reflected the government's concern to contain the inflation stemming from wage rises in the public sector.

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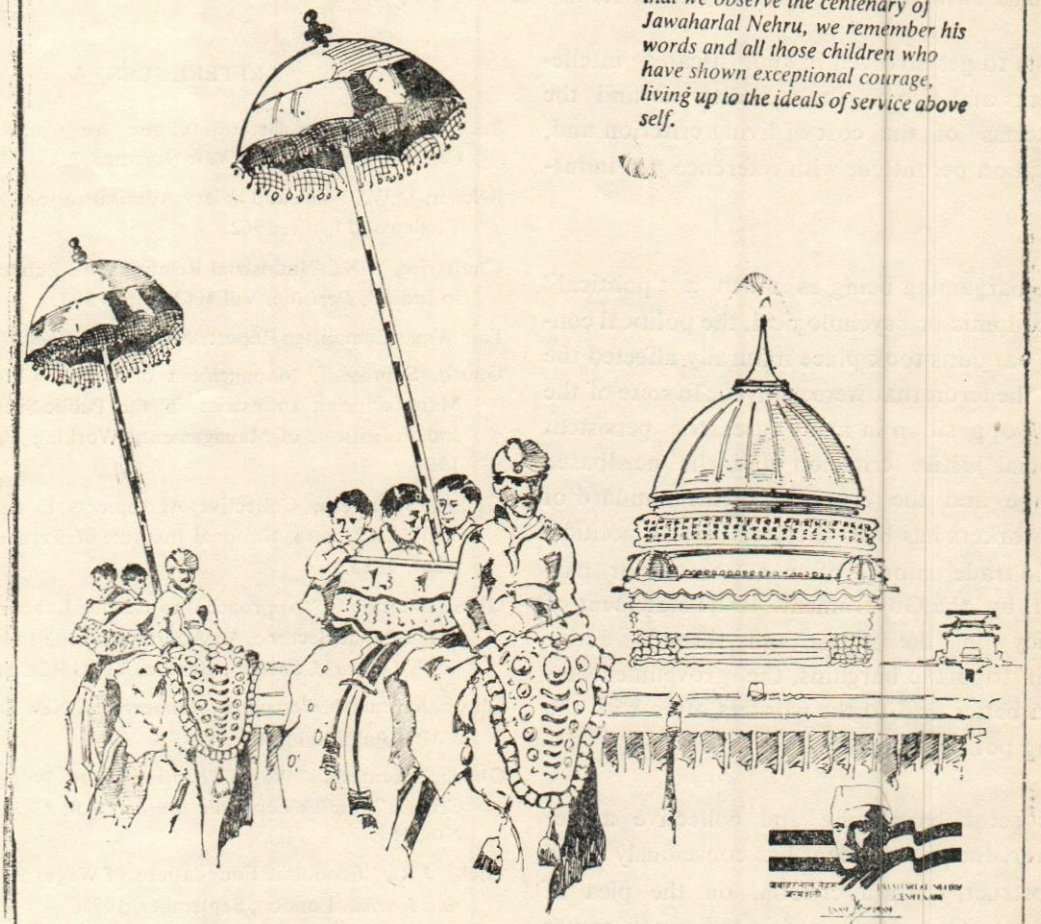
"Be Brave and all the rest follows"

Jawaharlal Nehru

This is what Jawaharlal Nehru wrote to his daughter, Indira Priyadarshini, in a letter dated Oct. 26, 1930.

Today, Republic Day, in the year that we observe the centenary of Jawaharlal Nehru, we remember his words and all those children who have shown exceptional courage, living up to the ideals of service above self.



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Policy Analysis for Solution of Complex Techno-Economic Problems

P.N. Rastogi

Techno-economic and developmental problems are usually complex, ill-defined, and unprogrammed. The paper outlines a cybernetic methodology for a systematic analysis to policies. Its application is illustrated with reference to two problems—a micro-level situation of rural poverty, and a macro-level situation of low productivity in thermal power plants. Explanation, problem-solving, and prognostic inference are seen to be interrelated facets of the analysis which also provides a logically simple paradigm for multi-criteria decision-making.

P.N. Rastogi is Professor in the Indian Institute of Technology, Kanpur.

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The complexity of developmental problems stems from the multilateral interactions of diverse technical economic, ecological, social, political, administrative, and psychological factors. Their ill-defined nature stems from a poor understanding of their structure and dynamics. Their unprogrammed nature arises from the non-avaiability of algorithmic computational procedures for analysis and solution. In what follows, a cybernetic methodology, with reference to two problems—a micro-level situation of rural poverty, and a macro-level situation of low productivity in thermal power plants, is elucidated.

A detailed discussion of the methodology and its applications is to be found in Rastogi (1979, 1986 a, 1987, 1988 b). Similarly, a detailed discussion of the rural poverty situation is given in Rastogi (1986 b) and the thermal power plant situation in Dastoor (1988). Application of the methodology to productivity, innovation, management, and development is given in Rastogi (1988 a).

The Base of the Methodology

The base consists of a multi-feedback loop model of an investigated problem situation. The model consists of a set of empirically determinate variables and their multi-lateral relationships in the form of interacting negative and positive feedback cycles. The feedback cycles represent the dynamic mechanisms of stability and change. A negative feedback cycle is a

circular reactive structure of system variables oriented towards the objectives of goal-seeking, stabilization, and balance. A positive cycle is concerned with achieving growth or decline in a cumulative manner. Each feedback cycle is associated with an empirically determinate cycling period over which it completes one interaction. Differential interaction of these cycles across differing (initial) values of their variables, non-linear relationships, and delay periods amongst them, random impacts from the system's environment, and the varying periods of the interacting cycles, together generate diverse modes of variation of a phenomenon. These modes of variation are capable of replicating the past, present, and future course of the situation being considered.

A multi-loop model of poverty and government development programmes in a central U.P. village is shown in Figure 1. It consists of some 30 variables including three exogenous variables, organized together in seven positive and negative feedback cycles. The cycles here are malfunctioning i.e., they are failing to achieve their intended role of poverty removal. They depict the failure of the development programme through corruption, inefficiency, inadequacy, and the unresponsiveness of the development administration and the persisting and deepening poverty of the weaker sections, exploited as they are by usury and suppression. Exogenous variables i.e., population growth, arbitrary accounts by the money lenders, and Partisan Role of the Police, are seen to aggravate the rural malaise through their long and short-term impacts.

A generalized multi-loop representation of the thermal power plants' situation is given in Figure 2.

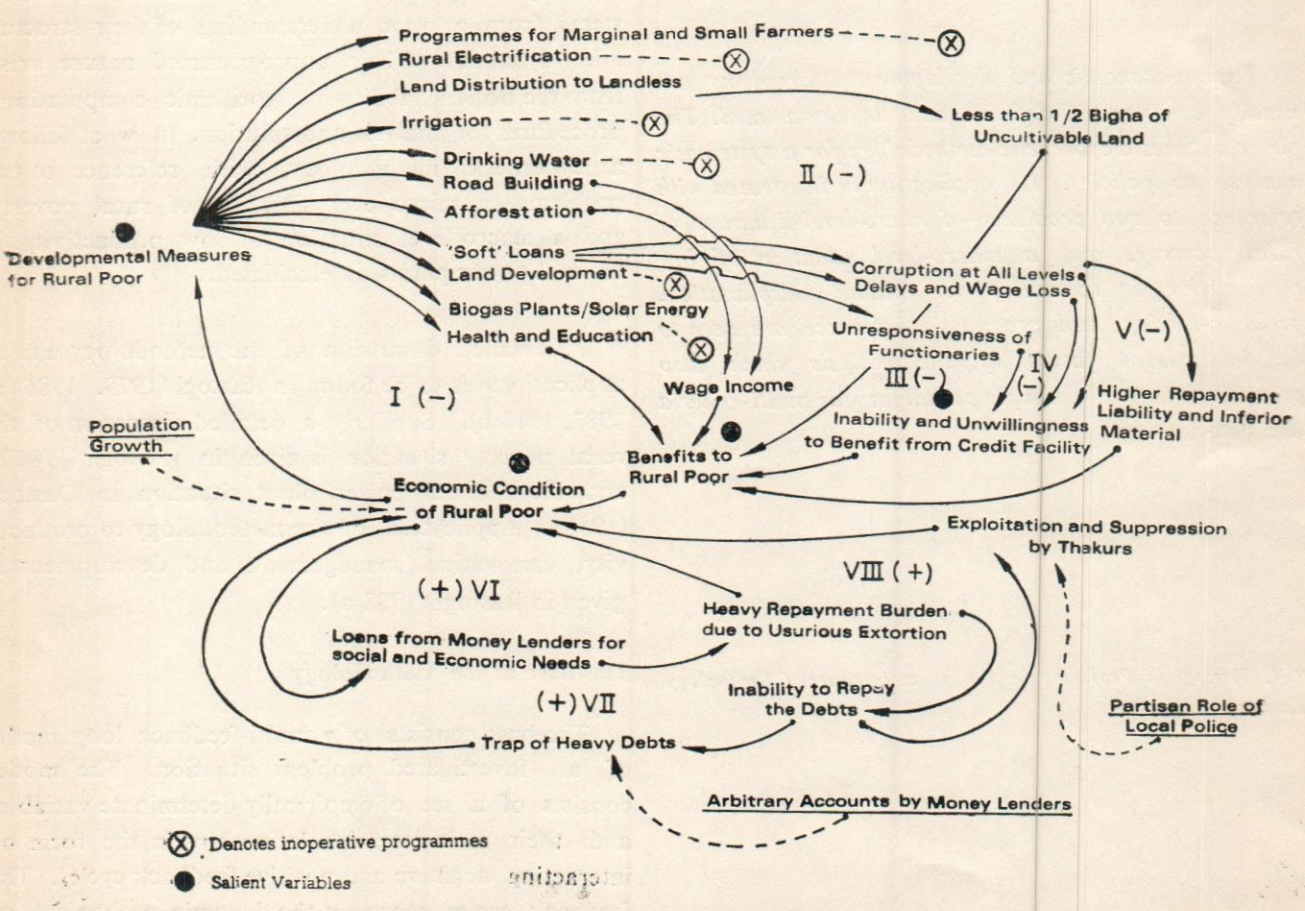

Fig. 1 Dynamics of Development at Duari and its Hamlets

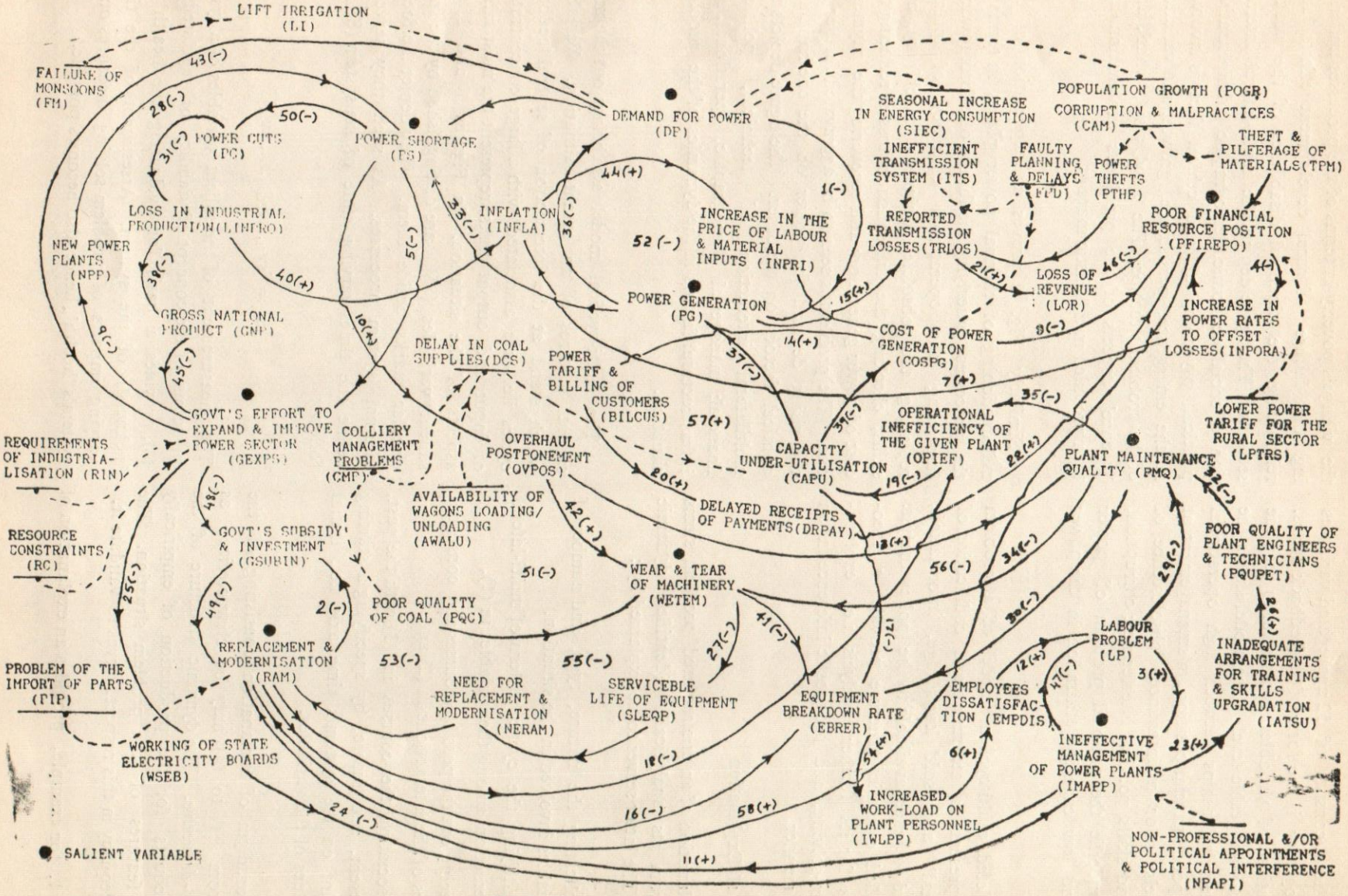

Fig. 2 Dynamics of Thermal Power System

The model here consists of 52 aggregated variables organized together in the form of 58 feedback cycles. The aggregation of variables is essential to keep the analysis at a manageable level. The model shows the complex interrelationships between high operational inefficiency, poor financial position, mismanagement at various levels, poor maintenance, obsolescence of machinery and skills, political interference; corruption, etc that underlie the national problem of power shortage and low capacity utilization in the power plants.

A completed multi-cyclical model of a problem situation represents an integration and codification of all the 'hard' and 'soft' knowledge, information, insights, and evidence, available to the policy analyst. Such a unified dynamic structure provides a theoretical basis for its further analysis i.e., explanation, problem-solving, and prognostic inference in an interrelated manner.

The Nature of Explanation

The explanation of an unstructured problem stems logically from its analytically identified dynamic structure. The latter serves to be explained by :

(1) Explicating the nature, type, and number of variables involved in the situation.

(2) Identifying the cyclic pattern of multi-lateral interaction among the variables in (1),

(3) Tracing out the possible courses and consequences of the interactions in (2) and

(4) Associating the courses in (3) with the past, present, and future, by specifying a starting point on the system's time axis i.e., initial values of the variables.

This paradigm of explanation consisting of the themes from (1) to (4) may be characterized as *hypothetico-deductive*. The dynamic structure of the model accounts for the production of empirically observed features of the problem situation. The model's adequacy in this respect, serves to validate it.

Figure 1, for example, provides an explanation of the village's poverty in terms of the processes underlying the failure of rural development efforts and reinforcing the financial disabilities of the weaker sections. The figure depicts the multi-lateral interaction of social, economic, demographic, administrative, political, psychological, and ethical factors involved in the emergence, persistence, growth, and variation of the problem situation. The 'how', why', 'what', and 'whence' aspects of the problem's explanation are then provided in a holistic manner.

Similarly Fig. 2 proves an explanation of the malfunctioning of thermal power plants in terms of the processes underlying the failure of efforts towards improving the operational efficiency of plants; replacing the obsolete equipment, machinery, and skills; checking the transmission losses; reducing the cost of power generation; and recovering the payments due. The problem is seen to be aggravated further by the rising demand for power on the one hand and political factors on the other. The figure depicts the multilateral interaction of technical, political, financial; managerial, demographic, operational, and infrastructural factors in the dynamics of the problem situation.

The multi-cyclical model also brings out the most salient features of an extant situation. Variables which stand at the intersection of several feedback cycles i.e., are associated with a large concentration of input and output links, represent the most salient aspects of the situation. In Figures 1 and 2, the salient variables (SV_s) are distinguished by the small circular marks beside them. They depict the foci of internal system processes. As such they serve to define the times-varying state of the system (SS_t) as follows:

$$SS_t = [SV_{1t}, SV_{2t}, \ldots\ldots, SV_{nt}]$$

The measurement of the salient variables of a system in terms of the concept of viability or regulatedness (λ), provides a basis for evaluating the 'health' (or sickness') of the system. Assessment of the time-varying impacts of problem-solving measures on the system's 'health', hence also becomes possible.

Viability (λ) Measurement of Salient Variables & System's 'Health'

The viability (λ) of a variable designates its 'regulatedness' (i.e., effectiveness from the standpoint of system regulator/problem solver) on a scale of 0 to 1. The concept represents a generalized evaluative measure mapped on to the performance values of the variables in their respective units. A viability measure of one ($\lambda=1$) corresponds to the maximum or uppermost limit of the performance value of a variable. A zero measure ($\lambda=0$) analogously denotes its lowest limit of performance. Midpoint of viability scale ($\lambda=0.5$) stands for the concept of an 'average, level of performance. The λ zones of 0.5 to 0.75, and 0.25 to 0.5, represent the spans of 'above average' and 'below average' performances respectively. Analogously, the zones of 0.75 to 1, and 0.25 to 0.0, represent the range of the 'most excellent' and 'chaotically worst' performance values respectively. Mapping the boundary value points of the four λ zones onto their corresponding performance values of the variables, yields a common base of measurement. The expression for system viability (Z_t) or 'health' during a given period t is then computable as below (Rostogi, 1979) :

$$Z_t = \sum_{i=1}^{N} /\lambda_i/ \; /N$$

where i is the viability measurement of the i*th* salient variable, and $i=1, 2, \ldots\ldots, N$ is the number of salient variables. Sidce λ ranges between 0 to 1, the value of Z also varies between 0 to 1.

The expression for system viability does not include any term indicating the relative importance of a system's salient variables. All the salient variables are equally important insofaras they represent the social system analogs of Ashby's concept of "essential variables", in biological systems (Ashby, 1956). Any essential variable by itself is capable of plunging the system in a state of acute disorder and eventual collapse if its value approaches and crosses its critical threshold (e.g., 107°F for human body temperature). Analogously; the entrance of any salient variable into the collapse zone of $0 \leqslant \lambda \leqslant 0.25$, would engender a state of serious disorder in a social system. The requirement of differential weights for the salient variables is therefore irrelevant.

In the light of the foregoing discussion, a number of inferences may be outlined as follows:

(i) For a 'healthy' system, $0.5 < Z_t \leqslant 1$, and $0.25 < SV_i\ (\lambda_i) \leqslant 1$.

(ii) The normative or goal state (GS_t) or problem-solution state of a system is definable by

(a) $0.75 \leqslant z_t \leqslant 1$, or equivalently,

(b) $GS_t = [SV_1\ (\lambda_1)_{iv}, SV_2\ (\lambda_2)_{iv}, \ldots\ldots, SV_n\ (\lambda_n)_{iv}]$

where SV_1 to SV_n are the n salient variables, and $(\lambda)_{iv}$ represents the IV zone of viability i.e., $0.75 \leqslant \lambda \leqslant 1.0$.

(iii) The sariousness or magnitude of a problem situation (SPS_t) is representable by

(a) $SPS_t = 1 - Z_t$, or equivalently,

(b) $SPS_t = d\,[(GS_t), (SS_t)]$

where d is the distance between the two sets of values.

(iv) Improvement in the status of a given problem situation (IPS_t) is representable by

$IPS_t = (Z_t - Z_{t-1})$,

where (IPS_t) is positive. Its negative value would analogously denote the situation's deterioration, while a null or near—null value would depict a state of stagnation or stability.

The problem situations depicted in Figures 1 and 2, show gradual decline or slow deterioration. The growth-inducing development mechanisms in the systems are weak and dominated by the growth-depressing socio-political processes. The viability values of the systems or their 'health' status (Z_t) are computed at $< 0.37\ \lambda$. They highlight the fact that the benefits of the development measures are not only low, but also are peripheral. The values of (IPS_t) in the situations are deemed to be slightly negative.

Time-varying values of (IPS_t), enable a policy analyst to evaluate the impact of policy measures over

a given period of time. But how and on what basis may one identify the nature and number of policy measures required for dealing with a complex problem situation?

Policy Analysis for Problem-Solving

The rationale of policy analysis for problem-solving emerges directly from the multi-cyclical model. The basic concept here is the *intended regulatory role* of a feedback cycle. A feedback cycle is a control mechanism whose intended regulatory role depends on the norms and values of the given social system. When the feeback cycles of a system fail to attain their recognized regulatory objectives, 'problem(s)' are generated within the system. The magnitude of the 'problem(s)' engendered by the cycles' failures, is assessable in terms of the observed discrepancies between the actual and the planned or desired values of the salient variables. The nature of malfunctioning cycles serves to bring out the causal and interactive factors behind a problem and its symptoms.

The necessary and sufficient conditions i.e., policy requirements for the solution of a problem thence also follow in a logically derivative manner. These requirements are empirically identified as the set of policy measures required for rectifying the malfunctioning cycles and thereby restoring their intended regulatory roles. The policy measures required for problem-solving may also be identified on the basis of the necessary and sufficient conditions for increasing the viability of the salient variables towards the IVth λ zone. If one or more of the identified conditions cannot be met in practice, the problem situation would continue to persist as incompletely resolved. This follows from Ashby's Law of Requisite Variety according to which the 'variety' of a problem situation/system to be regulated must, at least, be matched, if not exceeded, by the 'variety' of the responses available to the system regulator, (Ashby, 1956).

Multi-cycle models provide further useful insights toward policy analysis. For example, the variables with the highest values of $\Sigma\, 0_v/\Sigma\, I_v$ are most important from the control point of view. Most important constraints of the system are similarly represented by the variables with the highest values of $\Sigma\, I_v/\Sigma\, 0_v$. The variables for which the expression

$$BLV = [(\Sigma 0_v/\Sigma I_v)\,(\Sigma I_v + \Sigma 0_v)]\ \max$$

is maximum, represent the system's Basal Lever of change variables (BLV). Sustained improvement in the λ values of such variables produces cascading changes throughout the system leading to its enhanced viability. In a total society system model, BLVs were found to be Education in the sense of improving the productive skills of people, and Investible Resources i.e., the amount of productive investments in a national economy (Rastogi 1976, 1977, 1978). In the situation depicted in Figure 1, Developmental Measures for Rural Poor is the dominant BLV, while Economic Conditions of Rural Poor, and Benefits to Rural Poor are the most important system constraints. In Figure 2, the most important constraints are Poor Financial Resource Position and Transmission Losses, while the BLVs are absent. Their absence denotes a highly intricate situation.

A problem-situation is deemed to be 'solved', when the performance values of its salient variables reach the λ values of $\geqslant 0.75$. The policy goals of problem-solving are defined unambiguously by the normative or goal state (GS_t) of the system.

The multi-cycle model also specifies the lower *time-limit for the success of problem-solving efforts.* This time limit corresponds to the cycle time of the system. The cycle time of a multi-cycle system may often be approximated by that with the longest period of delays between that cycle's variables. This time limit attests to the fact that the impact of problem-solving measures cannot percolate through the system in a period less than the system's cycle time.

Importance of Policy Measures & Problem Dimensions

Identification of the problem dimension (D_i) and policy measures (P_j) required for their solution, follows from the analysis of the system's malfunctioning cycles, or its salient variables, as stated earlier. The rank orders and differential importance (or weights) of the policy measures may be determined

in the following manner. A binary matrix (PD) of policy measures *vs* problem dimensions is set up. The association coefficients C_{ij} between the problem dimensions D_i and D_j are calculated as follows :

$$C_{ij} = \frac{P_{ij}}{P_i + P_j - P_{ij}}$$

In the above expression, P_{ij} denotes the number of policy measures applicable to both D_i and D_j, and P_i and P_j denote the number of policies applicable individually to D_i and D_j respectively. The value of C_{ij} varies from zero to one. The relative importance (W_i) of a problem dimension D_i is then determinable as follows :

$$W_i (D_i) = \sum_{j=1}^{n} C_{ij},\ i \neq j$$

राष्ट्रीय उत्पादकता परिषद् पुस्तकालय नई दिल्ली

The weights of various problem dimensions involved in the situation of Figure 1, for example, emerge as follows :

(i) Indebtedness	= 0.16
(ii) Usury	= 0.16
(iii) Exploitation	= 0.15
(iv) Corruption	= 0.13
(v) Underemployment	= 0.12
(vi) Unawareness of Officially Available Benefits	= 0.12
(vii) Uncultivated Land	= 0.10
(viii) Lack of non-agricultural skills	= 0.06

A dimension D_i may be adjudged to co-occur with other dimensions D_i and D_k etc., if its association coefficients viz. C_{ij}, C_{ik} etc., exceed a specified threshold value (ϕ). The co-occurrence span (COS) of a dimension D_i may be expressed as

$$COS (D_i) = [D_i, D_j, D_k \ni D_{ij}, C_{ik} \geq \phi, \forall\ i \neq j \neq k]$$

Relative importance of a policy measure P_j is computable in terms of its plural applicability $A(P_j)$ to various problem dimensions (D_i). The applicability vector $A(P_j)$ is determined from the dimension weight vector $W(D_i)$ and the policy-dimension matrix PD. The matrix equation is,

$$A(P_j) = [(PD)\ \ (W\ (D_i))]$$

Computational results for applicability vector $A(P_j)$ for revealing the relative importance of policy measures in the situation of Figure 1 are :

(i) Legal Aid to the poor	= 0.25
(ii) Liberalization of 'Soft' Credit Scheme	= 0.24
(iii) Education Regarding Benefits and Legislation	= 0.14
(iv) Promotion of Animal Husbandry	= 0.125
(v) Anti-Corruption Measures	= 0.10
(vi) Land Reclamation and Distribution	= 0.08
(vii) Training in Trades & Crafts	= 0.065

Analogously the relative importance of the problem dimensions in Figure 2 are found to be as follows:

(i) Political Interference	= 0.11
(ii) Increasing Demand for Power	= 0.10
(iii) Slow Expansion of the Power Sector	= 0.10
(iv) Poor Quality of Coal	= 0.08
(v) Poorly Trained Plant Personnel	= 0.08
(vi) Delayed Receipt of Payment	= 0.07
(vii) Irregular Supply of Coal	= 0.07
(viii) Labour Problems	= 0.07
(ix) Worn out and/or Obsolete Plant & Machinery	= 0.07
(x) Over-staffing	= 0.07
(xi) Power Theft	= 0.06
(xii) Capacity Under-utilization	= 0.06
(xiii) Delayed/Irregular Servicing of Equipment	= 0.06

These thirteen values together constitute the column vector $W(D_i)$ for this problem.

Relative importance of policy measures in the context of this situation is seen as follows:

(i) Effective National Planning	= 0.26
(ii) Insulation of Political Influences	= 0.16
(iii) Improvement in Coal Quality	= 0.09
(iv) Regular Training of Plant Personnel	= 0.08
(v) Optimal Maintenance Schedule	= 0.08
(vi) Disciplined Climate of Work	= 0.08
(vii) Improved Working of Collieries	= 0.06
(viii) Timely Replacement of Obsolete Equipment	= 0.06
(ix) Improved Availability of Coal	= 0.05
(x) Vigorous Measures for Revenue Collection	= 0.05
(xi) Vigorous Anti-Corruption Measures	= 0.03

Most of the foregoing measures are managerial-cum-administrative in nature whilst the two most important ones are essentially socio-political. It may, thus, be seen that the deeper roots of the techno-economic problems of power plants lie in the socio-logical limits to growth.

The implementation of policy measures is however often bound up with the problem of resource constraints and their most effective use. Let Q_j (r_e), be an effectiveness function indicating the extent to which the objectives of a policy can be achieved by an expenditure of R resource units out of a total of N units available, and the value of r being R/N. If further, there exists a probability p for the relization of a system objective corresponding to a given level r of resource deployment, then the effectiveness function may be defined as

$$\theta_j (r_e) = 1-(1-p)^r,$$

where $0 \leqslant p \leqslant 1$, $0 \leqslant r \leqslant 1$, and r = R/N. This relationship indicates that both the effectiveness function and the probability p increase as r increases. The p may be deemed as a Bayesian estimate depending on a number of internal and external contraints, or experienced administrators may assign it a figure based on their experience and judgement.

The weighting factor (W) for a policy measure (P_j) is thence given by

$$W(P_j) = A\ (P_j) \times \theta_j (r_e)$$

or $$= A\ (P_j)\ [1-(1-p)^r]$$

Micro-Level Policy Analysis for Problem-Solving

The foregoing policy analysis for problem-solving however, yields solution measures at a relatively gross level. One may, often, be interesed in identifying more specific solution measures at the level of persons places, things, events, methods, procedures, time elements, interpersonal tensions, information channels, actors' definitions of the situation, and their perceptual and subjective factors. Such an identification of micro-level specific soluation measures is made possible by an analytic procedure of hierarchic disaggregation of the salient and/or problem symptom variables. This procedure is termed the 'morphological analysis'. It involves the micro-level dissection of the salient/symptom variables to uncover the fine level morphological structure of a problem situation or phenomenon (Rastogi, 1986 a, 1987).

The procedure of morphological analysis may be illustrated as below. It involves the disaggregation of a variable at successive levels of specificity and detail as follows :

(i) At the first level, the variable is decomposed into a set of distinct and non-overlapping 'Task & Activity' (T & A) elements. These elements represent the overtly observable empirical features of the variable. These elements are then assessed in terms of their relevant indicators as applicable. Those T & A elements which are non-normal or in 'disturbed' status; i.e., whose indicators are at variance with their normal expected values, are marked as such. They are then selected for further disaggregation. The unmarked or normal elements are not explored further.

(ii) At the second level, the social/organizational Role Types involved in the production of abnormal elements of level (I) are indentified. Their identification helps to trace the spread of the problem/phenomenon in the social or organizational structure(s). The non-normal Role Types are marked as before and explored further.

(iii) At the third level, the persons playing the non-normal roles are identified. If the number of persons coming under a role category is rather large (viz., landless labourers, marginal farmers, industrial workers etc.), their population may be appropriately sampled to limit their number for a manageable empirical investigation. The non-normal or disturbed elements i.e., the relevant persons are also marked here as before and examined further. The nature and number of individuals involved in the situation highlights the extent, complexity, and diversity of the problem's dimensions.

(iv) At the fourth and last level, the individuals identified in (III) are diagnosed in respect of their actions/behaviours, social linkages, world views, and definitions of the situation. The objective features of their situation space i.e., extant norms, policies, methods, facilities, resources, communication pattern, inter-personal linkages, and artifacts are indentified. They are juxtaposed together with the subjective factors of cognition and affect/motives, to bring out the incongruities, inconsistencies, and non-obvious aspects of the situation. The abnormal, disturbed, and dissonant elements are marked here also in the same manner as before.

The elements marked as disturbed/non-normal in the morphological analyses of all the salient variables are then conjoined together in terms of their empirical linkages. Such an assemblage of disturbed elements and their relational linkages is designated as the *morphological map* of the problem situation. The morphological map of the situation depicted in Figure 1 is given in Figure 3.

The micro-level specific policy measures for a problem are thence defined in terms of the requirements of eliminating all the abnormal elements and their pathological relationships i. e., disintegrating the map. A morphological map delineates the fine structure of a problem situation i.e., the micro-level specific non-normal factors engendering the situation and accounting for its persistence, deterioration, complexity, and difficulty. The map also provides a prognosis, or predictive inferences regarding the situation's course in the immediate future. It also enables one to trace and assess the differential impact of various policy solution measures which may have been tried in the past or may be tried at present.

The morphological map of a macro-level problem situation like the one in Figure 2 may not usually be possible in so far as its representation is generalized i.e., does not refer to specific power plants. Based on the micro-level commonalities of a number of specific situations, a generalized morphological map may however, be constructed. Macro-level generalized situations may however be further explored through policy experiments on their simulation models. The development of simulation models and identification of policy experiments are logically facilitated by the multi-cyclical representations and the identifications of salient variables respectively (Rastogi, 1979; Dastoor, 1988). A discussion of simulation models and policy experiments is outside the scope of this article.

Policy Levels for Problem Solution

Analyses of the morphological maps of several complex problems including that in Figure 3, show the different levels of policies for the solution of a complex problem. These levels are in an increasing order of difficulty and may be outlined as follows:

(I) At the first level of policies for problem solution, improvements in the problem follow from the optimization of time, facilities, and work schedules; removal of resource and blocking deficiencies; use of efficiency, productivity, and monitoring techniques; and so on. The quantitative techniques of operations research and simulation modelling

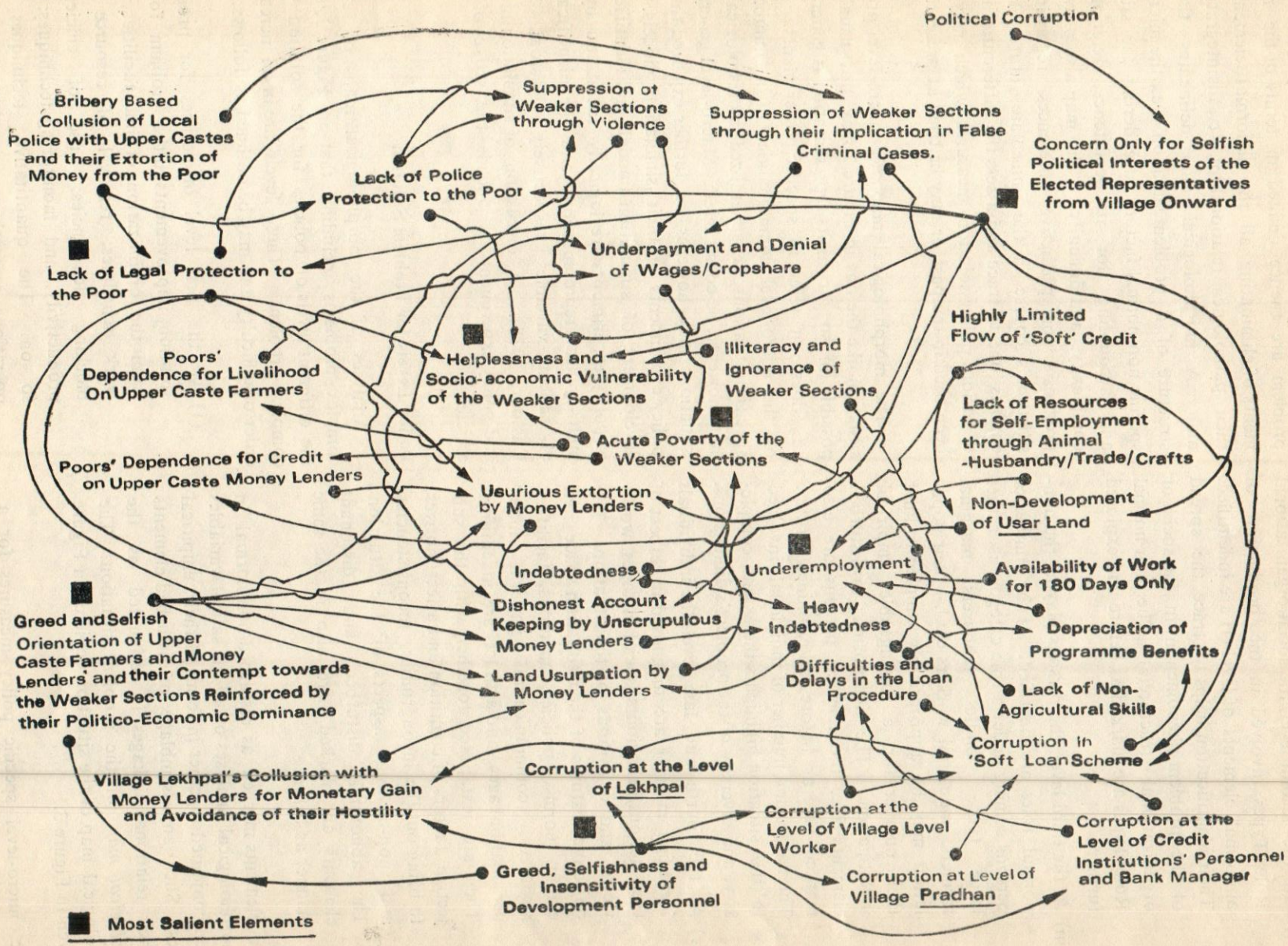

Fig. 3 Morphologieal Map of the Village's Poverty

have a very useful role to play in this context. The remedial policies adopted here may lead to a more efficient utilization of the available resources.

(2) At the next policy level, improvements in the problem usually require substantive changes in the existing policies and structures of the organization (s) associated with the problem situation. Such changes owing to their deeper and far-reaching nature, are not easy to implement. They may require considerable use of social, psychological, political, managerial, and leadership resources, besides economic/financial inputs. Poor availability of these non-economic resources may retard the progress towards problem-solution. The relevant analytical techniques involved here are strategic planning/analysis, organizational restructuring, system design, policy modelling and so on.

(3) The third and the most basic long term policy move involves planned changes in the subjective factors like motives, perceptions, attitudes, and outlooks of the actors involved in the problem. Subjective factors represent the most intractable aspects of complex problem situations. In the context of poor motivation for work and productivity, they refer to the 'X in-efficiency' of the workers/employees (Leibenstein, I976). They are however, seen to be essentially reducible to a limited set of disturbed emotions/motives/affect orientations (e^*/m^*). This set comprises egotism/pride/contempt, greed/selfishness/acquisitiveness, lust/hedonism, anger/revenge/wounded ego, and excessive parochialism/attachment.* This set can be nullified only through the four super-rational value operators (SRV) of man's unity in Divinity (*satya*), universal goodwill (*prema*) inner serenity (*shanti*), and righteous action consisting to duty and service (*dharma*) (Rastogi, 1984, 1985, 1986 (a)). Symbolically, $(<e_1^*/m_1^*, \ldots, e_6^*/m_6^*>.\rightarrow./<SRV_1, \ldots, SRV_4>)$

The four super-rational values i.e, truth, universal goodwill, inner serenity, and righteous action, according to Sri Satya Sai, represent the essence of man's life. *In so far as the third level of subjective factors is the most basic one for the solution of complex real world problems, it follows that human social systems cannot be improved in the absence of man's internalization of the transcendental spiritual values.* In the morphological map of Figure 3, the intractable subjective factors of disturbed emotions/motives are identifiable as greed, selfishness, contempt, insensitivity, and irresponsibility of the usurers, policemen, development personnel and political leaders. They are seen to lie at the root of the extant situation.

Analysis for Prognostic Inference

Prognostic inferences concerning a problem situation/phenomenon are made possible by the analysis in the following number of ways:

(i) Qualitative inferences of the form, 'IF X, THEN Y', where both X, and Y, may be plural, follow from the examination of a situation's multi-cyclical representation. They include inferences regarding the state and course of the system as a consequence of the exogenous impacts on specific system variables. They also include inferences as a result of specified changes in the system's endogenous controllable variables.

(ii) Control, constraint and basal lever (BLV) variables; specifications of $\lambda_i > 0.25$; and time varying values of Z_t; provide other useful predictive and diagnostic inferences.

(iii) Prognostic inferences regarding the state and course of the system in the near future are provided by the morphological map of the problem situation.

(iv) However, insoforas social systems are 'open'

* These disturbed affect orientations represent the 'six enemies of man', according to Indian scriptures. Unless and until, a man succeeds in overcoming them, he cannot realize the prime meaning and purpose of life.

systems i.e., subject to time-varying random exogenous impacts, meaningful and verifiable predictive inferences are possible only for limited time periods. The inferences would correspond to a specified set of environmental conditions which are expected to obtain over a relevant future period. Long range predictions are questionable as the nature and pattern of external events and situations may not be properly visualized over long spans of time.

(v) An important theoretical principle in deriving prognostic inferences is Wiener's principle of the Entrainment or Matching of Frequencies (Wiener, 1958, 1962). According to this principle, the constituent parts of a dynamic system tend to function together at a compatible and matching pace. It implies a reguirement of consistency in the values of the salient variables of a dynamic system. The state of a complex dynamic system during any given period tends to display an equilibrial behavioural profile. The salient variables of the system tend to be in phase with one another. The impacts from the system's evironment may however engender transient disequilibrium within the system. Such a disequilibrium may lead the system to a new state of internal consistency and equilibrium. The principle of matching or entrainment leads to a very powerful theoretical implication. Knowing the λ values of only one or more salient variables, one can infer the corresponding values of other salient variables on the basis of the requirement of consistency and balance amongst them.

The relationships involved here are:

$$\int_{t-1}^{t}\int_{0}^{1} SV_1(\lambda)\, d\lambda\, dt \equiv \int_{t-1}^{t}\int_{0}^{1} SV_2(\lambda)\, d\lambda\, dt \ldots, \equiv \int_{t-1}^{t}\int_{0}^{1} SV_n(\lambda)\, d\lambda\, dt$$

or more simply,

$$SV_1(\lambda) \equiv SV_2(\lambda) \equiv \ldots \equiv SV_n(\lambda)$$

The following additional implications for predictive inferences also follow from Wiener's Law:

(i) If the non-transient values of one or a few salient variables persist at extreme and critical levels, then values of the remaining salient variables would also tend to become critical in a matching manner.

(ii) Similarly, if the non-transient values of some salient variables persist at a high level of viability, then the values of the remaining salient variables would also tend to become correspondingly viable.

(iii) If the non-transient values of most of the salient variables are at a given level of viability, then the non-matching transient viability values (high or low) of the remaining few variables would also come (up or down) to the level of the majority of the salient variables.

The transient and non-matching values may come about as a result of the sudden and powerful impacts of random exogenous factors. The system reverts to its earlier state of equilibrium, when these exogenous impacts cease, or would attain a new level of equilibrium if they persist over a long period of time. Quantitative predictive inferences may be obtained through the simulation of the multi-cyclical model on a digital computer. The deficiencies of specification in the numerical values of parameters, variables, and non-linear functional relationships in the simulation model, however, tend to reduce the significance of predictive results to a qualitative level only.

Analysis for Decision-Making

The contribution of cybernetic analysis to the problem of decision-making may be seen along the following lines:

(i) The methodology of problem-solving clarifies the rationale and context of decision-making in complex situations. It also explicates the relative importance of problem dimensions and the policy measures required for their solution.

(ii) Morphological analysis serves to define the nature, objectives, and requirements of decision-making at a considerable level of specification and detail.

(iii) Cybernetic analysis also affords a perspective on monitoring and preventive or *anticipatory decision-making*. The perspective implies that the decision-maker should periodically monitor the salient variables of the system in order to forestall or check their descent toward their respective critical thresholds. The decision imperative in this context is that none of the salient variables should be allowed to reach its critical state lest it drive the system chaos.

(iv) The most distinctive perspective on decision-making here is, however, provided by the concept of the maximization of the system's viability (λ and Z values) in contrast to the concepts of money and utility. The decision-making paradigm here may be outlined as follows:

(a) Decision-maker (DM) identifies the salient aspects or core criteria of the situation over which he wishes to appraise his decision alternatives.

(b) In so far as, each of the selected criteria or aspects is salient i.e., compulsive, the issue of their respective weights becomes irrelevant.

(c) Each of the specified salient criteria is divided into four zones of performance values corresponding to the four zones of viability (λ). The resulting performance scales which may be non-linear i.e., only piecewise linear over the zones, are then mapped on a common linear λ-scale of 0 to 1.

(d) Any alternative involving a λ measure of $\leqslant 0.25$ for any core criterion, is thence ruled out from consideration. This premise may be viewed as a counterpart of the Elimination By Aspects (EBA) approach to decision-making.

(e) Among the remaining alternatives, the one with the highest value of Z (i. e., $\Sigma \lambda_i/N$), then emerges as the logical choice. The experssion for Z corresponds to the linear multi-attribute model for decision-making. The robustness of such a decision-making model has been noted by a number of writers (Edwards, 1985). The λ_i values are however, derived here from non-linear performance scales. Hence, they do not suffer from the infirmities of a linear utility scale, specially in respect of the concept of marginal utility. This model is also free from the arbitrary procedures and assumptions of the so-called 'lottery method' and computation of 'certainty equivalents'.

The viability measures are here derived from the performance scales whose terminal, average, and intermediate points, reflect the values, standards, and subjective world-view of a DM. The paradigm outlined here then conforms to the basic psychological premise of individuals' being rational within their subjective frames of reference.

Conclusion

The cybernetic methodology sketched here provides an integrated approach toward systematic policy analysis for explanation, problem-solving, prognostic inference, and decision-making in complex, real world problems. It abjures *adhoc* assumptions, and is extremely parsimonious in its conceptual frame. It provides full scope for the inclusion of 'soft' data, imprecise information, and qualitative insights based on experience and observation in the model formulation. It is applicable to a wide variety of problem domains, and is capable of being falsified through empirical verification.

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Biotechnology and Productivity in Agriculture

B.L. Dinakar

India, with its year-round sunshine, trained, scientific population, irrigation facilities and wide industrial base, is favourably placed to harness the benefits of biotechnology. The author lists the most recent trend in this field with particular reference to research carried out in various laboratories in India.

B.L. Dinakar is a Research Associate in National Institute of Bank Management, Pune-411 022

The introduction of science based technology in agriculture in the sixties resulted in an increase in the production of foodgrains in what came to be known as the 'Green Revolution'. The elements of this revolution apart from improved plant varieties, were chemical fertilizers, irrigation and mechanisation—all fossil-fuel and capital intensive technologies.

The improved plant varieties were evolved mainly in rice, wheat and maize due to the discovery of dwarfing genes in third world countries like Taiwan. Most of these varieties responded well only when fertilizers and irrigation were applied. The indiscriminate use of fertilizers coupled with irrigation has brought the soil salinity level higher and increased water logging by bringing the water table close to the surface. Alongwith the new varieties, there was an outbreak of diseases and new pest varieties, which necessitated the use of plant protection chemicals. The pesticides not only left their residues in the food articles, thus reducing the quality, but also ousted the natural enemies of pests that existed in nature. In the absence of natural enemies which are beneficial to the crop growth, application of pesticides was a recurring phenomenon, thus, increasing the cost of cultivation.

Whatever may be the consequences of the 'Green Revolution' it did increase food production in our country and helped to attain self-sufficiency in food grains. But the population growth rate (2.4 percent) remained more than the food production growth rate (2.1 percent) during the last 25 years in India. Thus, the marginal increase in production was offset by the ever increasing population. Even though with the present level of agricultural technology, the world can feed the forecasted 10 billion population (Table 1) at

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TABLE 1 **Population Projections (in millions)**

Selected countries	1950 AD	2000 AD	2100 AD
China	603	1194	1462
India	362	994	1632
Nigeria	42	169	594
Developing countries	1670	4884	9463
Developed countries	834	1357	1407
Total World	2504	6147	10870

Source : World Bank, 1984.

2000 AD, in the developing countries of Africa and Asia the trends are very much disturbing.

In the case of India the population at 2000 AD will be 994 million and the food grain requirement will shoot upto 223-225 million tonnes leaving a gap of more than 75 million tonnes. Out of our 328 million hectares of land, 145 million hectares are subjected to severe erosion. As a result of growing deforestation, salination, desertification and increased land use for construction and industrial purposes, the possibility of increasing the crop land is remote. The per capita land available for cultivation will be reduced to 0.175 hectares in 2000 AD as against 0.292 hectares in 1971.

Thus, three important dimensions—population growth, ecological imbalance and the high cost of modern agriculture—demand that agricultural planners should reconsider the present strategy. "For planning purposes it is best to assume that virtually all growth in food output by the turn of the century will have to come from raising productivity" (United States Department of Agriculture, 1984). Thus, there exists a great challenge before scientists and development administrators in the identification and introduction of new methods by which the productivity in agriculture can be enhanced. One of the new methods is biotechnology. In India, we face the problem of having to improve production and consumption simultaneously. This will be possible under current economic conditions only if production costs are kept as low as possible so that the output price is reasonable to a majority of consumers. The alternative method is to subsidize the inputs or outputs which imposes a heavy burden on the financial resources. "This challenges those in charge of technology development to bring about continuous movement in the production of major farming systems per unit of land, water, time and energy without detriment to the long run production potential of the soil" (Swaminathan, 1982). Can biotechnology help in this ?

Biotechnology

Biotechnology encompasses many facets of the management and manipulation of the biological system. In 1981, the European Federation of Biotechnology defined this branch of science as "the integrated use of biochemistry, microbiology and chemical engineering in order to achieve the technological application of the capacities of microbes and culture cells." A recent offshoot of biotechnology is genetic engineering which involves gene splicing and recombinant DNA technology. For all practical purposes biotechnology can be defined as "Commercialization of biology."

Biotechnology includes the oldest technology of making leavened bread by the use of microorganisms (yeast) to the newest technique of making monolonal antibodies. There are as interesting experiments as incorporating animal gene in plant (mouse gene in oat), putting genes from different types of bacteria into one bacterium (superbug), crossing plants like potato and tomato (resulting pomato). This shows that today's revolution in the sophistication of biotechnologies and the science of genetics is slowly breaching biological barriers, raising the prospects that useful traits may soon be transferred between species that could never before be crossed by conventional breeders. But for a developing country like India the important technologies are tissue culture and biological nitrogen fixation in crop husbandry and super ovulation and embryo transfer in animal husbandry.

Plant Cell and Tissue Culture

Tissue culture, an innovation that is about two decades old, can be directly applied to increase food production in developing countries with dramatic results. This technology produces genetic duplicates of superior plants, each grown from bits of plant tissue that are taken from a single parent plant and placed in a test tube. "This represents the fastest method of cloning, upto a million times faster than traditional methods and scientists have perfected test tube environment for hundreds of plants" (Lewis, 1982) ranging from horticultural, agricultural to forestry plants.

The experiments conducted at the National Chemical Laboratory, Pune, documents that tissue culture-grown plants of Eucalyptus species showed greater height, diameter and biomass value (Table 2). But in these experiments a very high early increase in growth was noticed, the increase gradually decreasing with time. The unit cost per plantlet based on the capital and recurring expenses was estimated to be two rupees whereas on the recurring cost alone the price was half this amount. Authors opined that "although gains at the end of 60 months shows a fall in the increase in biomass but there is still a small gain. This suggests that tissue culture could have immediate commercial application. Since a gain however small in an applied forest tree improvement programme can be of enormous economic benefit when distributed over thousands of hectares of plantations established annually" (Mascarenhas, et. al., 1988). As a technique it is promising, and the same can be standardized in other crops of importance. However the cost factor can be still reduced.

Another potential area of tissue culture application in India is the upgradation of vegetable oil-bearing trees like coconut and oilpalm. Edible oils, which drains our exchequer to the tune of Rs. 1000 crores every year, has been a perpetual problem for Indian administrators and planners. In the absence of a breakthrough in field crops which give edible oil, an increase in the availability from tree sources has become the need of the hour. But most of the coconut holdings in India have uneconomic palms and the prevalence of diseases has aggravated the situation further leading to a steady decline in production and productivity in recent years. The average yield of coconut in the country is about 30 nuts/year/tree. In order to upgrade the population genetically, and thus increase in yields, an ambitious project has been launched in Kerala to plant high yielding coconut varieties/hybrids after removing uneconomic plants. To complete the project in about 40 years, it is estimated that the requirement of high yielding varieties/hybrids will be about 3 million seedlings per year. One of the major constraints is the non-availability of high yielding cultivars and hybrids in adequate quantities. However, the process can be accelerated by the application of tissue culture technology. A number of plants have been identified which are not only high yielders (500 nuts/tree/year) but presumably also resistant to diseases (Bhaskaran, 1985), such as root wilt and stem bleeding. One more advantage of tissue culture is that when tissue from the top of plant part such as leaf (meristem culture) is taken and plants are regenerated in the laboratory the resulting seedlings are found to be free of diseases. Apart from this many seedlings identical to the high yielding parent plant can be raised within a very short time, cutting down the generation cycles.

Developing countries can use tissue culture technology in several ways. Breeders can clone the best adapted superior plant varieties to produce duplicates for large scale production. If breeders begin with clean material, they can increase the productivity of a variety from 30 to 300 percent. By placing plant embroys in tissue culture, plant breeders can rescue rare-hybrids-offspring that combine the desirable traits of two varieties. In connection with the innumerable applications Bollinger (1980) has called tissue culture "the botanical equivalent of laser in that there are more potential applications than originally conceived."

Despite tissue culture's advantages in quickly selecting useful plant varieties, some of the most important cultivated plants cannot yet be consistently regenerated in a laboratory. Standard technologies are to be developed for wheat, maize, soyabeans etc.

TABLE 2 Growth Evaluation Data—Eucalyptus tereticornis

Age (Months)	Height (M)		Diameter		Biomass (Kg/Plant)	
	TC*	Control	TC	Control	TC	Control
34	8.45 ± 0.04	7.08 ± 0.06	6,60 ± 0.02	5.55 ± 0.02	4.80 ± 0.02	3.02 ± 0.02
42	9.47 ± 1.66	7.50 ± 2,62	7.80 ± 1.27	6.45 ± 2.39	14.30 ± 2.7	11.20 ± 2.9
52	9.75 ± 1.27	8.17 ± 2.62	8.75 ± 1.75	7.46 ± 2.39	18.50 ± 3.0	15.95 ± 3.1
60	10.25 ± 1.52	8.45 ± 2.42	9.35 ± 2.66	8.25 ± 2.55	20.15 ± 2.8	19.10 ± 3.5

Result of pilot scale trial after 60 months
Plant date : July, 1983
Spacing : 2 M X 2 M
Plot Size : 100 Sq. M
No. of plants : 36
*TC : Tissue Cultured Plants
Source : Mascarenhas *et. al.*, 1988

Biological Nitrogen Fixation

Nitrogen is frequently the limiting nutrient in agricultural productivity. Although 78 percent of the earth's atmosphere is composed of nitrogen gas (N_2), plants are unable to use it in that form. The nitrogen must be fixed, that is combined with other elements such as hydrogen, carbon or oxygen before it can be assimilated by higher plants. This is an energy-intensive process where heavy government subsidy is involved. For example, during the year 1984-85, the fertilizer subsidy in India reached an all-time high of $ 1009.00 million (Table 3). Apart from this the total value of fertilizers imported from abroad to meet domestic demand was Rs. 9252.2 million. (1984-85); urea alone accounted for Rs. 5399.2 million. Thus man-made nitrogeneous fertilizers are prohibitively expensive especially for developing countries and crops capable of fixing their own nitrogen have acquired urgent importance.

Some varieties of leguminous plants have the ability to fix atmospheric nitrogen. This ability is due to the enzyme present in the microbes of the roots of such plants. Superior strains of *Rhizobium* (which fixes N_2) are being evolved, by exploring their performance in different plant varieties and under different conditions of acidity, temperature and soil nutrient level. Some procedures developed at the International Crop Research Institute for Semi-Arid Tropics (ICRISAT), Hyderabad have, increased the rate of nitrogen fixation in legumes by 300-500 percent.

TABLE 3 Total amount of fertilizer subsidy* in some selected countries (US $ million)

Country	1981-82	1982-83	1983-84	1984-85†
India	307.99	571.67	873.11	1009.00
Greece	216.57	209.36	147.35	124.03
Indonesia	414.24	430.28	296.86	—
Iran	306.67	299.00	348.07	—

* Subsidy on indigenous fertilizers
† 1 $ Rs. 11.893.
Source : FAO, Fertilizer Year Book, 1985.
Note : In India subsidy programme started in 1977 for indigeneous nitrogen fertilizers and in 1979 for indigeneous phosphatic fertilizers.

A very promising system of nitrogen fixation in connection with rice cultivation is 'blue-green algae'. When rice is grown in submerged conditions the co-existing algae *Anabaena* alongwith a fern plant *Azolla* can sustain the crop without additional N_2 application. The potential of Azolla as a nitrogen-fixing, green manure crop suitable to rice culture has been recently recognised by many researchers, agricultural administrators and farmers. Some species of Azolla

can fix nitrogen at the maximum rate of about 3 kg/ha (*A pinnata*) to 10 kg/ha (*A foliculoides*), daily according to the experiments conducted at International Rice Research Institute (IRRI), Manila (Roger and Kulasooriya, 1980).

By using the bio-fertilizers mentioned above we are not only abandoning the use of man-made fertilizers which is a very costly input, but also reducing the pollution created by fertilizer factories and also the soil and water pollution created by the application of these fertilizers. These technologies are easy to follow, cost-effective and ecologically sound. Scientists are now trying to transfer the nitrogen-fixing genes from micro-organisms to leguminous plants as well as to non-leguminous plants like cereal.

One of the limitations of the biological nitrogen fixation technique especially in the context of *Rhizobia* is the indigeneous soil. A number of other micro organisms can make the added *Rhizobia* ineffective. A crop-specific and area-specific development of Bio-fertilizer is the only answer for this.

Animal Productivity

India's population of cows and buffaloes is 260 million, which is 1/6th of the world's population of cattle and $\frac{1}{2}$ of the world's buffaloes. Surprisingly, annual milk production is only 7 percent of the estimated world's production (NDDB estimates, 1984). The reason for this disparity is that 80 percent of the animals are non-reproductive (Young, 1987). Embryo transfer can be a useful tool for rapid multiplication and proliferation of genetically superior cows by utilising less reproductive cows as recipients.

A hormone called Bovine Follicle Stimulating Hormone (BFSH), a genetically engineered product plays a vital role in producing many embryos in a superior cow instead of, only one embryo. These are then fertilized with the sperm from a genetically valuable bull and placed into surrogate mothers which are less valuable cows who carry the embryo through to birth. This technique which is called 'superovulation' can produce 50-60 superior calves in a single year (Young, 1987). In addition, embryo transfer accelerates the introduction of new genetic material into indigeneous cattle; with a herd of recipient cows, it requires one generation. The conventional method of artificial insemination requires three generations before the off-spring are seven-eight the genetic make-up of the new breed.

Some of the experiments conducted (Toley, et. al., 1988) in the National Institute of Immunology, New Delhi have given encouraging results in this direction (Table 4). A total of 47 Holstein and crosses of Holstein × Sahiwal cows were superovulated with different doses of follicle stimulation hormone injection. Donors were then inseminated with semen and after a week embryos were collected and transferred to the non-descript cows. The researchers were able to recover 9 calves of which one was 100 percent Holstein. From the data obtained, they concluded thot non-descript, low genetic quality cows which are available in large numbers in the country can be better utilized for the production of genetically superior high milk producing cows by embryo transfer technology.

TABLE 4 **Production of multiple embryos from prized cows**

Dose of FSH (mg)	No. of cows Super-ovulated	Cows responded to treatment	Mean no. of embryo per donor	Mean no. of transferable embryos per donor
50	15	8	4.5	1.5
40	6	4	3.75	2.5
28	16	14	4.7	3.1

Source : Totey *et. al.*, 1988.

In the west many commercial houses are in the early stages of engineering a growth hormone for poultry. These proteins can reduce maturation from eight weeks to six, thus, reducing cost to farmers by 25 percent. Another growth hormone called Bovine Somatostatin (BST) can increase milk-yields 20 percent when injected into cows regularly. The dairy farmer can now produce the same amount of milk with fewer cows and less feed and equipment.

India's Favourable Position

Biotechnology works best where there is year round

warmth, sun, and controlled water i.e., irrigation (Malgavkar, 1988). India lies in the tropical climate zone, being placed just above the Equator. During the ripening period of the important cereal crops like rice the incident solar energy received are around 300 and 500 calories per square centimeters (cm^2) in the wet and dry seasons respectively. India irrigates 22.02 percent of the total agricultural area of 180 million hectares which is far above that in more developed countries like the USA (Table 5). Our manpower resource is abundant as we have the third largest stock of scientists and engineers after USA and USSR in the whole world. In 1977, India had 2.3282 mlllion qualified personnel with degrees in science and technology and way back in 1974-75, India trained 15,000 engineers and technologists and 5000 graduates in agriculture (Alam, 1987). Many institutions have started research in biotechnology (Table 6) and many have come out with usefu! contributions which can increase the productivity in agriculture as discussed earlier.

TABLE 5 **Land Use and Irrigation**

(000 hectares)

Country	Total Area	Total Agricultural Area	Irrigated Area	Irrigated area to the total agril. area (%)
USA	937,261	431,382	19,831	4.60
China	959,696	386,582	45,420	11.75
India	328,759	180,250	39,700	22.02
Egypt	100,145	2,474	2,474	100.00
North and Central America	2242,75	633941	27,414	4.32
Asia	2757,496	1100532	136,962	12.45
Europe	487081	225,510	15,616	6.92

Source : FAO, Production Year Book, Vol. 39, FAO, Rome, 1985.

TABLE 6 **Agencies Involved in Biotechnology in India and their Priorities**

* National Biotechnology Board (NBTB, 1982).

Hormones, Gene Therapy, Antibiotics and Antibodies

* International Centre for Genetic Engineering UNIDO sponsored : Agriculture, Animal health

* Institutions

1. Indian Agricultural Research Institute (IARI) :
   Micro-organism and plant interaction
2. CSIR's centre for Biochemicals :
   Enzyme Manufacturing
3. National Chemicals Laboratory, Pune :
   Plant tissue culture, virus free sugarcane
4. TIFR and BARC, Bombay : Genetic Engineering
5. Indian Institute of Science (IISc) Bangalore :
   Rice embryo culture, Biological N_2 Fixation
6. Indian Institute of Technology, New Delhi :
   Conversion of cellulose to Alcohol

* Industries

1. Hindustan Lever Ltd.
   Coconut propagation through tissue culture, N_2 fixation through genetic engineering
2. Beardsell—Madras (with State Ltd. UK)
   Single cell protein from wastes
3. Tatas' Plantic (with Native Plants International US)
   New strains of tea and oil palm through tissue culture
4. Tata Oil (TOMCO)—Fats from molasses
5. Hindustan Insecticides Ltd.—Microbial insecticides

Thus with its already well developed science and technology infrastructure, availability of trained manpower, diversified industrial base, rich genetic heritage and the low cost India is uniquely placed to harness the potentials of biotechnology for increasing its agricultural productivity.

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□



Converting dreams into deeds is the credo of productivity!

Rabies is fatal but you can prevent it

HOW IT IS CAUSED ?

— Rabies is caused by the bite of a rabid animal, mostly dogs.

— Once you get rabies, it leads to death as there is no treatment available to cure rabies.

PREVENTION

— But Rabies can be prevented. Get all the pet dogs vaccinated against rabies.

— Help authorities in catching and eliminating stray dogs as stray dogs get rabid and infect the pet dogs.

— In case a dog bites you, wash the wound with soap and water and go to the nearest hospital clinic immediately.

ANTI RABIC VACCINATION

— Take anti-rabic vaccination on the advice of the doctor



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Inventory Behaviour in Cotton Textile Industries

V. Selvaraju

Inventories are necessary to keep the production process continuous and also to manage the fluctuations in sales. Taking the cotton textile industries as an example, this study attempts to establish the nature of the relationship between sales and inventories and discover whether there are any differences in inventory behaviour among states with different endowments. The results estimated both at cross-sectional and time-series levels by using a linear regression model reveal that the level of sales and inventories are positively related.

V. Selvaraju is a Doctoral Fellow at the Institute for Social and Economic Change, Bangalore-560 072.

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Inventory means a stock of some kind of physical commodity having economic value. Thus, the term includes items like stocks and stores of raw-materials, components, work-in-progress and finished goods. The size of the inventory is governed by many considerations—psychological, commercial and speculative. Inventories are generally held to keep the production process continuous and to manage the fluctuations in sales. They also support the time required for the economic transformation to be performed. At the same time holding of inventories involves costs of storage, insurance and financing as well as the risk of obsolescence. (Chadda, 1971). Therefore, the management of inventories is a process of balancing from holding additional stocks against their marginal cost. (Stanback, 1968).

Inventory behaviour has long been the concern of business cycle theorists. Among them, the relationship that exists between the level of inventories and sales was first established by JM Clark (1917). Since inventories and sales are related, the management always attempts to vary the level of inventories with, though not necessarily in proportion to, the level of activity of the firm. Usually, firms aim to maintain a fixed relationship between inventory and sales. (Hirsch and Lovell, 1969). Assuming JM Clark's proposition this study attempts to find out:

(1) the nature of relationship that exists between the level of inventories and sales, and

(2) whether there is any difference in inventory behaviour among the states with different endowments.

For the purpose of analysis, the cotton textile industries in three major cotton states, namely Gujarat, Maharashtra and Tamil Nadu have been considered in this study. The cotton textile industry has been selected for this study because of the crucial role played by inventories in the industry when compared to others. One of the major inputs for this industry is cotton which is seasonally grown. This seasonal supply is also not always guaranteed because of the heavy dependence of Indian agriculture on the monsoons.

The significance of this sector to the Indian economy is seen from the fact that nearly 10 percent of the total industrial labour force of the country have been employed in this industry. It contributes nearly Rs. 6,000 million to the national exchequer by way of taxes and earns Rs 5,000—6,000 million in foreign exchange per year through exports. (Kothari's Industrial Directory of India, 1988-89). The number of cotton mills also have grown significantly from 378 in 1951 to 984 in 1984-85. (Indian Cotton Annual, 1985-86).

Features of the States Selected

Out of the 984 mills in India in 1984-85, nearly 70 percent were located in three states, namely Tamil Nadu (427 mills), Gujarat (116 mills) and Maharashtra (115 mills). These three states account for nearly 60 percent of the total area under cotton crop in India (Tables 1—4). Maharashtra and Gujarat rank first and second in India in respect of area under cotton crop whereas Gujarat ranks first in respect of cotton production. Though the area under cotton and total cotton production is less in Tamil Nadu, the maximum number of mills and a maximum yield per hectare can be seen in this state.

Data

The secondary data published by Kothari's Economic and Industrial Guide of India have been used for this analysis. The data on the volume of sales and inventories have been collected for a period of one decade i.e., from 1976 to 1986. Both sales and inventories have been measured in monetary units i.e., in rupees; they have been defined in the guide as follows :

Inventories Inventories include stocks of raw-material, components, finished goods, loose tools, goods-in-transit, stores, goods-in-progress and such other items as are generally listed under inventories.

Sales It includes sales of finished goods, processing charges, service charges and such other items as are identified as income.

The Model

A linear regression model has been used in this study which is of the form :

$$I = a + b\,(S) + u$$

where

I = Inventories

S = Sales

a and b = Parameters and

u = Random term

The equation given above does not strictly hold good in the practical situation because of the randomness of the observed phenomenon. The linear approximation is basically used to explain the movement of the dependent variable within the region over which the linear approximation is assumed to be valid, but not outside the region. (Intriligator, 1978).

Using the above equation, both cross-sectional and time series models have been tried for the three states separately. The cross-section analysis for each year from 1976 to 1986 for each state have been tried by using the data of various cotton mills. The number of observations vary from year to year because of non-availability of data for the same number of cotton mills in the subsequent years. This may be one of the limitations of the present study.

Time series analysis for the period 1976 to 1986 has also been done for each state separately. For this

TABLE 1 **Cotton Data for Gujarat**

	Area Under Cotton (in 000 Hect.)	Cotton Production (in bls of 170 kgs. in 000s)	Yield per Hect. (in kgs.)	Cotton Consumed for Khadi Production (in bls of 180 kgs.)	Cotton Produced by CCI (in bales)	Cotton Consumed for Khadi/ Total Production (%)	Purchase by CCI/ Total Production (%)	Contribution to CCI (%)	Area under Cotton/ Area under Cotton in India (%)	Share of Cotton Production in India (%)
1975-76	1778	1677	160	—	44650	—	2.66	29.87	24.19	28.02
1976-77	1726	1630	161	4953	121471	0.32	7.45	22.71	25.07	27.92
1977-78	1829	1942	181	4367	111862	0.24	5.76	16.77	23.25	26.81
1978-79	1759	2102	203	5095	267374	0.26	12.72	25.80	21.67	26.41
1979-80	1717	1785	177	5928	164699	0.35	9.23	14.78	21.13	23.34
1980-81	1572	1714	185	7881	215471	0.49	12.57	18.27	20.09	24.45
1981-82	1531	2095	233	8832	242150	0.45	11.56	22.94	19.00	26.57
1982-83	1496	1548	176	9712	211051	0.66	13.63	21.74	19.01	20.54
1983-84	1399	1445	176	8219	94541	0.60	6.54	18.01	18.12	22.62
1984-85	1383	2069	254	7502	124730	0.38	6.03	18.65	18.73	24.32
1985-86	1404	1987	241	8622	496571	0.46	24.99	31.56	18.52	23.07

Source : Indian Cotton Annual, Various Issues.

TABLE 2 **Cotton Data for Maharashtra**

	Area under Cotton (in 000 Hect.)	Cotton Production (in bls of 170 kgs. in 000s)	Yield per Hect. (in kgs.)	Cotton Consumed for Khadi Production (in bls of 180 kgs)	Cotton Produced by CCI (in bales)	Cotton Consumed for Khadi/ total Production (%)	Purchase by CCI/ total Production (%)	Contribution to CCI (%)	Area under Cotton/ area under Cotton in India (%)	Share of Cotton Production in India (%)
1975-76	2310	772	57	—	—	—	—	—	31.43	12.97
1976-77	2120	833	67	723	—	0.09	—	—	30.79	14.27
1977-78	2314	1263	93	646	134687	0.05	10.66	20.19	29.42	17.44
1978-79	2509	1317	90	844	59639	0.07	4.53	5.79	30.90	16.55
1979-80	2588	1695	111	739	—	0.05	—	—	31,84	22.16
1980-81	2667	1269	81	931	—	0,08	—	—	34.09	18.10
1981-82	2710	1465	92	1206	—	0.09	—	—	33.64	18.58
1982-83	2648	1609	103	1318	—	0.09	—	—	33.64	21.36
1983-84	2685	814	52	1036	—	0.13	—	—	34.78	12.74
1984-85	2685	1467	93	1284	—	0.09	—	—	36.37	17.24
1985-86	2753	1894	117	1304	—	0.07	—	—	36.31	21.99

Source : Indian Cotton Annual, Various Issues.

TABLE 3 Cotton Data for Tamil Nadu

	Area Under Cotton (in 000 Hect.)	Cotton Production (in bls of 170 kgs. in 000s)	Yield per Hect. (in kgs.)	Cotton Consumed for Khadi Production (in bls of 180 kgs.)	Cotton Produced by CCI (in bales)	Cotton Consumed for Khadi/ total Production (%)	Purchase by CCI/ total Production (%)	Contribution to CCI (%)	Area under Cotton/ area under Cotton in India (%)	Share of Cotton Production in India (%)
1975-76	208	253	207	—	23229	—	9.18	15.54	2.83	4.25
1976-77	240	348	246	14678	28881	4.47	8.30	5.40	3.49	5.96
1977-78	325	538	282	16174	35780	3.18	6.65	5.36	4.13	7.43
1978-79	347	569	278	12461	81951	2.32	14.40	7.91	4.27	7.15
1979-80	280	387	234	13594	41560	3.72	10.74	3.73	3.45	5.06
1980-81	223	265	202	13199	84971	5.27	32.06	7.20	2.85	3.78
1981-82	240	278	197	14354	72302	5.47	26.01	6.85	2.98	3.53
1982-83	191	248	221	15328	38154	6.54	15.38	3.93	2.43	3.29
1983-84	178	262	250	16995	24291	6.87	9.27	4.63	2.31	4.10
1984-85	253	585	393	18155	31044	3.29	5.31	4.64	3.43	6.88
1985-86	261	549	358	17513	25992	3.38	4.73	1.65	3.44	6.37

Source : Indian Cotton Annual, Various Issues.

TABLE 4 Cotton Data : All India

	Area Under Cotton (in 000 Hect.)	Cotton Production (in bls of 170 kgs. in 000s)	Yield per Hect. (in kgs.)	Cotton Consumed for Khadi Production (in bls of 180 kgs.)	Cotton Produced by CCI (in bales)	Cotton Consumed for Khadi/ total Production (%)	Purchase by CCI/ total Production (%)	Exports (170 kgs) in 000 bales)	Exports/ Total Production (%)
1975-76	7350	5950	139	—	149503	—	2.51	405	6.81
1976-77	6885	5839	144	51249	534863	0.93	9.16	10	0.17
1977-78	7866	7243	157	52984	667189	0.77	9.21	15	0.21
1978-79	8119	7958	166	55061	1036403	0.73	13.02	270	3.39
1979-80	8127	7648	160	63406	1114117	0.88	14.57	531	6.64
1980-81	7823	7010	152	73594	1179425	1.11	16.82	697	9.94
1981-82	8057	7884	166	78324	1055746	1.05	13.39	400	5.07
1982-83	7871	7534	163	87166	970760	1.23	12.89	665	8.83
1983-84	7721	6387	141	86954	524864	1.44	8.22	357	5.59
1984-85	7382	8507	196	87983	668694	1.10	7.86	179	2.10
1985-86	7581	8612	193	85328	1573632	1.05	18.27	453	5.26

Source : Indian Cotton Annual, Various Issues.

purpose average sales and average inventory have been calculated for each year. This has been calculated by dividing the total sales and inventories by the number of cotton mills. The use of total sales and total inventories will be misleading because the number of mills are not same for each year. Hence to avoid the distortions, average sales and average inventories have been used.

Results of Cross-Section Analysis

The estimated cross-section results have been given in Tables 5—7. The regression coefficient b which explains the level of changes in the inventories for a unit change in the sales assumed a positive sign in all the three states and satisfied the theoretical expectation. The magnitude of the value of b varied much in Gujarat i.e., between 0.17 and 0.32, when compared to Maharashtra and Tamil Nadu. This implies that the cotton mills in Gujarat could easily adjust their level of inventories according to sales. The larger production of cotton in this state might have facilitated greater flexibility in the procurement of raw materials by mills.

Theoretically, firms are expected to keep a minimum level of inventory even if there are no sales, under the assumption that lack of demand for a product is a short term phenomenon. The intercept term a in the model gives the level of inventories to be maintained in a situation where there are no sales. The estimated value of this coefficient for Gujarat assumed positive sign for all the years except for the period 1979 to 1981 during which period it turned out to be negative. But in the economic sense, a negative inventory is meaningless. In the case of Tamil Nadu

TABLE 5 Cross Section Estimates—Gujarat

	N	a	b	R^2	F
1976	19	54.28 (1.88)	0.20 (10.61)	0.87	112.68
1977	20	32.75 (1.20)**	0.19 (13.14)	0.91	172.73
1978	17	81.46 (1.79)*	0.17 (7.62)	0.79	58.00
1979	25	—35.33 (—1.68)*	0.24 (4.25)	0.98	162.08
1980	17	—88.51 (—2.45)	0.26 (12.50)	0.96	111.40
1981	13	—110.99 (—1.62)*	0.32 (7.97)	0.83	53.79
1982	20	100.52 (1.20)**	0.19 (12.53)	0.90	156 89
1983	18	252.76 (2.60)	0.18 (9.68)	0.85	93.78
1984	21	285.84 (1.84)	0.17 (5.44)	0.61	29.61
1985	15	285.16 (1.62)*	0.21 (6.35)	0.76	40.36
1986	15	319.71 (2.01)	0.17 (5.31)	0.70	28.14

Figures in Parentheses are t values.
* indicates significant at 10% level.
** indicates significant at 15% level.
Other t and F values are significant at 5% level.

TABLE 6 Cross-Section Estimates—Maharashtra

	N	a	b	R^2	F
1976	20	134.32 (2.22)	0.22 (11.84)	0.89	140.25
1977	20	158.79 (3.09)	0.21 (15.91)	0.93	253.15
1978	20	171.53 (3.20)	0.19 (16.12)	0.94	260.00
1979	15	93.57 (1.41)*	0.21 (13.75)	0.94	189.08
1980	11	21.14 (0.45)**	0.23 (11.59)	0.94	134.38
1981	18	90.05 (1.57)*	0.16 (6.32)	0.71	39.94
1982	26	141.84 (1.62)*	0.20 (11.67)	0.85	136.26
1983	20	216.50 (1.65)*	0.25 (8.54)	0.80	72.92
1984	20	230.97 (2.26)	0.20 (8.85)	0.80	78.37
1985	20	267.89 (2.72)	0.15 (16.64)	0.94	276.99
1986	15	231.94 (2.23)	0.18 (7.31)	0.84	53.39

Figures in Parentheses are t values.
* indicates significant at 10% level.
** indicates significant at 15% level.
Other t and F values are significant at 5% level.

TABLE 7 Cross-Section Estimates—Tamil Nadu

	N	a	b	R^2	F
1976	37	−15.63 (−1.77)*	0.26 (18.14)	0.90	310.79
1977	30	−10.90 (−0.78)***	0.23 (8.24)	0.71	67.91
1978	30	−5.44 (−0.46)***	0.22 (10.34)	0.79	106.83
1979	20	28.39 (1.42)*	0.19 (6.80)	0.72	46.28
1980	21	13.51 (1.11)**	0.18 (10.33)	0.85	106.63
1981	25	23.87 (1.19)**	0.19 (10.68)	0.83	114.09
1982	14	85.68 (1.12)**	0 18 (4.96)	0.67	24.61
1983	13	30.98 (0.44)***	0.22 (7.20)	0.82	51.79
1984	12	93.19 (2.01)	0.27 (7.81)	0.86	61.06
1985	11	30.71 (0.63)***	0.20 (10.42)	0.92	108.51
1986	9	63.23 (1.25)**	0.18 (9.05)	0.92	81.89

Figures in Parentheses are t values.
* indicates significant at 10% level.
** indicates significant at 15% level.
*** indicates not significant.
Other t and F values are significant at 5% level.

also, the coefficient assumed a negative sign during 1976-1978. These coefficients are positive in all the years for Maharashtra.

The coefficient of determination i.e., R^2, which is a measure of the extent of movement in the dependent variable that is explained by the independent variables, is quite high i.e., above 61 percent for Gujarat, above 71 per cent for Maharashtra and for Tamil Nadu it is above 67 percent. The estimated values of a and b, and also R^2 have been proved statistically significant by 't' and 'F' tests respectively.

The cross-section analysis in general reveals that Maharashtra, maintained positive inventories throughout the period and hence the addition to the inventories for a unit increase in the sales was less. In Gujarat and Tamil Nadu the stock of inventories fluctuated much and hence additions to inventories for a unit increase in salesw as more. The influenee of sales on inventories was very high when the stock of inventories declined to zero.

It can be concluded from the above analysis that the minimum required level of inventories will be less where the quantity of sales is less and vice-versa. The influence of sales on the level of inventories will be more or less same at any particular point of time irrespective of the level of sales, production of raw materials, or the number of firms. The influence of sales on inventories will be slightly more when the stock of inventories approaches zero and vice-versa.

Results of Time Series Analysis

The estimates of the time series analysis (Table 8) reveal that the influence of sales on inventories is more in Gujarat (0.26) and in Tamil Nadu (0.24) when compared to Maharashtra (0.18). The minimum required level of inventories on an average was negative in the former states. The explanatory power of the models estimated is quite high i.e., above 84 percent. The model as well as the parameters have emerged statistically significant and they have been confirmed by 'F' and 't' tests respectively.

The estimates of the time series analysis substantiate some of the observations drawn from the cross section analysis. Further, they reveal that the states, like Gujarat and Tamil Nadu, with more of raw-material production and or with a larger number of firms could achieve economies of cost over a period of time by keeping lower levels of stocks of inventories. But states like Maharashtra had to keep higher levels of inventories in order to run the industries which involves additional cost for the industries. This leads to the cost difference among the industries in different states which in turn leads to the concentration of industries in states like Tamil Nadu where there is an economic gain. If this process continues the industries in other states may slowly disappear. Further, concentration of an industry in a particular state, may, after a certain level, leads to diseconomies of scale.

In order to reduce the concentration and the regional disparities, the Cotton Corporation of India

TABLE 8 Results of Time Series Analysis

	N	a	b	R^2	F
Gujarat	11	−64.80 (−1.65)*	0.26 (20.42)	0.98	416.96
Maharashtra	11	230.31 (2.38)	0.18 (6.91)	0.84	47,76
Tamil Nadu	11	−11.48 (−11.48)	0.24 (26.44)	0.98	699.09

Figures in Parentheses are 't' values.
* indicates significant at 10% level.
Other t and F values are significant at 5% level.

(CCI) has to undertake the task of buying the entire production directly from the farmers through regulated markets. The CCI should also channelise the distribution of cotton to all the states. The distribution should be made in proportion to the number of cotton textile industries in each state in order to avoid discrimination. This will go towards reducing the cost of idle inventory.

But the present situation is not encouraging. For example, more than 80 percent of the cotton produced in the country has been purchased by the private traders and the CCI has purchased less than 20 percent during 1976-86 (Table 4). So any attempt by the government in the field of cotton textiles should be through CCI and the latter has to be made more active.

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Structural Transformation Towards Stagnation : An Overview Kerala Economy

Jose Sebastian

This paper is addressed to the unique development experience of Kerala. Over the last two decades Kerala economy has been undergoing a process of structural transformation. There has taken place a marked shift in the sectoral composition of workforce and state domestic product from primary sector to the secondary and tertiary sectors. But the structural change, instead of leading to economic development, resulted in the stagnation of primary and secondary sectors. The paper seeks to inquire into the nature and causes of the present crisis.

Jose Sebastian is a Research Fellow in the Institute of Management in Government, Trivandrum.

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It is generally held that economic development is accompanied by structural transformation. The term denotes the shifts in the contribution of different sectors to total output and also in the proportion of employment in agriculture in favour of secondary and tertiary sectors (Kuznets, 1972; Clark, 1960). Though the term is used in the context of countries, the generalizations may be applicable to regional economies within a country as well. Attempts have been made to put forward a 'Kerala model of development' and to suggest it as a replicable model for other less developed countries. At the same time, the trends in production and productivity in various sectors suggest that the economy of the state is moving towards stagnation. In the present paper an attempt is made to examine the salient features of Kerala's development pattern and to inquire into the nature and causes of the present crisis.

The most noteworthy feature of Kerala's development pattern is the achievements in various social and infrastructural fields. These achievements are far ahead of most Indian States and in some instances even comparable to that of developed countries. In Table 1 some of the selected development indicators of Kerala and India are presented. In most of the indicators, Kerala is far ahead of India. The demographic and infrastructural indicators present the picture of a fairly developed econmy; but a closer look at the structure of Kerala economy provides an entirely different picture—a picture of stagnant productive sectors which co-exist with a growing tertiary sector.

TABLE 1 Development Indicators—Kerala and India

Sl. No.	Indicator	Unit	Kerala	India	Reference period
1.	Per capita SDP/NDP	Rs.	1951	2180	1983-84
2.	Per capita consumer expenditure	Rs.	1837.65	1537.50	1982-83
3.	Per capita consumption of nonfood items	Rs.	713.58	552.85	1982-83
4.	Birth rate	per 1000 people	22.9	32.7	1985
5.	Death rate	per 1000 people	64	76	1985
6.	Infant morality rate	per 1000 birth	32	102	1986
7.	Life expectancy	years	66	54	1981
8.	Growth rate of population	percent/annum	1.9	2.5	1980-81
9.	Population below poverty line	percent	26.8	37.4	1983-84
10.	Literacy rate	percent	70.4	36.2	1981
11.	Road length	per 000 square km	2744	470	1981-82
12.	Vehicles registered per lakh of population	No	966	981	1984-85
13.	Per capita bank deposits	Rs.	1559	1396	1987
14.	Total rural assets per family	Rs.	80,000	35,000	1981-82
15.	Physical quality of life Index	No	50	29	1961
16.	Index of infrastructure Development	No	140	100	1985-86
17.	Villages electrified	percent	100	73	1988 January
18.	Per capita domestic power consumption	KWH	32.2	25.3	1986-87
19.	Non agricultural workers as a percent of total work force	percent	59	33	1981 Census

Source: Central Statistical Organization, Statistical Abstract of India, various issues

Table 2 shows that production in the primary sector has registered an absolute decline in 1983-84 over 1970-71. The performance of the secondary sector is better; but only when compared to the primary sector. The tertiary sector, on the other hand, is having a higher growth rate than primary and secondary sectors. The State domestic product has registered a growth rate of only 2.05% per annum. But for the decline in population, the percapita income would have registered an absolute decline.

For a deeper understanding, we may consider the sectoral distribution of work force and State domestic product. For purposes of comparison the corresponding All India magnitudes are also presented in Tables 3 and 4.

TABLE 2 **The Indices of domestic product and their growth rates for important sectors**

Sector	Index of domestic product 1983-84 (1970-71=100)	Annual growth rate
Agriculture	96.46	−0.14
Forestry	40.38	−5.03
Fishing	100.35	−2.22
Primary sector	95.73	−0.28
Industry	135.96	2.41
Construction	184.21	4.09
Electricity and irrigation	301.78	10.23
Secondary sector	154.16	3.41
Transport and communication	232.51	6.36
Trade, Hotels and restaurants	129.34	1.47
Banking	315.10	7.93
Public Administration	343.27	9.22
Tertiary sector	180.25	4.14
State domestic product	131.81	2.05
Percapita income	104.38	0.30

Source : T.N. Krishnan (undated).

Table 3 shows that during the period 1961-81, the percentage of main workers to total population registered a decrease for both India and Kerala though the former always stood above the latter. This means that not only the work participation rate of Kerala is below that of India but over the period it has been steadily falling. Coming to the sectoral distribution of workers, we find that the percentage of cultivators to total main workers is much higher for India than for Kerala. At the same time the percentage of agricultural labourers in the total main workers is somewhat higher for Kerala than for India. On the other hand, the percentage of workers in the nonagricultural secotrs is substantially above India in all the three censuses.

We may, now, relate the distribution of work force to the sectoral composition of State domestic product.

Some Structural Features

Though the percentage of work force employed in the primary sector is much higher for India than for Kerala, the percentage share in domestic product is more or less similar. The disproportionate share of the primary sector of Kerala in domestic product may be explained by the predominance of cash crops whose value of output is much higher than that of food crops. On the other hand, the secondary and tertiary sectors in which more than 50% of the total work force is employed contribute around 30 to 35% of State domestic product only. The corresponding figures

TABLE 3 **The Distribution of Workforce for Kerala and India 1961-81**

Percentage of	Kerala			India		
	1961	1971	1981	1961	1971	1981
Main workers to total population	33.3	29.12	26.68	42.98	33.06	33.45
Cultivators to total main workers	20.92	17.80	13.07	52.49	43.07	41.58
Agricultural labourers to total main workers	17.38	30.69	28.23	17.05	26.71	24.94
Household industry workers to total main workers	8.68	4.28	3.69	6.40	3.57	3.47
Other workers to total main workers	53.02	47.23	55.01	24.06	26.65	30.01

Source : Census of India, Various issues.

marketed surplus of these crops have increased the market participation by rural households.

Net Imports

But the industrial sector of Kerala failed to exploit the tremendous potentialities of the consumption boom. Only a small proportion of the total demand for manufactured consumer goods is met by the industrial sector of Kerala. As a result, a major part of the manufactured consumer goods has been imported from other states. According to a study conducted by the State Planning Board (1980) on the trade balance of Kerala, the State experienced an adverse balance of trade in 1975-76. Aggregate imports exceeded aggregate exports by about Rs. 165.55 crores. A 1983 study on interstate movement of goods by road for the year 1980-81 by the Directorate of Economics and Statistics showed that the value of incoming goods was Rs. 1990 crores while the value of outgoing goods was only Rs. 1381 crores. According to the study, the incoming goods were mainly finished consumer items the outgoing goods were agricultural products, raw materials and petroleum products. The adverse trade points towards the fact that the State has become a market for manufactured products from elsewhere. The comparatively higher growth rate of transport and communication and banking has to be viewed in this background.

As for the achievements in various social and infrastructural fields, the explanation has to be sought from the socio-political and cultural roots of Kerala. The high level of male as well as female literacy combined with widespread public health facilities explains the better demographic indicators of the State. The activities of the various social and political movements compelled the popular governments to initiate and carry out a number of infrastructural facilties. Thus, it appears that the achievements in various fields are largely influenced by factors unrelated to the level of economic development in the State.

But can Kerala sustain her achievements for long with the slender production base? Recent developments suggest that this will be a remote possibility unless some fundamental changes take place in the structure of the economy. A good number of migrants working in the Gulf countries have returned and more and more people are expected to return within a short period. The flow of remittances is fast drying up. Already educated unemployment is a pressing problem for the State. According to the National Sample Survey (N.S.S) 38th Round (1983) Survey, Kerala has the highest rate of unemployment in the country. The estimates of the Department of Employment shows that in 1984 there were 23-35 lakhs applicants on the live registers of employment exchanges. The Gulf returnees will aggravate the already precarious employment situation in the state.

Some Lessons

The solution to the present malady lies in the exploitation of the employment and income potential in the primary sector. The development of agriculture will rejuvenate the existing agro-based industries like coir, cashew and coconut. The income, thus, generated will widen the already existing market for consumer goods and may further accelerate the pace of industrialisation in the State. Though the strategy appears to be simple, there are a number of obstacles to be overcome in its actual implementation.

The lesson that may be drawn from the development experience of Kerala is very obvious—economic development in the ultimate analysis is dependent on the activization of the productive sectors. And the overall socio-economic progress which is not rooted in the productive sectors is not sustainable in the long run.

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The Electricity (Supply) Act, 1948 provided for the creation of state electricity boards (SEB), charged with the responsibility of generation, transmission and distribution of electricity in the state. This Act also envisaged the creation of a central body, the Central Electricity Authority (CEA), with the responsibility

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of evolving a national power policy as well as co-ordinating the activites of the power sector in the country. The CEA has also been given the responsibility of providing technical advice to the electricity boards regarding the formulation of projects for power development.

In addition to the SEBs, the Central Government plays a direct role in the power programme through: (a) Damoder Valley Corporation: (b) Neyveli Lignite Corporation: and (c) Nuclear Power Projects. By an amendment to the Act in 1976, the National Thermal Power Corporation (NTPC), the National Hydro-electric Power Corporation (NHPC) and North-Eastern Electric Power Corporation (NEEPCO) were set up to construct power stations, exploit economies of scale and cater to the needs of several states.

Transmission and distribution of power is the responsibility of the state electricity boards. Due to diversity in consumption patterns between states as well as variations in generation mix, transfer of power between the states takes place during different times of the day as and when the need arises. The need to promote regional integration of power systems to ensure optimum utilization of scarce national resources was strongly felt. Keeping this in view, the country was divided into five regions and Regional Electricity Boards were set up in Delhi, Bombay, Bangalore, Calcutta and Shillong to act as nodal agencies to monitor inter-state exchanges of power. The ultimate objective is, of course, to integrate the activities of these boards to form a national grid.

Growth of Electricity Supply and Demand

Installed capacity The installed capacity has doubled between 1970-71 and 1980-81 and again between 1980-81 and 1987-88. The installed capacity in the country as at the end of March 1988 was 54195 MW (hydro-17215 MW; thermal-35650 MW; nuclear-1330 MW). Details pertaining to growth in installed capacities over the years is given in Table 1. A State-wise breakup is given in Annexure 1.

It is quite obvious that most of the states are dependant predominantly on either hydro or thermal sources. The share of hydro in the total installed capacity for all-India has fallen from 43 percent in 1970-71 to 32 percent in 1987-88. This is the situation inspite of the emphasis by the Rajadhyaksha Committee (Government of India, 1980) on adding more hydro capacity, mainly as a backup for shortfalls in thermal generation, as also to meet peaking demand. The Rajadhyaksha Committee also cautioned against placing extra emphasis by some states on hydel power (e.g. Karnataka, Orissa), as a failure of monsoons can and did have disastrous consequences.

Gross energy generation Gross energy generation has grown at an average rate of 10 percent during the period 1960-61 to 1987-88 (Table 1). The share of thermal generation has also increased over the years, from 53.7 percent in 1960-61 to 74 percent in 1987-88. Thermal generation accounts for 91 percent of the total generation in the western region; the figures for the other regions are: eastern region, 87 percent; northern region, 62 percent; southern region 59 percent and north-eastern region, 56 percent.

TABLE 1 **Installed capacity and energy generation (1960-61 to 1987-88)**

Year	Installed capacity		Energy generation	
	MW	% thermal	GWh	% thermal
1960-61	4653	58.8	16937	53.7
1965-66	9027	54.3	32990	53.8
1970-71	14709	53.7	55827	50.4
1975-76	20117	54.7	79230	54.7
1980-81	30214	58.1	110844	55.3
1985-86	46769	64.1	170350	67.1
1986-87	49265	64.4	187799	68.7
1987-88	54195	65.8	201753	74.0

Source : TERI, (1988).

Energy consumption Over the last three decades, electricity consumption has grown at a faster rate as compared to the growth of oil and coal. While electricity consumption grew at 8 percent compound during the period 1970-71 to 1986-87, the growth

rates for oil and coal were 5.5 percent ant 5.0 percent respectively. There has been a structural change in the consumption pattern across various categories over the years (Table 2) :

(a) There has been a marked increase in the share of electricity consumed by the agricultural sector (from 5.0 percent in 1960-61 to 21.0 percent in 1986-87).
(b) The share of industries has declined from 74.5 percent in 1960-61 to 61.8 percent in 1980-81. The share went down further, to 52.8 percent in 1986-87.
(c) The share of residential and commercial sectors has increased from 14 percent in (1960-61) to 20 percent in 1986-87.

TABLE 2 **Breakup of energy consumption across different consumer categories**

(GWh)

Year	Agriculture	Industry	Domestic & Commercial	Others
1960-61	833	12455	2340	1083
	(5.0)	(74.4)	(14.0)	(6.5)
1970-71	4470	34291	6412	3262
	(9.2)	(70.8)	(13.2)	(6.8)
1980-81	14489	55363	13928	5881
	(16.1)	(61.8)	(15.5)	(6.6)
1984-85	21194	73455	22001	7946
	(17.0)	(58.9)	(17.7)	(6.4)
1986-87	28218	71496	27235	9132
	(20.7)	(52.8)	(19.9)	(6.6)

Source : Central Electricity Authority (1987).
Figures in brackets indicate percentages.

Recognizing tne important role played by electricity in development, the SEBs have embarked on a massive electrification programme in the rural areas. States such as Punjab and Haryana have already achieved 100 percent village electrification. Gujarat, Andhra Pradesh and Karnataka have planned for 100 percent village electrification by 1989-90. States in the north-eastern region, Utter Pradesh, Orissa and Bihar would still have substantial scope for electrification. The large scale rural electrification programme has its impact on the performance of the boards and this will be discussed in the subsequent sections.

Reliability of Power Supply

The power supply position in the country has moved from a power surplus state in the early sixties to a deficit one from late seventies onwards. The peak demand in the country registered a growth rate of 8.4 percent during the period 1960-61 to 1985-86. It must be stated, here, that of peak demand only indicates the availability rather than the unrestricted peak demand mainly because peak demands in almost all the state electricity boards have been suppressed due to power shortages.

Cuts are imposed both on energy consumed as well as on maximum demand (for details of power cuts imposed, see Annexure 2). The sectors which are affected the most are the industries and agriculture. The agriculture sector resorted to rostering of loads to manage power demand. As against this, the industries sector installed captive diesel generating, sets in order to avoid cut-backs in production. It is not uncommon to find industries meeting almost 100 percent of their demand through captive sources.

The SEBs undertook large scale rural electrification programmes only to find that there was no power for supply to rural areas. The actual load growth in the rural areas was far higher than the projected figures. As a result, rural consumers have had to go without electricity for the major part of the day. By rostering, electricity is supplied for 6-8 hours during the day. Again, the better off farmers have standby diesel generating sets for use in the farms when power is not available. This is an option which is very expensive for the economy.

One of the major reasons for shortfalls in supply has been the substantial slippages in the addition of capacity (see Table 3). Targets are set, only to be revised downwards; even this revised target is often not met. Simultaneously, the expenditure in each Plan period has exceeded the outlay for the sector. Both cost and time over-runs have become a common

TABLE 3 Plan-wise slippage in additions to installed capacity

Plan	Target (MW)	Achievement (MW)	Slippage (%)
First Plan (1951-56)	1300	1100	15.4
Second Plan (1961-61)	3500	2250	35.7
Third Plan (1961-66)	7040	4520	35.8
Annual Plan (1966-69)	5430	4120	24.1
Fourth Plan (1969-74)	9264	4579	50.5
Fifth Plan (1974-79)	12499	10202	18.4
Annual Plan (1979-80)	2945	1799	38.9
Sixth Plan (1980-85)	19666	14226	27.7
Seventh Plan (1985-87)	7856	6848	12.8

Source : TERI, (1988).

feature. The gestation period for thermal stations range from 60 to 84 months, while that for hydel stations from 80 to 145 months. The record for nuclear power stations is again of the order of 150 to 180 months.

Delays in materials procurement and in boiler/ turbine deliveries, the practice of tendering and re-tendering for major equipment, getting environment, clearance, and the responsbility to resettle displaced population etc. have all contributed to the delays in commissioning. There have been changes in designs of sub-systems, plant layout and civil construction and these have added to shortfalls in capacity additions. The Bureau of Indian Standards has recently initiated steps, in collaboration with CEA, NTPC, BHEL etc. for standardizing plant layouts, civil construction etc. in order to minimize construction period for thermal power stations. This is one of the major thrust areas that the SEBs would have to address for reducing the power shortages in the state.

Transmission and Distribution

The growth of the transmission and distribution network (T & D) in the Indian power sector has not kept pace with generation facilities. There have been several intances when generation had to be backed down due to poor reliability of the T & D network. This has only added to the already existing power deficit situation in the country. The Rajadhyaksha Committee (1980) had recommeneded that 50 percent of the total outlay for the power sector should be for T & D facilities. As against this the actual outlay for T&D during the Sixth and Seventh Five Year Plans has been about 38 percent only.

Losses in the T & D network continue to be a matter of serious cocern. T & D losses have actually increased over the years, from 17.5 percent in 1970-71 to 21.5 percent in 1986-87 (for state-wise details, see Annexure 3). Inadequate provision for the T & D network is one of the major resasons for this situation. Also, distribution lines have been laid without due planning, a result of haphazard growth of load centres, thus leading to overloading of the network and contributing to higher losses.

There is a problem in estimating losses in the T & D network. Consumption for all consumer categories, except agriculture is taken from energy billed. For agriculture, this is not possible since consumption is not metered in most of the states. Hence, consumption is estimated based on assumed hours of operation and, thus, the balancing figure of losses is arrived at. Hence, losses could always be offset against agricultural consumption, to a limited extent, thus, distorting the picture.

Performance of Thermal Power Stations

Plant load factor As mentioned earlier, the share of thermal energy in gross energy generation has gradually increased from 55 percent in 1980-81 to 74 percent in 1987-88. There has also been a gradual improvement in the plant load factor of thermal power stations over the years (see Table 4).

Measures to improve plant load factor mainly by way of better maintenance management has yielded results. From a low of 44.2 percent in 1980-81, PLF of thermal power stations has gradually but steadily increased to 56.5 percent in 1987-88. The modernization and renovation programme undertaken by the

TABLE 4 All-India plant load factor in thermal power stations, 1975-76 to 1987-88

Year	P.L.F. (%)
1975-76	52.16
1976-77	55.47
1977-78	50.98
1978-79	47.99
1979-80	44.30
1980-81	44.21
1981-82	46.42
1982-83	49.43
1983-84	47.94
1984-85	50.15
1985-86	52.46
1986-87	53.27
1987-88	56.58

Source : Central Electricity Authority, (1988).

SEBs are also largely responsible for the improvement in PLF of some of the older power plants. Also, there has been a significant change in the unit size of thermal power stations and this has enormously assisted the SEBs in increasing the PLF. The improvement in PLF has come mainly from unit sizes of 200 MW and above. Most of the power plants in this category have achieved PLF of over 70 percent (Vijayawada, 92.4 percent; Singarauli, 79.7 percent; Trombay, 79 percent; Tuticorin, 77.3 percent). Also, the average for units in the range of 500 MW has also been substantially high. As against 79.5 percent in 1986-87, the PLF of this category of units have increased to 87 percent in 1987-88 (for details, see Table 5).

Coal and oil consumption The SEBs have had serious problems relating to poor quality of coal and this has resulted in higher coal and oil consumption in the thermal power stations. Data on coal and oil consumption for some SEBs is given in Table 6. It

TABLE 5 Performance of thermal generating units (20 MW and above) during 1987-88 vis-a-vis programme and during 1986-87

Capacity group	No.	Capacity (MW)	P.L.F. (%)		
			Actual 1986-87	Prog. 1987-88	Actual 1987-88
500 MW	6	3000.0	75.9	51.1	87.0
200/210 MW	77	16050.0	59.6	57.5	63.7
140/150 MW	9	1270.0	51.1	53.3	57.3
120 MW	20	2400.0	40.7	46.3	37.1
110 MW	36	3960.0	44.8	47.9	48.4
100 MW	11	1100.0	51.4	48.8	48.4
70/80 MW	7	540.0	36.7	43.5	38.5
62.5/63.5 MW	19	1191.5	57.4	55.7	55.5
60 MW	25	1500.0	50.4	54.6	47.1
50/55 MW	31	1565.0	50.5	49.4	53.3
20-40 MW	33	956.0	45.0	52.2	38.0
Total	274	33532.5	53.2	53.5	56.5
Units less than 20 MW & G.T.		1730.5	—	—	—
Total		35263.0	53.2	53.5	56.5

Source : Central Electricity Authority (1988).

TABLE 6 Coal and oil consumption in some SEBs

Board	1984-85	1985-86	1986-87
Coal (kg/kWh)			
MPEB	0.767	0.79	0.88
APSEB	NA	0.72	0.76
TNEB	0.62	0.67	0.70
HSEB	0.63	0.90	0.86
UPSEB	0.83	0.83	0.81
ASEB	0.62	0.61	0.60
Oil (ml/kWh)			
MPEB	20.26	13.18	10.97
APSEB	NA	3.39	3.24
TNEB	39.07	9.06	5.44
HSEB	24.00	28.00	32.00
UPSEB	17.58	16.01	13.79
ASEB	119.45	145.24	71.72

Source : Compiled from annual reports of State Electricity Boards.

NA—Not available.

must be noted that these figures represent averages for the state and for a detailed analysis, one would have to collect data at the power station level. However, these figures are indicative of the situation in the SEBs and are intended to give a range of consumption across power stations in the boards. While the coal consumption varies from 0.604 to 0.896 kg/kwh, oil consumption varies from a low of 5.44 ml/kwh in Tamil Nadu, to a high of 119.45 ml/kwh in Assam. These figures must be seen in the light of the quality of coal being used by different power stations in the states. While there is no data available on quality of coal being supplied, it is a well-known fact that there is a lot of exteraneous matter being supplied alongwith coal like shale, stones, overburdens etc. Oil consumption is high particularly during the rainy season, when the moisture content of coal is high and also due to frequent start-ups because of high occurrance of tube failures and forced outages. There is however considerable scope to reduce the consumption of coal to 0.65 kg/kwh and oil to 10 ml/kwh (NCPU, 1987). This would enable the boards to reduce their costs cosiderably.

Staff strength in SEBs The SEBs have generally been considered to be an outlet for employment and the senior officials of the boards often receive requests to accomodate persons even where there is no post sanctioned. Overstaffing is in the boards and the boards have expressed their inability to control this phenomenon. Table 7 gives details of employees per million units sold and per thousand consumers for

TABLE 7 Employee ratios for select utilities in India and Abroad

Board	1984-85	1985-86	1986-87
Employees per MU sold			
MPEB	7.47	6.77	6.27
APSEB	NA	5.33	4.84
TNEB	8.49	8.63	7.71
HSEB	9.00	8.50	8.08
UPSEB	8.76	8.11	7.16
ASEB	19.52	17.84	17.66
KEB	6.22	6.56	NA
MSEB	5.22	4.59	NA
SCE	0.26	0.27	0.26
KEPCO	0.38	0.37	0.34
Employees per 1000 consumers			
MPEB	22.72	21.47	19.71
APSEB	NA	14.00	13.00
TNEB	15.71	15.23	15.06
HSEB	20.80	21.09	20.10
UPSEB	38.00	35.00	33.00
ASEB	70.69	65.73	61.00
KEB	13.28	12.68	NA
MSEB	19.18	17.53	NA
SCE	4.92	4.89	4.60
KEPCO	2.75	2.84	2.88

Source : Compiled from annual reports of State Electricity Boards.

SCE—Southern California Edison Company
KEPCO—Korea Electric Power Company
NA—Not available.

some boards and also for the Southern California Edison Company (SCE-capacity 22,000 MW, energy sold 65.5 Gwh, number of consumers 3.7 million in 1987) and for the Korea Electric Power Company (KEPCO-capacity 19,000 MW, energy sold 66 Gwh, number of consumers 7.7 million, in 1987). The two foreign utilities have been included only to give an indication of the levels at which these utilities operate. Even if one agrees that the conditions in which these utilities operate are different from those prevailing in India, there is still substantial scope for improvement. Even across SEBs in India, the range for employees per million units sold is from 4.84 to 8.08 (if one excludes a figure of 17.66 for Assam), and that for employees per 1000 consumers is from 13 to 33 (a factor of 2.53), again not including Assam. This is an important area of cost control that the SEBs would have to seriously consider, for this would greatly assist them in improving their productivity.

Finances of State Electricity Boards

The Electricity (Supply) Act, 1948, specifies that the electricity board should operate as a commercial undertaking and not incur losses in its operations as far as possible. To enable the board to do this, it could adjust its tariffs accordingly from time to time. Inspite of the autonomy given, the poor financial performance of state electricity boards continues to be a matter of concern for the central as well as state governments. Various committees have been set up in the past to review the functioning of the electricity boards and have recommended measures, from time to time, to improve their performance. One of the main reasons for this state of affairs is the high quantum of subsidy for some consumer categories. The agriculture sector continues to get the largest subsidy as far as electricity consumption is concerned. In most states, electricity supply to the agricultural sector is charged at a flat rate, which is far below the cost and in some cases it is almost free. A flat rate also encourages misuse of electricity by way of running small industries under this category.

A working group set up by the Planning Commission in 1963 had recommended that boards should earn a return of 12 percent (including electricity duty) on capital, after providing for operating expenses and depreciation. The Venkataraman Committee in 1964 recommended that the boards should earn a return of 11 percent on the capital employed, if not immediately, at least within the next ten years. This return was to be taken after providing for operating cost and depreciation, but including receipts from electricity duty, which were estimited to be 1.5 percent of the capital. In negotiations for assistance to power projects from external agencies like the World Bank, a return of 11 percent including 1.5 percent from electricity duty, on the average capital base was agreed to. This, however, was never implemented, mainly because the shortfall in achieving this rate of return was often made up by a subsidy from the state government. This enabled the boards to fulfil the obligations to the World Bank. Presently, the boards are expected to achieve a statutory 3 percent rate of return after providing for operating expenses, interest liability and depreciation. This 3 percent is to be calculated on the total capital as at the beginning of the financial year. Most of the SEBs are not even able to earn enough to meet the average cost of energy sold to their consumers.

Tariffs in SEBs

One of the major reasons for the continued poor financial health of the boards is the unremunerative tariffs for some consumer categories and the inability of the tariffs to keep up with the cost of supply. The Planning Commission has estimated that about 80 percent of the losses incurred by the boards is due to low tariffs for the agriculture sector (NCPU, 1987). While there may be reasons for giving this sector a rate below cost, there is no economic justification for the present very low tariffs that encourage misuse and inefficient use of electricity. Agriculture consumers have a flat rate per hp of connected load in almost all the SEBs and the small farmer gets electricity free (a small farmer is defined as one who owns either 2.5 acres of wet land or 5 acres of dry land and depends solely on agriculture for his livelihood). There is no metering of consumption and there are several instances of farmers running small industries with this connection. A summary of the average rates in force in the SEBs is given in Annexure 4. The other categories

who recieve electricity below cost are the domestic, LT industries and in some states the power intensive consumers also.

Several government committees have commented on the need for a rational tariffs structure which would encourage efficient use of electricity. Tariffs based on time-of-day would help in reducing consumption at peak and encourage counsumption during off-peak hours (more on this in subsequent sections). The SEBs could, to begin with, introduce inverted block rates for domestic and commercial consumers, which charges higher blocks of consumption at progressively higher rates. This would serve the double purpose of providing cheap electricity to the poorer consumers and at the same time encouraging demand management.

Future Issues Facing the Power Sector

As mentioned in the earlier paragraphs, an attempt has been made briefly to draw a profile of the power sector. We have looked at the growth in installed capacity, energy generation, structure of energy consumption across different consumer categories, as well as the technical and financial performance of the power sector. Over the last five years, there has been a gradual improvement in the performance of the state electricity boards on technical account. On the financial side, the situation is not very good. Losses have been mounting and the SEBs have found it difficult to find finances for adding to capacity. The SEBs, which form core of the power sector in India, will have to address themselves to several new issues apart from just adding to capacity and generating and transmitting the energy.

Demand Management The concept of demand management is yet to catch on. Presently demand management is restricted to staggering of holidays, enforcing energy and demand cuts mainly on HT consumers and rostering of loads in the agriculture sector. The SEBs will have to look beyond physical means of managing demand. An important area in this regard is the role of tariffs. Several developed countries have shown that price can be used to influence demand and have used tariffs effectively not only to generate resources, bot also to flatten their load curves.

Electricite de France (EdF) the leader in the area of time-of-use tariffs. In 1956, France introduced, for the first time in the world, a marginal cost based tariffs, which has progressively been modified and expanded to what is probably the most sophisticated tariff structure. The rates are based on seasons (summer and winter) and also on time-of-day. The highest rate is during the three evening peak hours in winter; this was followed by day-time "full-use" hours; and the lowest rate was levied during off-peak hours in summer. EdF has reported that the national load curve flattened by 5 percent, after a year under this pricing system. The total resultant saving, including investment in generation, T & D was estimated at more than 50 billion Franc, for the seven years following the new tariff (Meek, 1973).

Another example often quoted in literature is the case of Korea. Introducing peak load control tariffs has decreased the peak load ratio (defined as the ratio of peak load to average load during a day) from 127.3 to 119.7. As against this, the off-peak ratio increased from 79.7 to 85.7. Based on this, the Korean Electric Power Company estimated a possible saving of US$ 250 million in future investments. A number of utilities in the USA are moving towoards using peak load control tariffs to influence demand. Proposals relating to spot pricing which means that consumers are informed of prices 24-48 hours in advance are also being talked about in order to influence the demand. (for details see Ramesh and Natarajan, 1987).

Utilities in the USA have been late entrants in the area of time-of-use pricing. Nevertheless, they are increasingly becoming aware of the usefulness of TOU pricing for demand management. Several utilities have introduced TOU rates and customer awareness has reached such levels that consumers who are presently not covered under TOU rates are demanding that they be included. An interesting case is of the Pacific Gas and Electric Company, who in 1987 were ordered by the California Public Utilities Commission to install 20, 000 TOD meters across all customer

classes (California Public Utility Commission, 1988-87). The Commission deferred installation of these meters for residential consumers until 1988 when the cost of meters is expected to fall below US$ 200. Similar orders are expected to be issued to San Diego Gas & Electric Co. and Edison Light and Power in future proceedings.

In India, tariffs for different consumer categories are restricted to a simple energy rate for LT consumers and a demand and energy rate for HT consumers. A beginning has been made by Gujarat where time differentiated tariffs were introduced. However, there is no information to determine the effectiveness of these tariffs. Tamil Nadu has introduced special concessional rates for night consumption. Preliminary indications are that consumers are taking note of this incentive and are gearing up their production systems in order to avail of this benefit. Before introducing these rates, it is improtant that studies are carried out to determine consumer response for effective implementation.

Energy Conservation The utilities in India have not considered conservation as an option for adding to generation. Utilities in developed countries have benefitted by not only participating in, but also initiating energy conservation programmes in their area. The utilities have realized that by investing in energy conservation, they can avoid or postpone investments in future capacity. It is well known that the success of the concept of storage heating among residential consumers was largely due to the active support from the utilities. The utilities found that they could better utilize their capacity at higher load factors of consumers used off-peak energy to heat their homes and also released some of the demand from the daytime. Several utilities in the USA have invested in Installation of energy-efficient lighting systems, particulary in the area of street lighting. The SEBs in India should consider invesments in these areas as an option for adding to capacity.

Utilities in developed countries, especially, USA, Germany, Japan etc. have specialized officers (called "account executives" in some utilities) to initiate and follow-up on energy conservation activities in their area. This is done more for large cosumers and these executives constantly advise the consumers on ways and means to reduce their energy either through conservation or by taking advantage of off-peak concessions. This special team of executives has been responsible for the success of the energy conservation programmes in these countries.

In India, attempts at conservation, if any, have been initiated by the industries themselves, due to increased awareness of the energy shortage and also as a means to reduce there cost of operations. In a situation where industries face demand and/or energy cuts, the consumers who undertake conservation measures are the ones who are at a disadvantage. SEBs often decide on quotas based on demand and energy records of the last 12 months. This is a big disincentive for consumers who have taken steps towards conservation. On the contrary these consumers should be encouraged and one of the ways to do this would be to either restore their quotas or to determine the quota based not on the last 12 months' consumption pattern, but on the basis of a 12 month period starting 24/36 months back.

On the domestic fronts, there is an enormous potential for energy conservation by way of improving the efficiency of domestic appliances. It is a well known fact that most of the domestic appliances like water heaters, room heaters, air-coolers, fans etc. are manufactured with little or no control on quality. Even though the Bureau of Indian Standards has issued several standards relating to these appliances there is nothing done to enforce them. Another problem relates to cosumer awareness of efficient energy use. Consumers prefer to buy appliances which have lower intial costs and tend to ignore the higher energy bills that they would have to pay rather than going in for energy efficient equipment, which would cost more initially, but save on energy bills. This awareness is yet to come. Flat rates and charges on minimum consumption are levied by a few of the SEBs. This is a disincentive for the energy conservation efforts by the household consumer.

Cogeneration is another option that would assist SEBs in reducing the power shortage. SEBs should

actively encourage industries that have requirements of both steam and energy to go in for cogeneration. The sugar industries and some chemical industries have already taken the lead to generate power and steam simultaneously and some of these industries also feed the surplus energy into the grid. Again, drawing on experiences in the USA, cogeneration has forced the utilities to market their energy in a more aggressive manner, for several large consumers have been resorting to self-generation to meet their power and steam requirements. The SEBs in India now see their role as only power supplying agents and have not looked at other alternatives which would enable them to achieve their objectives. This view would necessarily have to change because it is the boards that would benefit by taking these measures.

Consumer Awareness The question relating to consumer service has to get increased attention. Utilities in developed countries have realised that any programme launched by the electric utility has a greater chance of success if the consumer is kept in the picture right from the beginning. If the consumer is informed of the costs and the likely benefits, both to him and to the utility, and the possible role that he has to play and the co-operation that he must give, utilities have found that this helps their programme enormously. To mention the Korean experience once again, peak control tariffs were not introduced overnight through an administrative order. KEPCO had a 18 month preparatory period wherein consumers were taken into confidence ragarding the new tariff structure and the benefits likely to accrue to them were highlighted and their full cooperation sought in this exercise. Experts from KEPCO spent a substantial amount of time with each HT consumer and explained to him ways by which the consumer could benefit by way of reduced costs. The utility, of course, benefits by way of optimum utilization of existing capacity.

The present Indian environment would have to change. There have been several instances where the government has had to go back on rates already increased due to pressure from consumer groups. There is a lot to be done in improving the relationships with the consumer as well as improving the image of the electric utility in the eyes of the consumer. During discussions with HT industrial consumers on peak load tariffs, the consumers expressed their lack of confidence in the board, sofaras keeping promises was concerned. They pointed out that even though they were prepared to pay a higher rate at peak time, they were not sure that the board would give them assured supply. Confidence building is a major exercise that the SEBs have to undertake during the next 2-3 years.

Energy From Renewable Technologies Energy from renewable energy technologies is an important area in the government's energy plan. The Department of Non-conventional Energy Sources which is the nodal agency for planning and implementing the renewable technology programme, in consultation with the state nodal agencies, has been making efforts to promote these technologies. The electricity boards presently perceive their responsibilities mainly as agencies for adding power stations This thinking will have to be re-evaluated. Electric utilities in India will have to take a fresh look at policies ralating to investments in renewables, as a part-substitute for adding power stations, especially in remote areas where substantial losses are to be incurred in transmission and distribution. Electric utilities in developed countries have considered investments in renewable energy sources as options for power generation especially taking into account the fact that costs of power supply are on the increase and the cost of the renewable is falling. One or two electricity boards have gone in for ventures in the area of wind farms and have done reasonably well. The SEBs stand to benefit from more such ventures.

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ANNEXURE 1 **Statewise Power Generating Capacity (1960-61 and 1986-87)**

	Installed capacity (MW)				Growth rate %
	1960-61	1986-87			
	Total	Hydro	Thermal	Total	
Dominantly Hydro					
Kerala	137	1,476	—	1,476	9.6
Himachal Pradesh	—	306	—	306	—
Meghalaya, Tripura, Manipur & Assam	19	295	495	790	—
Sikkim	—	12	—	12	—
Jammu & Kashmir	13	176	23	199	11.1
Karnataka	191	2,082	420	2,502	10.4
Orissa	136	730	470	1,200	8.7
Andhra Pradesh	270	2,442	1,825	4,267	11.2
Bhakra Beas Management Board	—	2,705	—	2,705	—
Daminantly Thermal					
Delhi	76	—	1,196	1.196	11.2
West Bengal	754	41	2,927	2,968	5.4
Haryana	11	16	635	651	17.0
Madhya Pradesh	268	115	3,452	3,567	10.5
Gujarat	333	300	3,193	3,493	9.5
Bihar	351	150	1,425	1,575	5.9
Uttar Pradesh	397	1,422	4,663	6,085	11.1
Maharashtra	760	1,556	5,875	7,421	9.2
Punjab	336	334	860	1,194	5.0
Tamil Nadu	517	1,389	2,850	4,239	8.4
D.V.C.	—	104	1,655	1,759	
Dominantly Nuclear					
Rajasthan	71	321	660	981	10.6
All-India (utilities)	—	15,962	32,624	48,586	—

Source : CMIE (1987).

Note : 1. Thermal includes nuclear capacity also.
2. The capacity for each state includes only the power plants located in the state boundaries and excludes the multi-state projects.

ANNEXURE 2 **Power Cuts/Restrictions: February 1987**

A. No Notified Power Cuts/Restrictions

States/Union Territories/Systems			
1. Madhya Pradesh	5. Bihar (a)	8. Manipur	11. Assam (c)
2. Goa	6. Damodar Valley Corporation (DVC) (b)	9. Mizoram	12. Nagaland
3. Andhra Pradesh	7. Arunachal Pradesh	10. Meghalaya	13. Tripura
4. Kerala			

(a) Though there are no notified power cuts/restrictions in Bihar, load shedding is being taken recourse to on a day-to-day basis depending upon availability of power.

(b) Power cuts/restrictions were imposed by DVC on a day-to-day basis as per their order of priority depending upon availability of power vis-a-vis the requirement.

(c) Although there are no notified power cuts in Assam, load shedding is being taken recourse to on a day-to-day basis depending upon availability of power.

B. Power Cuts/Restrictions in Force during February 1987

	Demand cut	Energy cut
Delhi	Peak period restrictions on industries	10%
Haryana	1-2 off days/week with 6 1/2—8 1/2 hrs /day supply to industries	60%
	Agricultural consumers were supplied power for 6—8 hrs/day	—
Chandigarh	Staggered weekly off days and peak period restrictions on industrial consumers	—
Jammu & Kashmir	4—19 hrs /day supply to industrial, commercial, domestic and agricultural consumers	—
Himachal Pradesh	Peak period restrictions on industries	—
Punjab	50%. Peak period restrictions on general industries	—
	Agricultural consumers were supplied power for 11½ hrs. to 24 hrs/day depending upon day-to-day availability	—
Rajasthan	Peak period restrictions on industries	80%
	Agricultural consumers were supplied power for 6—8 hrs/day	—
Uttar Pradesh	Restricted supply for certain categories of industries 1 day/week closure for general industrial consumers with peak period restrictions	35%
	Agricultural consumers were supplied power for 8 hrs./day	
Gujarat	15%—30%	—
	Rural feeders were supplied pewer for 8—22 1/4 hrs./day	

(*Contd.*)

ANNEXURE 2 (*Contd.*)

	Demand cut	Energy cut
Maharashtra	10%—15% 24 hrs. power supply to rural areas	
Karnataka	10%—20%	20—70%
Tamil Nadu	15%—40% Agricultural consumers were supplied power as per the grouping of rural feeders	15—40%
Pondicherry	15%—40% Agricultural consumers were supplied power as per the grouping of rural feeders	15—40%
West Bengal	Restricted supply to certain categories of industries and also peak period restrictions on industries	—
Orissa	75% pewer cut on heavy and power intensive industries. Large industries except State Government Undertakings were subjected to 50% power cut. However, these were permitted to draw power purchased from outside sources by OSEB (being available at present) to meet their requirement and peak period restrictions on industries.	—

Source: Central Electricity Authority, 1987.

ANNEXURE 3 **Transmission and distribution losses in SEBs**

SEB/Department	T & D Losses (%)	
	1985-86	1986-87
Haryana	19.8	20.6
Himachal Pradesh	20.2	21.0
Jammu & Kashmir	35.6	33.5
Punjab	18.8	17.0
Rajasthan	26.5	23.9
Uttar Pradesh	20.5	20.0
Chandigarh	18.9	NA
Delhi	18.0	NA
Gujarat	25.5	24.0
Madhya Pradesh	18.9	20.8
Andhra Pradesh	19.2	18.5
Karnataka	22.5	22.2
Kerala	24.6	27.5
Tamil Nadu	18.7	18.7
Bihar	22.5	22.1
Orissa	23.0	22.0
West Bengal	23.1	23.2
Assam	20.0	21.0
Manipur	45.0	37.0
Mizoram	43.6	48.1

Source: TERI (1988).

ANNEXURE 4 **Average Electricity Rates as on 31 January 1987**

(Paise/kwh)

	Domestic (30 kWh/ month)	Commercial (200 kWh/ month)	Agricultural 5HP 10Z load factor (LF) (272 kWh/ month)	Small industries 5 HP 10Z LF (272 kWh/ month)	Medium industries 50kW 30Z LF (10950 kWh/month)	Large industries 1000 kW 50Z LF (3,65,000 kWh/month)
Andhra Pradesh	51.67	96.50	9.50	56.84	55.05	69.61
Assam	65.00	105.00	50.00	49.00	94.00	102.19
Bihar	62.33	83.50	96.00	112.00	110.00	97.28
Gujarat (May to Oct.)	65.00	90.07	36.51	86,42	93.63	95.49
(Nov. to April)	65.00	90.07	36.51	86.42	98.36	99.85
Haryana	45.00	106.75	32.35	65.00	86.00	91.60
Himachal Pradesh	45.67	82.00	21.94	44.00	59.00	57.00
Jammu & Kashmir	33.08	58.90	11.50	22.70	22.70	20.40
Karnataka	55.00	156.25	11.49	96.03	88.67	81.28
Kerala	47.66	60.50	15.22	30.77	22.72	34.20
Madhya Pradesh : Urban	48.00	103.50	16.00	68.00	77.61	95.03
Rural	46.00	103.50	16.00	68.00	77.61	95.03
Maharashtra : Bombay, Pune	38.50	109.80	15.31	60.00	80.54	111.33
Other areas	37.50	104.80	15.31	60.00	80.54	98.10
Meghalaya	50.00	81.00	21.60	70.00	66.85	48.60
Orissa	56.00	95.00	22.71	57.00	65.56	87.28
Punjab	60.33	116.00	13.50	64.00	73.35	71.89
Rajasthan	58.00	96.00	29.60	69.00	83.00	85.00
Tamil Nadu : Madras	55.00	120.00	11.49	100.00	100.00	93.12
Other areas	55.00	115.00	11.49	95.00	95 00	88.12
Uttar Pradesh	74.00	104.00	55.15	92.66	87.33	103.46
West Bengal	57.00	85.00	35.00	63.50		95.45
Arunachal Pradesh	50.00	50.00		27.00	27.00	42.00
Manipur	45.00	—		25.00	25.00	
Mizoram	48.00	60.00		25.00	24.46	
Nagaland	64.00	74.00	56.00	62.00	62.00	62.00
Sikkim	46.67	64.00	64.00	64.00	64.00	38 88
Tripura	60.00	77.00	35.00	40.00	40.00	
Andaman and Nicobar Island	58.00	51.75		43.00		
Chandigarh	36.65	88.00	17.76	32.20	42.37	44.44
Dadra & Nagar Haveli	60.00	92.75	54.19	103.75	98.89	98.61
Delhi : DESU	29.00	91.00	21.00	78.00	78.00	113.73
NDMC	29.00	92.00		78.00	78.00	
Goa	40.00	82.75	25.00	50.00	63 00	68.80
Daman & Diu	60.00	83.50	45.00	55.00	63.00	72.67
Lakshadweep	60.00	60.00		40.00	32.74	
Pondicherry	55.00	135.00	16.85	72.00	72.00	70.50

Productivity Norms for Agro-Paper Mills

NPC Research Section

In India, today, there are about 66 agro-paper mills accounting for about 0.55 million tonnes of paper production out of a total capacity in the country of about 2.8 million tonnes. In this study, the NPC Research Team has attempted to measure and analyse the major productivity ratios of the sector. The study also recommends productivity guide norms. This is a part of a major study just concluded at the National Productivity Council.

Prepared by a team of specialists consisting of S.A. Khadev, Regional Director, NPC, Madras; N.K. Nair, Director (Research) and A.K. Burman, Dy. Director (Research) NPC, New Delhi and K. Venkataraman, Assistant Director, NPC, Madras.

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Importance of Agro-Paper Mills

Pulp and Paper constitutes one of the most important segments of India's industrial economy and is treated as a basic sector. Its performance is crucial to the economy to the extent that the growth of its services sector, has been crucially dependant on the supplies of printing and writing papers and newsprint in order to meet the requirements in sectors like education, communication, trade and commerce, banking and insurance, public administration etc. The industrial sector also requires paper both for packaging and for its service sector components. The prominent role of paper continued untill recently when the revolutions in micro-electronics and petrochemicals posed a challenge to this industry.

Near famine conditions prevailed in the Indian paper market during the late sixties and through the seventies alongwith the increasingly uncertain supplies of wood from the Indian forests to the integrated paper mills due to economic, enviromental and ecological reasons, led to the setting up of a large number of short gestation period, less capital intensive and less energy consuming agro-residue based paper mills throughout India. Today, there are about 66 such mills having an installed capacity of over 0.55 million tonnes out of a total industry capacity of about 2.8 million tonnes. Most of them are small in size, with less than 30 tpd, while a few of them are having a capacity of 50 tpd or more. Based on the norm of 20 persons per tonne of capacity, the agro-paper sector employs about 110 lakh mandays in both direct and indirect activities including rawmaterial handling, i.e. about 41,000 persons. Based on an average price of

Rs. 9,000 per tonne including duties and levies the gross values of production at 100% capacity utilisation works out to be about Rs. 500 crores. At an assumed capacity utilisation ratio of about 70 percent, the sector produces an output, the gross value of which will be in the range of about Rs. 350 crores in recent years. Based on a gross value added to value of output ratio of 25 percent, the sector would be contributing about Rs. 88 crores as value added per year.

Scope and Objectives of the Present Study

The total paper industry in India seemed to undergo a difficult phase, particularly after the mid Eighties. Capacity utilisation ratio of the industry continued to fall reaching an all time low of 61 percent in 1987. There were fears among the industry managements that the rate of growth in demand for output was much lower than the rate of growth in capacity. Amidst the declining profitability in the industry, a few agro-paper mills closed down their operations and a few others were declared sick. While soaring input prices added momentum to the slide down by these mills, the absence of recovery units led to their suspected viability. The tightening of anti-pollution measures by the respective State Pollution Control Boards added to the woes of this sector. It became apparent that, unless there is a remarkable improvement in the productivity of various factor inputs deployed by the sector, this group of mills would not be able to survive in the market in competition with paper substituting technologies like those from micro-electronics and petrochemicals on the one hand, and the large size integrated paper mills with economies of size and recovery systems on the other. Further there are a large number of imported waste paper based small plants which enjoy advantages over the others under the existing market conditions and fiscal framework, although not intrinsically.

Under the above circumstances, the National Productivity Council in collaboration with the Indian Agro-Paper Mills Association decided to undertake a comprehensive study of the techno-economic status and productivity performance of the agro-paper mills sector in India. The study was divided into two parts. While the first part concentrated on the micro level aspects directly relating to the management of the mills, based on the shop-floor conditions available in India, the second part dealt with some of the crucial issues connected with the planning and management of the sector at a macro level. The detailed set of objectives are as follows:—

Part I

(i) To evolve an integrated Productivity indicator structure for typical agro based paper mills;

(ii) To work out industry level guide norms for vital productivity indicators on the basis of the historical performance of a sample of units representing a cross-section of the industry;

(iii) To prepare an analytical report on the productivity performance of the industry to unearth weaker areas and suggest remedial measures.

Part II

(i) To find out the numbers, installed capacities and production of agro-based paper mills in India with particular reference to the raw-materials used by this industry and their availability;

(ii) To analyse the reasons for sickness, if any, in the agro-based paper industry and to suggest remedial measures including available concessions and incentives:

(iii) To analyse the energy and water pollution implications of the industry;

(iv) Any other aspect of the agro-based paper mills which will be within the framework of the study but not included as the objectives.

The present paper covers some salient features of part 1 of the study.

Methodology

Pilot visits were undertaken by the NPC Study team to all the major areas of agro-paper mills concentration in U.P., A.P., Maharshtra, Punjab, Tamil

Nadu and Gujarat to understand the techno-economic aspects of thelr operations, the data monitoring structure etc. Subsequently, a Steering Committee was constituted to guide the Study Team. The constitution of the Steering Committee is given at Annexure I. The questionnaire for collection of data was formulated in consultation with the Steering Committee.

The measurement centres were arrived at broadly based on the general process sequence and measurability of the inputs and outputs. The various factors within each measurement centre were decided based on their importance in the cost of production. Annexure II gives the details of the various measurement centres and the respective factors considered for the development of norms.

In the process of evolving suitable measurement centres, the utility functions like Boiler House, Pump House etc. were not considered because of the fact that the level of operation of the utility functions is governed by the requirements of the process.

The questionnaires were then sent to about 60 agro-paper units spread all over India. Subsequently, field visits were undertaken by the NPC team to a large number of agro-paper mills for collection of required data.

The observed range of different indicators for various groups of agro-paper mills was worked out and presented to the Steering Committee. The guide norms were then finalised taking into consideration the steering committee's comments and suggestions.

Limitations

Being the first ever attempt to consolidate a data base on the agro-paper mills sector, the present study has several limitations. From the absence of an operationally valid concept of agro-paper mills to the data on cost of operations, the team faced empirical and analytical constraints throughout the study. Although the structured questionnaire was sent to as many as 60 mills and attempts were made to follow up with these mills through personal visits, responses were obtained only from 24 mills of which only 18 could be utilised for purposes of analysis. Remaining six were either incomplete or received very late. A list of respondant units is given in Annexure III.

The data obtained directly from these mills also could not be treated as error free. The data infrastructure in these mills was found to be extremely inadequate to arrive at consumption of any major material or fuel inputs particularly in various sections like the pulp mills, paper machine units etc. The data used here, therefore, may sometimes, be based on back calculations and, thus, suffer from inaccuracies. However, care has been taken to cross-check with experienced experts wherever found necessary.

Norms Development

The measurement of centrewies productivity ratios were worked out for the 18 units. The unitwise productivity ratios of each measurement centre were then classified into different groups based on type of raw material used, HP installed, product type and GSM range produced. These were presented to the Steering Committee with a view to arrive at a consensus on the groupings resorted to for the purpose, the need, significance and relevence of the indicators from the point of view of monitoring. The observed range of the various indicators were then worked out for different measurement centres ignoring the exceptional values on either side viz., maximum and minimum. Thus the guide norms recommended gives both the maximum and minimum values to take into account the possible variations that may arise due to different unaccounted factors, viz. the final input and output furnish composition, the GSM variations, level of technology etc.

Tables 1 to 4 give measurements centrewise observed range and the recommended ratios for different indicators. Though the guide norms give both maixmum and minimum values, it is recommended that the units should strive towards achieving the minimum values recommended.

Labour Productivity

One of the easier and vital measures of efficiency in a paper mill is the productivity of labour. This could

TABLE 1 **Productivity Ratios**

Group	Raw Material Handling etc.						Short Fibre Digesting					
	Kwh/T of RML cut		Mandays/T of RML received in the Yard		Mandays/T of RML cut (feeding)		Caustic/T of Pulp		Steam/T of Pulp		Kwh/T of Pulp	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Observed												
UNBLEACHED	—	—	—	—	—	—	—	—	—	—	—	—
Bagasse	6.4	23.3	0.2	0.4	0.6	1.2	0.15	0.20	2.1	4.0	20	35
Straw	—	—	1.2	—	2.5	2.7	0.14	0.15	2.0	4.3	17	25
Mixed	19.4	27.5	—	—	0.8	—	0.17	0.19	3.2	3.9	28	35
BLEACHED	—	—	—	—	—	—	—	—	—	—	—	—
Bagasse	—	—	—	—	—	—	—	—	—	—	—	—
Straw	3.5	47.3	3.1	3.7	2.5	—	0.15	0.21	2.5	3.6	38	42
Mixed	3.5	27.6	0.3	—	0.6	—	0.20	—	3.4	4.3	—	—
Recommended												
All Types	—	—	—	—	—	—	—	—	2.0	4.0	17.0	40.0
Unbleached	—	—	—	—	—	—	—	—	—	—	—	—
Bleached	—	—	—	—	—	—	—	—	—	—	—	—

Note : 1. The norms recommended are for those using more than 75% of own (Agro) Pulp.

TABLE 2 **Productivity Ratios**

Group	Stock Preparation						Paper			
	Sizing Che. in Rosin equv (Kg)/ T of pulp refined		Alum. (Kg)/T of pulp refined		Kwh/T of Pulp refined		Steam per T of Machine Production		Water per T of Machine Production	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max,
Observed										
All Types	—	—	—	—	—	—	2.7	5.6	37	190
Unbleached	3.0	28 0	29.0	97.0	93.0	300	—	—	—	—
Bleached	8.0	33.0	57.0	87.0	42	166	—	—	—	—
Reels	—	—	—	—	—	—	—	—	—	—
Sheetings	—	—	—	—	—	—	—	—	—	—
Recommended										
All Types	—	—	—	—	—	—	2.5	5.0	30	60*
Reels	—	—	—	—	—	—	—	—	—	—
Sheetings	—	—	—	—	—	—	—	—	—	—

Note : * However the water consumption may go upto 120m³/T wherever there are no fibre recovery systems. Thus concerted efforts should be made to have recovery system in order to enable recycling of water.

† The Loss from head box to shipment would be in the range of 5—11%.

in Pulp Making

Long Fibre Digesting						Washing & Screening		Bleaching				Pulping (Including Stock Prep.)			
Caustic/T of Pulp		Steam/T of Pulp		Kwh/T of Pulp		Water/T of washed Pulp (AD)		Chlorine/T of Pulp bleached		Lime/T of Pulp bleached		Kwh/T of Pulp refined		Steam/T of Pulp refined	
Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
0.06	0.12	—	—	31.0	60.0	—	—	—	—	—	—	400	675	2.0	5.0
—	—	—	—	—	—	37.0	97.0	—	—	—	—	—	—	—	—
—	—	—	—	—	—	35.0	110.0	—	—	—	—	—	—	—	—
—	—	—	—	—	—	43.0	48.0	—	—	—	—	—	—	—	—
0.06	0.08	—	—	22.0	60.0	—	—	0.08	0.24	0.09	0.21	680	760	2.0	5.0
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	94.0	98.0	—	—	—	—	—	—	—	—
—	—	—	—	—	—	76.0	120.0	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
0.06	0.12	2.0	3.0	17.0	40.0	—	—	—	—	—	—	—	—	—	—
0.06	0.08	2.0	3.0	17.0	40.0	—	—	0.08	0.20	0.09	0.22	—	—	—	—

2. The maximum is recommended to account for the furnish variations.

in Paper Making

Machine											
										Finishinug House	
Kwh/T of Machine Prodn.		Condensate Return per of steam		Fibre loss (%)		Moisture (%)		Pulp to Paper ratio		Finishing loss (%)	
Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
400	890	0.4	0.85	2	5	5	7	0.88	1.05	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
400	750	0.4	0.85	1.5	3	5	8	0.88	1.05	—	—
—	—	—	—	—	—	—	—	—	—	2†	5†
—	—	—	—	—	—	—	—	—	—	6†	10‡

1. The norms recommended are only for those using more than 75% own (Agro) Pulp.
2. The maximum is recommended to account for the furnish variations.

TABLE 3 Ratios in Effluent Treatment

Group	Waste Water Per T of Finished Paper		Effluent characteristics before treatment								Effluent characteristics after Treatment
			PH		TSS		BOD		COD		
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
Observed											
Unbleached	100	190	7	9	400	1100	400	1150	1000	2500	—
Bleached	170	250	7	9	650	1500	650	1100	1500	3250	—
Recommended											
Unbleached	70	180	6	8	—	—	400	800	1000	3200	As per Minas
Bleached	135	225	7	9	—	—	600	1200	1500	4800	standard

Note : 1. Maximum is recommended to account for the furnish variations.

TABLE 4 Productivity Ratios for Overall Plant

Group	Mandays per T of finished paper		Electricity per T of finished paper		Thermal Energy (steam equv) per T of finished paper		Water per T of finished paper		Caustics per T of finished paper		Sizing chemicals in terms of Rosin (kg) per T of finished paper		Alum. (Kg) per T of finished paper		Chlorine per T of finished paper		Lime (kg)/ T of finished paper	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Observed																		
Unbleached	20	35	800	1310	4	8	93	205	0.19	0.23	4.2	17.1	41.6	90.0	—	—	—	—
Bleached	20	35	1250	1800	7	10	180	320	—	—	7.9	19.2	72	140.0	0.13	0.25	75	170
Recommended																		
Unbleached	20		800*	1300*	4	6	75	200	0.17	0.22	4.0	12.0	40†	70†	—	—	—	—
Bleached	20		1000*	1500*	7	9	150	250	0.30	0.35	7.0	12.0	40†	70†	0.13	—	—	—

* Varies depending upon the furnish (output & input).

† Depends on PH of water and recycling of water.

Note : The maximum are recommended to account for the furnish variations.

be measured, in this context, as a ratio of total man-days to the total finished output at the company level. When the respondents were grouped based on the type of paper produced viz. bleached and unbleached, the ratios were in the range of 25 to 35. The reasonable value which these mills could achieve would be about 20.

A major part of the manpower was found to be deployed in raw material handling at the yard and in feeding in the case of almost all the mills. The observed value of mandays deployed at the yard and at the feeding stage per tonne of raw material received and raw material cut respectively is found to be in the range of 0.20 to 3.70 and 0.60 to 2.70 respectively. This extent of manual operation further gives rise to a high degree of raw material losses in handing which lies in the range of 3% to 9%. It is felt that partial mechanisation could be carried out at the raw material handling, feeding and cleaning stages to conserve the material resources. It is also felt that corresponding manpower fixation at the workforce level (direct and indirect and the staff level) be carried out to arrive at the requirements in tune with the level of operations in vague. It is also recommended that the units may evolve/adopt standard plant lay out practices so that multistage handling of materials is avoided on the one hand, and reclaiming methods could be adopted on the other, through which the net raw material losses may be reduced to about 3—4%.

Cooking Chemical Productivity

The most important chemical used towards production of pulp in chemical pulping is the caustic soda. The quantity of caustic consumption is governed by the type of end product and the extent of agricultural residue used. The caustic consumption per tonne of paper produced for these groups of mills is found to vary from 0.19 tonnes to 0.23 tonnes. It is suggested that in the light of rapid escalation in caustic price, the mills in the long run may consider retrofitting their pulp mills with vapour phase cooking technology so as to further improve on the specific caustic consumption ratio. Further, this helps in reducing the quantum of black liquor produced, directly leading to improvements in the associated effluent characterestics.

It is also suggested that the units may consider the option of premixing the caustics with the rawmaterial prior to feeding them into the digesters so as to improve the specific consumption ratio.

Loading & Filling Chemicals productivity

The loading and filling chemicals requirement is governed by the end products and the raw material mix. However, the usage of loading and filling chemicals do not affect the economics unfavourably and hence is not examined in detail.

Bleaching Chemicals Productivity

The consumption of bleaching chemicals viz. chlorine and lime, is found to be in the range of 0.13 to 0.25 T/T and 75 to 170 kg/T of paper produced respectively. The bleaching chemicals consumption again is governed by the output furnish and usage of bleached pulp. This is not, therefore, examined in detail.

Energy Productivity

The most important indicator to be monitored and controlled in a paper plant is the energy productivity which could be measured in terms of thermal energy per tonne of production and electrical energy per tonne of production for analysis. In the present study, specific electrical energy consumption was calculated as Kwh per tonne of paper produced. The specific thermal energy was calculated as equivalent tonnes of steam per tonne of paper produced using an evaporation ratio norm of 4.8 T of steam per tonne of coal. This ratio for the group of respondents is found to vary in the range of 4 to 10 T of steam/T and 800 to 1800 KWH/T.

The energy consumption in a paper mill depends on factors like the process employed at different stages, output furnish, raw material furnish, potential ability to recover waste heat in the units etc. In order to make an analysis, plants were grouped on the basis of the type of output produced viz. bleached and unbleached. It was observed during the field visits that most of the units do not even recover the condensate from the paper machine dryers efficiently.

Thus, as a top priority, the units may adopt efficient techniques to recover the condensate from the paper machine. It is also suggested that concerted efforts need to be undertaken to adopt suitable waste heat recovery system and also to conduct detailed energy audits so as to further improve upon the specific thermal and electrical energy consumption.

Water Consumption

The most vital input in production of paper is water. The water consumption per T of paper produced was found in the range of 93 to 205 CUM in the mills predominantly producing unbleached paper and 180 to 320 CUM in the mills producing predominantly bleached varieties of paper. The water consumption for a typical agro-paper mill producing writing and printing paper in West Germany is reported to be in the range of 100 CUM per tonne. The large quantity of water intake not only costs money in terms of required pumping load to be handled but also in terms of the pollution load to be handled in the effluent treatment plant.

Most of the agro-paper mills of smaller capacity do not have fibre recovery systems, which restraints them from using the back water of the paper machine. It is suggested that proper fibre recovery system may be installed which not only helps in recovering the fibres but also in using the back water of the paper machine down the line. Also it is felt that the mills may initiate possible water conservation techniques through implementation of 'safe all' system for complete waste water circulation and other judicious attempts in reducing the present level of water consumption.

ANNEXURE I **Steering Committee Members**

1. Dr. M.C. Bansal
   Institute of Paper Technology
2. Dr. A. Panda
   Central Pulp and Paper Research Institute
3. Dr. A.N. Rao
   Directorate General of Technical Development
4. Dr. N.J. Rao
   Institute of Paper Technology
5. Shri Ashok Goel
   Indian Agro Paper Mills Association
6. Dr. S.L. Keshwani
   Chemo Projects Desgin & Engineering (P) Limited
7. Shri Pramod Jain
   Shiva Paper Mills Limited
8. Shri D. Subba Rao
   Coastal Paper Mills Limited
9. Shri N.L. Todi
   Supreme Paper Mills Limited
10. Shri Badal Mittal
    Aurangabad Paper Mills Limited
11. Dr. G.K. Suri
    National Productivity Council
12. Shri B.K. Ghosh
    National Productivity Council

ANNEXURE II **Recommended Measurement Centres and Productivity Ratios**

Measurement Centre	Productivity Ratio	Unit of Measurement
Raw Material Handling, Preparation etc.	(i) Electricity per T of Raw material cut	KWH/T
	(ii) Mandays per T of Raw-material received in the yard	Mandays/T
	(iii) Mandays (feeding) per T of Raw material cut	Mandays/T
Short Fibre Digesting	(i) Caustic per T of pulp produced	T/T
	(ii) Steam per T of pulp produced	T/T
	(iii) Power per T of pulp produced	KWH/T
Long Fibre Digesting	(i) Caustic per T of pulp produced	T/T
	(ii) Steam per T of pulp produced	T/T
	(iii) Power per T of pulp produced	KWH/T
Washing and Screening	(i) Water per T of washed pulp (in AD bans)	M^3/T
Bleaching	(i) Chlorine per T of pulp bleached	T/T
	(ii) Lime per T of pulp bleached	T/T
Pulping (Inc. of Stock Preparation)	(i) Eiectricity per T of pulp refined	KWH/T
	(ii) Steam per T of pulp refined	T/T
Stock Preparation	(i) Sizing chemicals in terms of Rosin (kg) per T of pulp refined	Kg/T
	(ii) Alum (kg) per 1000 T of pulp refined	Kg/T
Paper Machine	(i) Steam per T of paper	T/T
	(ii) Water per T of Paper	M^3/T
	(iii) Power per T of Paper	KWH/T
	(iv) Condensate return per T of Steam used	M^3/T
	(v) Fibre loss	%
	(vi) Moisture at reel	%
	(vii) Pulp to paper ratio	%
Finishing House	(i) Cutting losses	%
Effluent Treatment	(i) Waste water per T of finished paper	M^3/T
	(ii) Effluent characteristics before treatment	
	(a) PH	Mg/lit
	(b) TSS	Mg/lit
	(c) BOK	Mg/lit
	(d) COD	Mg/lit
Overall Plant	(i) Total mandays per T of finished paper	Mandays/T
	(ii) Caustic per T of finished paper	T/T
	(iii) Sizing chemicals in terms of Rosin (kg) per T of finished paper	Kg/T
	(iv) Alum (kg) per T of finished paper	Kg/T
	(v) Chlorine per T of finished paper	T/T
	(vi) Lime kg/T of finished paper	Kg/T
	(vii) Thermal energy in equivalent steam T per T	T/T
	(viii) Water per T of finished paper	M^3/T
	(ix) Electriciiy per T of finished paper	KWH/T

ANNEXURE III **List of Respoondents**

Sl. No.	Name of the units	Capacity (TPD)
1.	Rahuri Pulp and Paper Mills	25
2.	Nizam Paper and Boards Mills Ltd.	20
3.	Zenith Papers (A unit of Zenith Ltd.)	50
4.	Pennar Paper Limited	15
5.	Amrit Paper (Div. of Amrit Banaspati Co. Ltd.)	30
6.	Rohit Pulp and Paper Mills Ltd.	22
7.	Coastal Papers Limited	33
8.	Pravara Sahakari Sakhar Karkhana (Paper Mill Division)	20
9.	Vamshadhara Paper Mills Limited	18
10.	Shree Datta Shetkari Sahakari Sakhar Karkhana Ltd. (Paper complex)	20
11.	Delta Paper Mills Limited	60
12.	Shreyans Paper Mills Limited	30
13.	Shiva Paper Mills Limited	30
14.	Madhya Bharat Papers Limited	50
15.	Babri Paper Mills Limited	12
16.	Nath Pulp and Paper Mills Limited	36
17.	Shamli Paper Mills Limited	10
18.	Aurangabad Paper Mills Limited	48
19.	Shree Bhawani Paper Mills Limited	33
20.	The Kopergaon Shakari Sakhar Karkhana Limited (Paper Mills Div.)	25
21.	UP Straw Limited	30
22.	Circar Paper Mills Limited	30
23.	Cheema Paper Mills Limited	15
24.	Coastal Chemicals Limited (Paper Division)	50

Towards Realistic Approaches to Management Consulting and Organisation Development

Why do we continue to do things the way we do in our organisations even when we know that they do not work ? Just to have three wellknown situations:

1. Despite the huge amount of planning and theoretical knowledge that goes into strategic business planning, reality disturbs more as a rule than as an exception in most well polished plans. Where was the real vision during the conception stage? Was planning based on budget necessities only or on wishful thinking? Were those planned in connection with reality? Still, we continue to use the same techniques and instruments of market research, computerised planning and so on.

2. Meetings drag on for hours without significant results; at the best, some form of agreement is reached on the surface. It is the informal circuit of personal contacts between some key managers which will make the deals later on, in the process, leaving many who took part in the decision making in the dark. But the latter will have to execute the decisions in practice. We, then, wonder why there is a lack of motivation, even sabotage?

3. Work executed is rarely up to standard, whether it concerns the starting and functioning of a new plant, the quality of products manufactured, or even the quality of a sales call attended. This, despite the fact that, instructions were clear and technical capabilities sufficient. And all rules and make-sure procedures to eliminate these problems, often, only result in more inventive ways of bypassing them. Still, we continue, as if nothing happened, with our approaches as before.

There is certainly no lack of information available for resolving these questions. Even more complex business-planning systems, computer-aided strategic planning, motivation-stimulating assessments and remuneration systems and, not to be forgotten, refined project-management and network planning schedules have become available. However, they have all one thing in common; they work to the extent that (like any calculation model) reality behaves as has been predicted by the variables in the system. The truth is, reality seldom does.

Some Consequences

Some of the consequences of the above mentioned approaches to organisational and management problems can be the following:

1. *An increasing communication distance* between those in boardrooms, managing largely on the basis of abstract notions, figures and plans, and the people out in the field, or on the shopfloor, dealing with day to day reality; with middle management facing an increas-

ingly difficult task of interconnecting top and bottom. As reality becomes more and more out of sight for the decisionmakers, the number of mistakes and incorrect decisions will grow rapidly.

For all concerned, this can lead to:

2. *Increasing lack of trust in one's abilities and vision* through an overall dependence on the external so-called objectlve instruments and recipes that seem ever so genius but fail to produce the desired results when tested in real life situations. This is because of the obvious fact that no two situations in life are ever the same; there are different people involved with different experiences, knowledge and attitudes, the organisation cultures are never the same and so on. But this obvious fact is hardly ever recognised and thought through to its full extent; if it has been, there would be less need for ever more sophisticated instruments. The goal would be to become one's own instrument by developing personal skills and abilities. To compensate for this lack of trust, refuge is often sought in dominant, seemingly self-assured behavior that in turn reinforces the lack of self-confidence of subordinates and colleagues.

Corporate culture, as a result of this mechanism, will be characterised by a:

3. *Defensive attitude* since the value of the applied instrument or planning technique is thought as beyond doubt, any discrepancy between the true result and the projected result must be accounted for by somebody. A lot of effort is spent in organisations to ensure this. The negative effects that such an attitude will have on organisational performance are obvious.

Thus, unless one can make a sound judgement on what to do in every single situation that occurs, based on factual observation and analysis, standardised or programmed approaches will mentally fail to produce the desired results.

Analogous Approach

Analogous to this approach of looking for tools outside ourselves, as individuals too we have the habit to often programme ourselves. We do this by means of imposing experiences from the past on present situations; often this is done in such a way that it becomes dogmatic; we tend to dislike the idea of taking a real look at the situation because what we see may cause us to judge our prefabricated solution as being inadequate. The strange thing is that once we start off in our working life, after school or university, we seem to forget that our experiences are the results of conscious learning processes, and that our knowledge, abilities and attitudes are only able to grow thanks to the fact that they are in constant motion.

And all learning-processes are characterized by the fact that the existing thought-patterns are changing, or better, qualitatively developing. For these processes to take place, it is essential that an inner judgement is continuously made on whether the old thoughts and notions, experiences and approaches provide adequate solutions in view of the new situation that presents itself.

When, for instance, continuously, severe quality problems occur in the manufacture of products, there is always the obvious quick solution: change some of the people, invent new rules and procedures or work harder on the suppliers. But often all that has been tried before in, one form or the other, do not work. When, therefore, yet another problem-solving technique is used, the decision to do so is based on the assumption that the limits of the existing thinking and acting framework should not be surpassed; the solution or the approach has to be found within the present framework of corporate do's and dont's, all within the organisational reference framework. In other words, learning from a situation and developing one's own abilities beyond the framework of the thinking done so far, is assumed to be unnecessary. It is our experience that in the majority of corporate cultures there is little tendency to see the work place as a learning-place. Yet, here lies the core

of many problems that organisations face today—problems such as why all instructions, instruments for control, tests and procedures do not prevent people from letting the same things do wrong over and over again.

So now we have to come back to our original question: why do we continue to do things in our organisation the way we do, even when they do not work?

We think that part of the answer has to do with a general fear to step beyond the boundaries of the thinking and acting that have been done so far. In other words, the existing ideas related to a specific situation often stem from the past, from experiences in comparable situations.

So an important question to really new-age management could be: has the past developed you to such an extent that you no longer see your suitcase full of experiences, knowledge and solutions as your most valuable assets? But sense that your really most valuable tool is your *ability to create in any new situation the ideas which are unique and perfectly adequate for the situation itself*; and that you are conscious of the fact that in order to reach this stage of professionalism your past experiences were all necessary, but at the same time must be abadoned when a new problem occurs to enable you to look at it and observe it without the projection of your experiences; if not, these projections will colour your observations, and re-shape reality in such a way that your familiar approach fits in. Thus, it is not the contents of your experiences that is important but the process of creating your ideas in the situation itself. And if you look back to your experiences, can you discover how this process took place, what were the conditions that made your idea-creating process at that time a successful one, or an unsuccessful one? The discovery of the laws governing this idea-creating process and the ability to apply them will be your greatest step in becoming your own instrument.

In looking at and making use of your experiences in this way you will put yourself in the process of rapid personal development and growth. Your abilities will increase and past experiences, knowledge and standardized approaches will not hamper you anymore to make the proper diagnosis and take the correct action.

As Albert Einstein once said : "The world we have made as a result of the level of thinking we have done so far, creates problems we cannot solve at the same level."

Now let's pose another question : are all problems in organisations of the same nature? And if not, what distinctions can be made, and why?

Important Questions

At NPI, Institute for Organisational Development, we see three categories of questions that organisations or parts of it can be confronted with, each asking for different abilities and skills to be developed and applied:

Preventive questions when processes and activities are running well. This is seldom because all factors contributing to this success are acknowledged, conscious and under control. Therefore, attention has to be paid to these processes in order to ensure that they will keep on running smoothly.

Problem solving questions : If a "problem" is defined as the deviation from an agreed standard, measures can be taken to correct the situation, to restore it to the original condition. This can be done only in those cases where it is possible to restore the original situation. But when people, their co-operation and interaction are concerned, situations can never be restored to the original because new constellations of people and individuals are continuously developing. Therefore, problem-solving questions only relate to situations where the human factor is not of much weight e.g. in technical, highly automated production systems, in financial systems and the like.

Questions of innovations, i.e. questions where existing structures, cultures, abilities and experiences are obviously inadequate. And thus, the most effective approach is to treat these questions not as a problem so as to put a solution to it; but to start working on developing the skills of the

people involved, individually as well as in groups, with or without the management, and creating conditions for individual and group development. And when as a result of such a process, totally new questions arise, we consider these the best proof that the previous level of thinking and acting, the abilities and disabilities of the past have been overcome and have developed to a further stage; that overall consciousness has increased.

And when we try to give an answer to the question mentioned at the beginning of this paper, it might be that the reason lies in our way of looking at, judging and approaching situations: we treat questions of innovation as though they were problem-solving questions. No doubt, this has to do with the fact that the methodology of physical sciences with all the material successes and important discoveries they have brought us, has also entered the field of social relations where other laws govern. If the assumption is true that people are static, programmable beings with behaviour that can be controlled, who do not develop and are not unique in all aspects, then the physical sciences will also have answers to problems in social sciences. But this, fortunately or unfortunately, is not true.

F.J.C.M. van Koolwijk
Nederlands Pedagogiseh Institute,
Valckenboschlaan 8
Zeist, the Nederlands.

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BOOK REVIEW

ALTERNATIVES IN INDUSTRIAL DEVELOPMENT: SUGARCANE PROCESSING IN INDIA, by H.H. de Haans, Sage Publications, New Delhi, 1988. pp. 177, Rs 165.

Many aspects of industrialisation in developing countries like India are coming in for searching enquiries, particularly in the light of the divergent experiences and conflicting theoretical positions. The question of alternative techniques adopted in industrial activities is one such area, providing a rich fare of theoretical issues, policy alternatives and empirical materials.

While posing the problem in the context of broader development goals and policy instruments, the emphasis is on alternatives in industrial technology, particularly owing to the simultaneous existence of a variety of methods of production which the author refers to as "co-existence of different modes of production" (p. 155)—an avoidable confusion since 'mode of production' is a term better known in a different sense.

The study is based on a detailed investigation, through primary and secondary data and field visits of the sugar industry in a limited geographical area. The study is presented against the backdrop of a crisp, issue-based survey of the theoretical and emperical work on the subject of choice among alternative technologies and the conflicts which arise in this process owing to multiple objectives. Using a social cost-benefit analysis and techniques of programming, the author examines the viability of Vaccum Pan Sulphitation process (VPS) used in large-sized modern sugar mills, the Open Pan Sulphitation process (OPS), an intermediate technology used in the medium-sized dispersed plants, Gur and non-sulphur Khandsari (GNSK) and the traditional gur-making technologies as alternative methods of processing sugarcane in Western Uttar Pradesh. The book provides a good descriptive account of these technologies and their organisational frameworks, a result of insights obtained from extensive field studies. The overall problems of the sugar industry and their relationship with the government also find, at places, a perceptive account. After describing the technologies and the socio-economic profile of the units making use of them, these technologies are evaluated on the basis of a social cost-benefit analysis.

Broadly, using Net Present Value (NPV) as the criteria for selection, both at the project and sectoral levels, the procedure followed is to make the estimates in terms of financial prices, economic prices and social prices. Apparently these tasks involve daunting methodological, data-availability, data handling and interpretation problems. One can easily find a number of snags, simplifications, adjustments, heroic assumptions and data gaps in any work of this kind. So long as one is cautious in interpreting the results, it would not be very fruitful to join issues with the author on such matters.

The results arrived at by the auther show that VPS is far superior to any other technology both at economic and social prices. The NPV of VPS at economic prices is so much larger than that of OPS, that, in terms of the Pareto-Hicks compensation rule, the losers from a re-allocation of sugarcane processing can be compensated "in principle". The author views the role of OPS (which is "likely to disappear" before long) as an instrument of rural development.

Given the high profitability of uncontrolled OPS, the author thinks that "an OPS plant might serve as an instrument for the upliftment of poverty-striken areas, suitable for cane-cultivation but not sufficiently iarge to supply a sugar mill" though, even this task is better served by a modern, large sugar mill. Even on account of equity, the author is unable to find support for his hypothesis that an intermediate technology like OPS would be a viable proposition. However, OPS is found superior to GNSK, though it cannot be preferred to gur-making, which is a subsidiary work for the small peasants and is eventually not a sweetening-agent but a food. The implications of recognising gur as a food and a wage-good are left unspecified.

These certainly are interesting and significant results. One may not be able to generalise them with respect to other industrial activities having a similar access to a wide spectrum of technologies. However, if these results are found credible enough, they have notable policy implications for the sugar policy and regional planning in Western U.P., both in the short and long-run. But a careful look at the theoretical foundations, methodologies, data-base, data interpretation, as well as the manner in which the problem is posed and analysed and the vorious adjustments and assumptions made tend to make one sceptical about both the validity and relevance of these results. Let us briefly state some of the problems one finds with the approach and conclusion of the present study.

The author has quite rightly adopted growth and equity (both relative and absolute) as objectives for guiding the choice of technology. He recognises that "growth of production alone is not sufficient to attain the employment targets". This view fails to recognise that growth of output may even be accompanied by a fall in output, particularly in the long-run. This is so when the growth of output is accompanied by greater concentration, non-growth of home market, change in product-mix in favour of capital-intensive products, increased use of imported inputs necessitating large external borrowing, ecological degradation and imbalances and increased damand for foreign consumption patterns and technologies. The experience of many Third World countries has made such apprehensions come dangerously true. Thus, what appears technically and allocatively efficient technologies may involve further underdevelopment and defeat the basic objective of industrialisation. Technical efficiency is geared to growth, while allocative efficiency is geared to existing market relations, distribution of income and pattern of demand. Technology choices and the satisfaction of these criteria may even mark a negative contribution to development as it is now generally understood. On the other hand, a technology which satisfies none of these conditions could still be an instrument of industrialisation geared to equity, use of available manpower, nautural resources and greater weight of merit goods. Morever, without satisfying these objectives attainment of sustainable and stable growth too may become problematic.

In general, the entire theoretical model in term of which various economic processes are worked out is that of private competitive market economy which is generally without imperfections except for some explicit mention of government controls and other imperfections. For example, it is maintained that new technology with lower unit costs will sell at a lower price; or higher profitability will generate a higher rate of investment which also will create more employment. These are indications of the inability to specify a model of the Indian econmy which is broadly operational in real life. In a work discussing various technologies, some of which pertain to certain segments of what is usually termed the unorganised or the informal sector, a model incorporating joint operation of the formal and the informal sectors is a basic pre-requisite for working out the project, sectoral and economy-wide implications of various technologies. Unfortunately neo-classical propositions are tacitly taken to be the reality on the ground, despite the empirical evidence collected by the author himself pointing in the other direction. This holds true even with respect to the VPS-using large mills, which overstate costs, delay payments to canegrowers and are enmeshed in the black economy no less than the OPS units

These difficulties reappear in the use of social cost-bensfit analysis (SCBA). For one thing, conversion of financial (i.e., market) prices into economic and

social prices apart from being highly imperfect and biased, does not go well with the basic character of SCBA. The SCBA identifies, quantifies, valuates and compares a much broader set of costs (in terms of forgone opportunites) and benefits (in terms of social objectives). Initial listing in terms of market cash flows builds in biases even with respect to non-externalities and quantifiables, let alone externalities, intangibles, qualitative and indirect factors. The macro and the regional parameters needed for SCBA in a particular region are absent from the persent exercise. The absence of such a framework leads to a neglect of crucial issues and vitiates the evaluation of alternative technologies.

Certain other factors also put a question mark on the results obtained by the author. The evaluation in terms of SCBA here refers to *exisiting* units and not the new or proposed projects. This fact has critical relevance as also the fact that non-VPS, non-OPS technologies are largely adopted by the canegrowers themselves, leading to vertical integration and *diversified* peasant/rural economy. On the question of employment, reliance on compensation *a la* walfare economics seems to be pedantic. Generally, it does not seem to be realised that ineffective employment for the poor masses has a human and social urgency and socio-economic costs, and any marginal improvement in productivity, capability and, thereby, access to means of livelihood has to be adopted, without making the best the enemy of better. In the absence of a theoretical frame which incorporates such concerns, which the author is aware, the adopted procedure does not appear to incorporate many factors relevant for the evaluation.

In sum, the problems of industrialisation are rather complex, particularly for late industrialisers with a lop-sided, industrial structure, and in a highly heterogeneous economy with a low degree of mutuality among its components. In such societies small-scale industries are not to be viewed basically as a means of producing goods at competitive costs in accordance with the existing market signals. *Giving higher productivity to workers over their already realised low level of productivity*, making use of skills and natural resources in an ecologically sensible manner, creating greater propagation effects, producing the means for an improved standard of living over the existing one and achieving spatial dispersal consistent with the factors mentioned above, are the tasks which industrialisation has to achieve. Such tasks widen the entrepreneurial base and put a brake on the incessant processes of concentration. The procedures for evaluation of technologies have to transform these kinds of factors which cannot be derived from an explicit or implicit competitive market model into quantifiable criteria for evaluating alternatives. The present book, despite its deft use of conventional analytical techniques, does not come close to the real challenges of industrialisation as an instrument of development.

Kamal Nayan Kabra
Indian Institute of Public Administration
Indraprastha Estate
New Delhi-110002

MINERAL RESOURCE ASSESSMENT FOR NATIONAL PLANNING AND POLICY FORMULATION—a Report published by Asian Productivity Organization (APO) and East-West Centre's Resource Systems Institute, Tokyo, 1988.

This is a report of the study meeting organised by APO & RSI in Bandung, Indonesia in July 1986, in which papers by experts from USA and Japan were presented before representatives from China, Indonesia. Malaysia, Papua New Guinea, Thailand and Vietnam. Among others, representatives from ESCAP and RMRDC also participated. The publication contains four leading papers on resource assessment programmes, mine/prospect evaluation and financial techniques for evaluation of mineral projects followed by seven case histories covering six countries.

The main aim of the publication is to encourage mineral resources assessment programmes in developing countries. It recommends comprehensive geological assessments followed by programmes where necessary, for collection of required data and their analysis to

arrive at an inventory of mineral resources. The procedures are time consuming and capital intensive and therefore require due planning. Besides the early development of mineral resources is a key factor in economic progress, with the returns proportional to the promptness with which they are exploited.

The report lays special stress on the estimation of resource potential and the methodologies used. Even though the techniques of assessment of resource potential are still developing, the report strongly recommends an early application of these methodologies for developing countries. It suggests that most countries have realised the need to assess their mineral reserves and potential resources. The interest of developed nations such as USA and Japan and others with endowment of less mineral wealth is understandable. Their strategy is two-fold; firstly encouragement to the assessment of resources in the Third World and secondly, continuing programmes of mineral resource assessments in their own countries. The need to conserve anticipated mineral resources as well as the environment in their own countries has impelled these countries to take interest in the mineral resources assessment of the Third World countries.

This report brings out the fact that China and Indonesia are very well endowed in mineral resources. The potential of China, which is very large indeed, is almost untapped as yet. In the Indian context, there is need to follow closely the results of the programmes undertaken for the assessment of our resource potential, particularly in their disaggregated forms, and relate them to an economic sub-model. Interaction is needed with the RSI, particularly in the context of an assesssment of the results pertaining to mineral resources where considerable work seems to have been done. For India where major future mineral discoveries are likely to be in virgin fields where mining activity is unknown as yet, the developments in these methodologies have to be not only carefully watched but a whole programme of productive mineral resource assessment methodologies has to be launched.

One of the examples of application of productive assessment is the Alaska Mineral Resource Assessment Programme (AMRAP) of the U.S. Geological Survey, which for the most part is based on standard field and laboratory methods. Its contribution however is significant in that it has systematically integrated geological, geo-chemical and geo-physical studies of the areas of complex geology with no mineral shows while at the same time making use of a successful productive technique. Similarly, the case histories of Indonesia, Papua-New Guinea and China illustrate the application of the technique of unit regional value, a new analytical technique for assessing mineral potential. Although the technique results in an aggregated estimate, it has served the purpose of the planners for exploration and development decisions. In Japan, a research and development project on deep sea manganese nodules was started in 1981; the case study illustrates the uncertainties of mining methods and recovery, pollution and economic viability in deep sea projects. It also brings out the fact that the nodule and metal recovery rates and efficiencies must be considered in addition to the overall resource potential. These are important conclusions for our country where a polymetallic nodules programme has been launched in the Indian Ocean. Japan's example has also highlighted the need to integrate mineral resources development with the Government's regional development plan. Interestingly the case history on assessment of mineral resources and development in Japan has highlighted the fact that superior hardware technologies to obtain precise geological data are an important part of a precise assessment of mineral resources, the assessment methodologies which are being progressively developed being considered as software technologies. Attention has also been drawn to the need for an effective national policy and funding for environmental impact studies and development of technology to prevent environmental pollution caused by operating and closed mines. These are essential to maintain a balance in the efficient and economical exploitation of resources and environmental protection.

There is a whole chapter devoted to the financial evaluation techniques and their application to mineral projects in which various methods such as the internal rate of return, payback period, net present value and others have been discussed and explained.

All in all, it is a very useful reference volume for

all those involved in the planning and development of mineral resource-exploration both in the Government and in the industry.

J.D. Jethra
Addl. Adviser
(Industry & Minerals)
Planning Commission
New Delhi-110001

MARKETING ENVIRONMENT AND PRACTICES IN NEPAL, by Y.S. Verma and M.P. Dhal, Sterling Publishers, New Delhi, 1988, 176p, Rs. 150.

The book presents the proceedings of a Seminar-cum-Workshop organised by the Institute of Management, Nepal. The proceedings have been edited by the authors dividing them into four Sections. Sections I & II contain articles written by various authors giving an overview of the Nepalese Economic & Marketing Environment; Cultural & Social Environment; Political & Legal Environment & Technological Environment. The information and data presented in the book such as regional distribution of population age-wise distribution of population, sexwise distribution of population, family life cycle, literacy of population, religious values and attitudes, economic growth in Nepal, employment income and expenditure, consumer price index, import export trend etc. will help exporters from India as well as manufacturers from Nepal to make decisions on new products and designs the right strategy for marketing.

Section III of the book makes an interesting reading. The case studies of the following organisations of Nepal have been presented in the book.

1. Royal Nepal Airlines Corporation
2. Janakpur Cigarette Factory
3. Veergam Sugar Factory Ltd.
4. Agricultural Tool Factory Ltd.

The authors of the papers have presented the philosophy and marketing strategy of the above companies which are not only informative but can also serve as models for designing the strategy for one's own organisation.

Section IV deals with the summary of the analysis of marketing practices in RNAC. JCF, PSF & ATF which is by and large duplication of the papers presented in Section III. Overall the book will be of some use to the exporters to Nepal and will be of more use to those who are engaged in marketing activities in Nepal

J.K. Jain
Director (Marketing)
National Productivity Council
Nehru Place
New Delhi-110019

AGRICULTURAL RESEARCH SYSTEMS AND MANAGEMENT IN THE 21ST CENTURY, Edited by K.V. Raman, M.M. Anwar and Gadoginath, National Academy of Agricultural Research, Hyderabad, 1988, 212p, Rs. 150.

The volume contains the proceedings of a Seminar on Agricultural Research Systems and Management in the 21st Century organised by NAARM Alumni Association, National Academy of Agricultural Research Management, Hyderabad, incorporating 17 papers. The papers are arranged according to four themes viz. (i) projecting the future demand of food and fibre for the 21st Century; (ii) developing technological innovations to meet the challanges of the 21st Century; (iii) Reviewing the current agricultural research and educational systems in the country and (iv) developing appropriates national agricultural research systems, to meet the needs of the 21st century.

The papers presented for projecting the future demands for food and fibre certainly make an interesting reading. One of the papers has indicated that at the prevailing consumption pattern and nutritional levels, it should be possible to feed 1,400 million people by producing 550 million tonnes of foodgrains by the year 2050 A.D. However, to reach this level of production with the level of arable land declining from the persent 140 million hectares to less than 125 million hectares, productivity per unit of land may have to be raised by a multiple of four or more. Development and application of science and technology ensuring income gains to farmers; mechanisation; strengthening

of credit and marketing; processing and warehousing and transport & communication infrastructure are mentioned as some of the main issues for research for the next century.

Another point that has been emphasised is that the productivity per unit of irrigated water will have to be raised because total water drawals including in agriculture, industry and civic needs would be 3030 million litres constituting 72% of the total estimated runoff, which does not seem to be within the realm of feasibility.

The supply of and demand for animal products like milk, eggs, wool and meat have been projected. For 2.001 A.D. the production of milk and eggs is likely to be more than the demand for them. However, while the projections for the supply of wool have been provided the demand for wool has not been projected. Similarly, the damand for meat has been projected but no projections are available for the supply of meat. It has been pointed out that, presently, only two-thirds of the fodder and one-fourth of the concentrates required for providing adequate nutrients to the livestock population is available. The problem of competing demands for food from an increasing population and fodder and concentrates for animals and birds has not found any place in the papers presented.

Despite the growing importance of synthetic fibres in the textile industry, cotton will continue to be the source of fibre for the masses and the cotton crop will be grown not only for its fibre but also for its vast edible oil and by-product potential. One of the papers indicates that a target of 132.5 lakh bales of catton for 2001 A.D. for a population of 1000 million and 282 lakhs bales for a population of 1600 million by 2050 A.D. is possible, without any increase in total area, but with slight increase in the irrigated croped area. Looking at the developments in the advanced countries, the scope for reaching the targeted production of cotton for the 21st century seems to be bright.

The collection of papers reviewing the current Agricultural Research and Educational Systems in the country covers the details of agricultural research systems in India. These papars review the present position regarding manpower and investments in agricultural research. The details about the Indian Council of Aricultural Research and various bodies working under it can also be found in the collection of papers. It has been mentioned in one of the papers that every third position in the ICAR and every fourth position in the state research systems continued to be vacant. The paper dealing with the Agricultural University system details of why and how Agricultural Universities came to be established. The specific features of organisation, planning and implementation of the tripartite roles assigned to these Universities namely, manpower training, research and extension education have also been discussed.

Towards the end, papers relating to the development of an appropriate National Agricultural Research System to meet the needs of the 21st Century have been put together. One of papers indicates that agricultural research in developing countries receives very limited resources (0.5% of the agricultural income in 1980), less than a third of its share in the developed countires. It further mentions that the overall level of spending on research will have to be increased and a strong National Agricultural Research System will have to be evolved. In these papers the whole of the Research System has been reviewed and future needs highlighted. A couple of papers presented by American experts have also been included. One expert has emphasised the need for private sector research in plant breeding for producing improved variety of seeds.

S.S. Jain
Dy. Economic & Statistical Adviser
Directorate of Economics & Statistics
Ministry of Agriculture
(Govt. of India)
New Delhi-110001

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BOOKS IN BRIEF

Behavioural Economics

By Peter E. Earl. England, Gower Press, Two volumes, 1988, 964p, £110.

'Behavioural Economics' is a relatively new School of economic thought and can encompass a number of strands, such as 'new-institutional/transaction cost' economics, economic psychology and psychological economics, consumer behaviour and decision theory. The papers presented here reveal something of the development, philosophy and range of applicability of 'behavioural economics.

Biotechnology Revolution and the Third World

By IRS. New Delhi, Research and Information System for the Non-Aligned and Other Developing Countries, 1988, 451p, Rs 250.

The biotechnology revolution presents an immense challenge for developing countries and international organisations to take appropriate policy measures to harness the development potential of new technologies and to ward off their adverce effects. The eighteen contributions in this volume by distinguished experts critically examine the nature of these challenges and suggest policy imperatives. Part one highlights to potential of bio-technologies for developing countries in different areas. Part two deals with various issues of concern to the Third World arising from the emerging trends in global biotechnology industry. Part three proposes the policy options and the strategies for the international community.

A Concise Introduction to Engineering Economics

Peter Cassimates. Mass, Unwin Hyman Inc. Co., 1988.

The empahasis is on problem solving, evaluation of projects, capital budgeting and resource allocation. The current theory of economics and finance is also discussed. The book proceeds through compounding, discounting and economic equivalence to cash-flow analysis and inflation. The author also deals with risk analysis, capital rationing methods and the evaluation of public projects. Economic decision models are presented, including profitability analysis and lease or buy decisions.

Corrosion Atlas

By E.D.D. During, Netherland, Krachtwerktuigen Association of Industries and Organisation for Energy and Environment, 1988, 2Vols, 242p, $342.

It comprises two loose-leaf volumes: Volume 1 contains the case histories concerning carbon steels; Volume 2 contains those concering stainless steels and non-ferrous materials. The case histories are classified by material and sub-divided according to the system from which the corroded part originates. A separate phenomenon index, a glossary of terms, and a comprehensive bibliography are included in order to keep the information as up-to-date as possible.

Developing Countries in the Gatt Legal System

By Robert E. Hudac. England, Gower Press, 1988, 280p, £ 12.95.

There is a growing conflict over the role that developing countries should play in the international trading system. Developed countries are calling on developing countries to assume fuller participation in legal disciplines of the General Agreement on Tariffs and

Trade (GATT). Developing countries are resisting these demands on the ground that their less favourable economic status entitles them to continue using GATT-prohibited measures in aid of development. The author's study traces the evolution of the GATT's current legal policy towards developing countries, detailing the succession of greater and greater departures from GATT obligations authorized since 1947 in order to satisfy demands for 'special and differential treatment'.

Dynamics of Co-operative Administration

By B.B. Goel. New Delhi, Deep & Deep Publications, 1988, 370p, Rs. 225.

Cooperatives are the vital instrument of social and economic transformation in the gigantic national efforts all over the world. These are still in a blossoming stage and have rarely found commanding the heights of economy. It calls for building cooperative discipline, strengthening primaries, democratisation and professionalisation of management, blending of schematic project approach and technology with cooperative principles and practices. This book, divided into 15 chapters, makes an extensive study of the entire gamut of cooperative administration based on painstaking empirical research. Some of the topics discussed are cooperative administration, board of management, personnel administration, cooperative legislation, rural development and cooperatives, and various aspects of management.

Economic Develpoment Since Independence

By R.K. Sinha, Editor. New Delhi, Deep & Deep Publications, 1988, 438p, Rs. 300.

The present collection of essays and papers is a welcome addition to the existing literature because of the keen analysis and depth with which various topics have been covered. As the contributors happen to be men who have held and are holding senior positions in the country it is hoped that their suggestions will be given serious thought and consideration which they deserve. The collection has been published at an appropriate time when a mid-term review of the current Seventh Plan has just been completed, very serious thought is being given about the priorities in the Eighth Plan and a number of new ideas are being debated about planning, plan formulation and plan administration in the country.

Energy and Environmental Terms : A Glossary

By Peter Brackley, England, Gower Press, 1988, 200p, £ 18.95.

This glossary provides a layman hundreds of words, acronyms, agreements, organisations, chemical names etc. that crop up daily in discussion and argument about energy and environmental topics. It tries to make them understandable to all those who lack the detailed knowledge of the scientific disciplines and industries involved. It provides simple explanations of some complicated ideas, and easy conversions of many confusing units of measurement.

Food Policy in India : A Survey

By R.N. Chopra. New Delhi, Agricole Publishing Academy, 1988, 414p, Rs. 275.

This book is a text on the evolution of food policy in India from pre-Independence years to the present day. Written by the former Chairman of the Food Corporation of India, it provides an 'inside view' of the various phases of food policy in India to give a balanced perspective of the growth of food and agriculture during the last forty years. Ably supported by statistical data throughout the text, the book contains a separate section on statistical tables which have been brought together for the first time.

Handbook of Applied Thermal Design

By Eric C. Guyer, Editor, NY, McGraw-Hill Book Co. 1988, $ 75.

This book tells how to specify appropriate materials, choose heating and cooling equipments and determine the best temperature measurement devices to monitor thermal effects. Other topics include heat transfer fluids, structural materials in thermal design, electric

powered heating, and thermophysical properties of selected material.

Indian Economy : Planning and Changing Dimensions

By Radha Raman Singh. New Delhi, Deep & Deep Publications, 1988, 387p, Rs. 275.

The present volume brings together the outstanding studies of the author on planning and development. Agriculture, industry, public distribution system, rural and urban development, rural credit and institutional credit agencies are discussed in depth. An attempt is made to investigate the impact of planned development efforts on the socio-economic conditions of the country. The author gives an appraisal of the Five Year Plans in the field of growth and development and a comprehensive and critical account of the public distribution system in Indla. The concluding chapter focusses on the respective approach and strategies which may prove effective in making the planning exercises more fruitful and equitable for the Indian economy.

Indian Social and Economic Development 1988 : An Index to Literature

By Cendit. New Delhi, Sage Publications, 1988, 206p, Rs. 175.

This is a valuable reference book. Being the second volume in a series, it contains over 500 entries divided into six areas—Ecology, Human Resources, Women/Children, Income Generation, Empowerment and Debates. Each item provides bibliographic details and a brief description of the contents. In the context of marked increase in developmental activity in India and the lack of access to literature from other countries, this book will be welcomed by all as a valuable reference tool.

Management of Working Capital in Public Enterprises

By A.K. Mukherjee. Allahabad, Vohra Publishers & Distributors, 1988, 339p, Rs. 275.

Public enterprises as a world-wide phenomenon have come to stay. The number of units in the public sector is constantly increasing since India achieved Independence. This is in keeping with the public policy in a socialistic pattern of society. This book makes an effort to assess various aspects of working capital mangement in selected public enterprises. It tries to determine the quantum of working capital and its adequacy both technical and operational. Besides working capital leverage, financing both internal and external, the impact of the size of business on working capital, the impact of change in working capital over profitability and the diversion of working fund towards capital fund are assessed. Thus, the book provides a new opportunity for researchers and professionals to look into the field of working capital management from a fresh angle.

Management Philosophy and Style in Indian Industries Volume I

By G.L. Tayal. New Delhi, Deep & Deep Publications, 1988, 382p, Rs. 500 (Set of two volumes).

Management Philosophy and Style in Indian Industries Volume II

By G.L. Tayal. New Delhi, Deep & Deep Publications, 1988, 774p, Rs. 550 (Set of two volumes).

Business leaders in India face many issues in their business policies and practices. To the increasing interference from the Government in business affairs are to be added specific challenges from the corporate social environment. For most managers, the challenges of comprehending and managing the environmental forces has been quite a difficult task. On the other hand, a number of researchers in the past few decades have been fascinated by the personality profile, philosophy and the style of managers. This study attempts to identify the management styles of top executives in large business enterprises. It also examines the relationship between management styles and the background of higher level managers. In accordance with its objectives, the study has been able to identify certain important elements concerning the philosophy and styles of top management in larger sized Indian Private and Public Sector Companies. The study has explored some relationships between manage-

ment philosophy and management style. Finally an attempt has also been made to interpret and explain the nature of findings.

Organisational Behaviour

By Pardeep Sahni & K.K. Sharma. New Delhi, Deep & Deep Publications, 1988, 351p, Rs. 225.

There are a number of scholarly works available which have touched upon several facets of organisational behaviour. Most of these books are by foreign authors on their respective countries. This book contains an empirical exploration of some of the important facets of organisational bevhaiour. After analysing the theoretical dimensions of each facet in detail, an attempt has been made to verify its applicability in various pubilc and private sectors in India. The meaning of organisation, organisational behaviour, job design and goal setting, transactional analysis, communication, leader and leadership and other topics are discussed in detail. Researchers and students of business and public administration and social workers will find this book a useful addition to their collection.

Performance of Integrated Milk Co-operatives: (A Study of Selected Cooperative Dairies in Gujarat and Maharashtra)

By C.G. Ranade, D.P. Mathur, B. Rangarajan and V.K. Gupta. New Delhi, Concept Publishing House, 1988, 143p, Rs. 100.

The study tries to explore the hypothesis that the cooperatives as they develop backward, forward and horizontal integration are to able increase the income of their farmer members through rationalization of costs and through undertaking value addition functions. The findings of the study reveal that cooperative in milk commodity have played an important role in improving the incomes of their members from the milk operation substantially and have also helped small landless to undertake milk production as a primary occupation.

Population and Economic Growth in India

By A.M. Goryacheva. New Delhi, Agricole Publishing Academy, 1988, Rs. 150.

This book deals with the question of economic and demographic processes in India after independence. On the one hand, the author examines the impact of changes in Indian economy on demographic behaviour particularly fertility and mortality rates, age composition of population and its occupational structure. On the other hand, influence of population growth on the rates, scales, character and efficiency of economic growth is studied. It is an important book for economists, planners, policy-makers and sociologists.

Process Design for Reliable Operations

By Norman F. Lieberman, Houstan, Gulf Publishing Co., 1988, 2nd edition, $ 35.

This edition explores a wide range of retrofit projects and explains why they went awry. It also examines ways to avoid poor process designs caused by over-reliance on computer design technology. It offers techniques to enhance the operating integrity, efficiency and flexibility of trayed and packed columns.

Regional Development Banks and Industrialisation

By L.K. Bansal. New Delhi, Deep & Deep Publications, 1988, 352p, Rs. 250.

The volume attempts to capture systematically and analytically the financial precedures, policies and operations of development banks in the field of large and medium industries, specially for the states of Punjab and Haryana. The efficiency and efficacy of these institutions have also been empirically tested. The study also highlights their inadequacies and shortcomings in performing their basic role. It presents a wide canvas to cover all important issues which may prove valuable to teachers, research scholars and policy-makers for the critical analysis of the development banks.

Rural Industry and Rural Industrialisation

By Ajit Kumar Sinha. Jaipur, Pointer Publishers, 1988, 144p, Rs. 140, $28.

The plan strategies for development have often been based on imported models. States like Bihar have remained non-industrialised backward regions.

The need for a native model for development in tune with socio-economic structure has often been stressed. This book is an attempt to work out a model development path for our economy on the basis of a balanced inter-relation between development, industrialisation and rural industries. A micro-level study based on field work, this work reveals that inspite of planned development efforts, rural industries continue to be an insignificant and inefficient activity in the rural areas. Industrialisation efforts of the country has had little or no influence on them. The study, tries to fill the gap of inadequacy of knowledge that exists on various aspects of rural industrialisation and its role in regional and national development. The author hopes that the study will provide new insights for future action for rapid development and thereby help in realising the dream of a developed India at the dawn of 21st century.

Scientists and Organisations: Managing People

By A.S. Menon. Trivandrum, CBH Publication, 1989, 214p, Rs. 160.

This book is the outcome of an indepth research study of work environments in a large Indian Research and Development Organisation and its impact on employee satisfaction and Organisational productivity. It deals with the Human Resource Management in an R&D Organisation. Unlike in other Organisations, Human Resources are the vital of all resources, which determine the productivity in an R&D Organisation. The chapter on Intrinsic work motivation forms a new aspect of contribution to motivation literature and should attract the theoreticians as well. The Chapter on Some guidelines and Practical suggestions, gives some indepth findings of the research.

Some Aspects of Resource Utilization in Agriculture

By Paul V. Solomakhin, New Delhi, Agricole Publishing Academy, 1989, 105p, Rs. 80.

The present monograph represents an example of integrated approach to problems of rational utilization of main production resources in agriculture. It is an inter-disciplinary study of several agro-disciplines such as economics, agronomy, mathematics, physiology, animal nutrition and others. The monograph is addressed mostly to agricultural economists and scientists working in animal feeding and nutrition and technologists and animal breeders. It would be useful for the students of agricultural specialities as well.

Technology, Growth and Welfare in Indian Agriculture

By Gobinda C. Mandal. New Delhi, Agricole Publishing Academy, 1988, 161p, Rs. 125.

This book deals with the author's findings to provoke intensive thinking on the possibility of overcoming hurdles to rural development arising in three ways: (1) Failure of the signals of price-mechanism to indicate the path of investment because of the prevalence of a large non-monetized sector in the rural economy where inputs are self-supplied (2) Domination of farm-business by small-sized units failing to create effective demand for capital goods and (3) Failure of scientific research in the field of technology to be geared to the formation of agricultural capital goods according to the needs of the agricultural sector.

Technology Options and Economic Policy for Dryland Agriculture: Potential and Challenge

By N.S. Jodha. New Delhi, Concept Publishing House, 1989, 365p, Rs. 250.

To review the current status of dryfarming technology and the support system it requires, a workshop was organised jointly by ISAE/ICRISAT/AICRPDA at ICRISAT Centre, Hyderabad in 1983. This publication brings together a selection of papers presented at the Workshop focussing on the main problems relating to dryland agricultural and the technological options that can alleviate them.

UNESCO and Social Sciences: Retrospect and Prospect

By S.P. Agrawal and J.C. Aggarwal. New Delhi, Concept Publishing Co., 1988, 366p, Rs. 250.

This book traces the history of UNESCO and examines its setup and constitution as well as its

objectives and its activities in the field of social sciences. The study also takes a close look into the interaction between UNESCO and India in different fields. The select list of UNESCO documents and publications on social sciences further enhances the utility of the book. The book provides an insight into the working of UNESCO and has sufficient reference material for use by students, teachers, research workers, social scientists, policy makers and administrators.

Union Management Relations in Banks

By R.K. Kothari. Jaipur, Pointer Publishers, 1988, 180p, Rs. 170.

The banking industry plays a significant role in the all-round development of a country. Trade Unions in the banking industry are in a very strong position and have tremendous bargaining power due to their well organised movement. The present work analyses union-management relations in the banks in Rajasthan. For this purpose two banks, one from the public sector and the other from the private sector have been chosen. Both these banks have more than 70 percent of their branches in Rajasthan with central offices in Jaipur. The study deals with the genesis, growth and the present situation of the trade union movement in the banking industry in India and throws new light on issues such as personnel policies, pay-scales, overtime and mechanisation and computerisation. Trade Union leaders, bank employers and policy-makers as well as research scholars would find this book interesting in their field.

Working Capital Management

By S.C. Bordia. Jaipur, Pointer Publishers, 1988, 261p, Rs. 240.

The book contains a comprehensive treatment of some important aspects of working of capital management. The book introduces the fundamental concepts of working capital and emphasises the role of the finance manager in working capital management. Various components of working capital such as inventory, receivables and cash are treated in depth. The pattern of financing working capital is also discussed in detail. The book focuses on the statistical techniques apart from financial management techniques which can be used for analysis of the working capital. Finally, it also offers suggestions for improving working capital management in order to enable a a firm to reduce its dependence on borrowed funds.

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S.N. Vig
Documentation Officer
National Productivity Council
New Delhi

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Compiled by:

U.A. Kunhumoideen &
S. Karunesh
Centre for Management Studies
Indian Institute of Technology
New Delhi-110016

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