Benchmarking: Principles, Typology & Applications in India

S.N. Nandi

The strength to compete, once developed, may not last long as competitors will soon develop such strengths with them. There is thus a need for continuous augmentation of such strengths by such magnitude that will be significantly more than the competitors achievements. This is the purpose for which western management have today recognized the need for an approach called 'Benchmarking' which has been found to be a very effective structured method to develop continuously the requisite strengths to compete, argues the author.

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Introduction

With the ongoing economic liberalization most of the Indian organizations are facing severe competition in their businesses. Many firms have been found to react in a limited manner. Corporate level measures—breaking total activity into many smaller businesses, developing collaborative arrangements with foreign firms and diversifying into different business areas of future importance, etc. — have been found to be the common response to face the rising competition. Such are responses are often necessary but may not be sufficient to attract new customers or even to retain existing ones. Customers will patronize over a time those products and services that will give them greater benefits. Many well known strategists (Porter, 1990) recognize that it is an individual business entity operating in a specific industry/market that competes. It is now widely accepted that it is at that level where competitive advantages are to be built in. Many of the domestic firms do not appear to have been paying sufficient attention towards developing such intensive power within their businesses. Over time, they would have to give more emphasis to business level strategy, products and services because it is only through these that customers could be attracted in.

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This is the purpose for which western management have today recognized the need for an approach called 'Benchmarking' which has been found to be a very effective structured method to develop continuously the requisite strengths to compete.

In most of the developing countries like India, almost all the industries untill recently, have a few number of products and services which differ markedly in their utilitarian characterstics. Customers had limited choices and therefore had been buying products, depending mainly upon their availability in accessible markets. Marketing muscles often attempt to generate quite superficial differentiation among products over those offered by various competing firms. However, such a situation is unlikely to be sustainable with increasing competition from foreign goods and services. In such a situation, competing firms have to continuously keep on improving various features of their products and services. The benchmarking approach not only provides a comparative profile but will also help the management team to identify generating innovative products and services.

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As a sequel to building up competitiveness, many of the Indian firms have been upgrading core technologies of their businesses but there are many other work practices to support the core technologies, which are too inefficient, resulting in sub-utilization of the core technologies themselves. Many of these supportive processes, whether technical or administrative, have been in practice for a long time. These have been designed based on age-old management principles of extensive fragmentation, divide and rule, checks-and-balances, etc. There is, therefore, considerable scope for improvement of such processes. An organization without efficient and effective operating and management infrastructure could not build up competitive advantage even when it has a state-of-the-art core technology and an excellent brand image. In fact, it is for this reason that there is emphasis on continuous process improvement under Total Quality Management (TQM). Such process improvement not only is time consuming but also require management to create appropriate cultural environment. It also requires that every employee changes their mindset to evolve better processes. Benchmarking approach has been found to be effective not only in providing new ideas for changes but also helps in building up appropriate commitment for change.

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Benchmarking as an approach for improvement helps build-up competitive advantages with businesses in a developing country like ours. This article, after explaining some of the salient features of the technique, also demonstrates applications of its different types in developing countries like India. Applications will be cited based on the experiences of the author and his colleagues in the National Productivity Council (NPC).

Principles of Benchmarking

The term 'Benchmarking' gives different meanings to different persons. Infact, dictionary definition says "a standard against which something can be measured. A survey mark of previously determined position used as a reference point." Though this is not entirely wrong, it misses an important aspect viz. learning.

The term has been originally coined by Xerox Corporation, U.S.A to mean "the continuous process of measuring our products, services, and practices against our toughest competitors or those companies known as leaders" (Camp, 1989). This definition also emphasizes the analytical part of the work-measurement and comparison. But one of the subsidiaries of Xerox-Rank Xerox, U.K. has looked at it some what differently. It views the technique as "a continuous systematic process of evaluating companies recognised as industry leaders, to determine business and work processes that represent best practices and establish national performance goals" (Eross & Iqbal, 1995). In operational terms, this is frequently condensed to "the search for industry best practices that lead to superior performance" (Camp, 1989). By "best practices" is meant here the methods and procedures used in work processes that best meet customer requirements. Benchmarking is then not simply about what we want to achieve—the benchmarks or the measurements of best performance—but also how they are achieved i.e. processes in action. This has been very

succinctly noted by Spendolini (1992) as "Find and implement best practices for high performance process that fully satisfy customer needs." In fact, Cook (1995) has very clearly defined benchmarking as "the process of identifying, understanding and adapting outstanding practices from within the same organisation or from other businesses to help improve performance". Thus, benchmarking is an ongoing task, at all levels of business of finding and implementing world best practices in the key things that are done to deliver customer satisfaction.

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On deeper reflection on all of the above mentioned definitions, it could be visualized that the benchmarking process consists of the following three elements or components.

(i) *Analysis*: breaking down an issue into components

(ii) *Comparison*: Component-by-Component comparison to find gaps or differences

(iii) *Synthesis*: Recombination of components with ideas stimulated from the differences.

An effort which does not include all the three above components should not be labelled as 'Benchmarking'. And it is for this reason that all kinds of comparisons or surveys could not be considered as benchmarking. Because of the obsession with analytical thinking and the sharp demarcation between thinkers and doers, prevalent in many societies, it is sometimes difficult to visualize the full significance of a benchmarking process.

The original concept of benchmarking had been in practice in India about 3000 years ago. The dominant method of learning which was known then to people, used to be watching the actions of leaders. Foot prints of wisemen are what common people are told to follow. Lord Krishna, according to Hindu philosophy, is believed to have taken various reincarnations only to demonstrate how an ideal leader should behave under different situations. Lord Krishna is, therefore, believed to be universal benchmark. Such principles of learning got subsequently spread to countries far away from India like Japan, for example, and transformed into a practical method of application in an industrial context. Japan calls it 'Dantatsu', a method of choosing the best of the best. Subsequently, a US organisation, faced with severe competition from Japanese firms, made use of this principle to develop a structured method of adaptive innovation and termed it as 'benchmarking'.

Benchmarking methodology when used with all its three elements has a sound psychological rationale behind its working. "Analysis' stage prepares the benchmarking group to form a common understanding and develop focused attention to a given issue. At 'comparison' stage, first, a sense of deprivation is generated with the revealed gap in performance and thus the individual's mind is activated to look around for ideas to overcome the anxiety developed out of a gap revelation. 'Synthesis' stage creates a new situation out of ideas directly borrowed or those sparked off out of observations. The benchmarking group is thus, highly energized to see its creation taking a shape in reality and thus contributes formally or informally to implementation. Benchmarking thus, is a true innovative adaptation. Many psychologists call it as a 'vicarious learning method'.

Looking from the user's side, such adapatative innovations are faster and productive than learning during working or learning from the fundamentals. Chew and others (1991) identified four primary ways in which an organisation learns:

1. Vicarious learning or Benchmarking
2. Simulation: learning through artificial models.
3. Prototyping: Learning through pilot applications.
4. On-line learning: learning during operations.

This study showed that there was a clear hierarchy existing among the four methods of learning as shown in Fig. 1. As we move from vicarious learning towards on-line learning, information accuracy increases, no doubt, but cost of learning increases too. Thus benchmarking/vicarious learning provides the fastest approach to learning and exposes the organisation to outside views and experiences.

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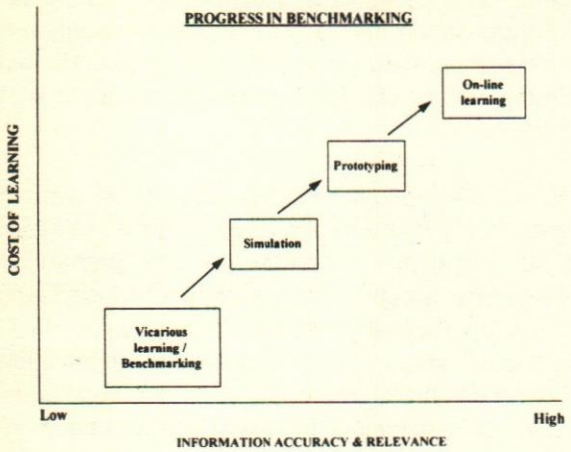

Fig. 1. Progress in Bench Marking

Types of Benchmarking

Since benchmarking is essentially learning from comparison with others, it is categorised in to different types depending upon either objects being compared or the units with which comparison is made. Based on the objects, benchmarking has been classified into 4 categories:

1. Product Benchmarking
2. Performance Benchmarking
3. Process Benchmarking
4. Strategic Benchmarking

Product Benchmarking

This is also alternatively termed as 'Customer Satisfaction Benchmarking' or 'Customer Value Profiling'. This refers to both engineering or qualitative comparison of products and services among competing offerings. Many of the manufacturing organizations have been implementing several kinds of reverse engineering to benchmark various features of their products. Recently several organizations especially in service sector showed concern in comparing their services with others. Product benchmarking also could help in identifying activities where improvement could be done. Product benchmarking quite often leads to redesign of existing products and services.

Product-Benchmarking involves comparison of different features and attributes of competing products and services either through engineering analysis or through analysis of perception of customers. The method normally known as reverse engineering is basically technical; engineering based approach comprising tear-down and evaluation of technical product characteristics. Most of the consumer goods and capital equipment manufacturing firms have been, one or the other way, doing reverse engineering to finalize product specifications. Some of the Indian firms also carried out value analysis in conjunction with reverse engineering. Value analysis facilitates searching for cost-effective alternatives for the chosen components or sub-assemblies, specification of which are found out through a comparison process. Engineering department equipped with tools of value engineering can develop suitable product specifications which are comparable, if not better, to competitive offerings.

Comparison of customer-perceived-quality assumed great significance during the end of 70's when it was revealed to be the most important factor driving market share in competitive economic conditions. The later observation was made based on the PIMS (Profit Impact of Market Strategy) detabase containing relevant information of about 3000 business units. It was observed that customers make their judgement relative to value i.e. quality and price. The relative perceived quality is from the customer's perspective, with respect to alternative competitive offerings in the market. PIMS observations on relationship between market share and relevant perceived quality shows that profitability with the same market share is more when relative perceived quality is higher (Table 1) (Buzzell & Bradly, 1987). Product benchmarking involving comparison of customer-perceived-quality could help a company to plan right positioning of its products and services.

Table 1: Profitability—Market Share and Quality

RELATIVE MARKET SHARE		Low	Average	High
	High	21%	27%	38%
	Equal	14%	20%	29%
	Low	7%	13%	20%

RELATIVE PERCEIVED QUALITY

It may be noted that there is a strong linkage between customer satisfaction and product design as found out by a Japanese scientist—Noriaki Kano. Kano's model indicates that companies exhibit 3 types of performance as they design their products for customers (Watsan, 1993) as represented by the 3 curves in Fig. 2 innovative performance, competitive performance and basic performance. Product benchmarking could help a company to identify basic performance as well as other features present in a product offered by a specific firm to increase customer satisfaction. The technique could also help identifying

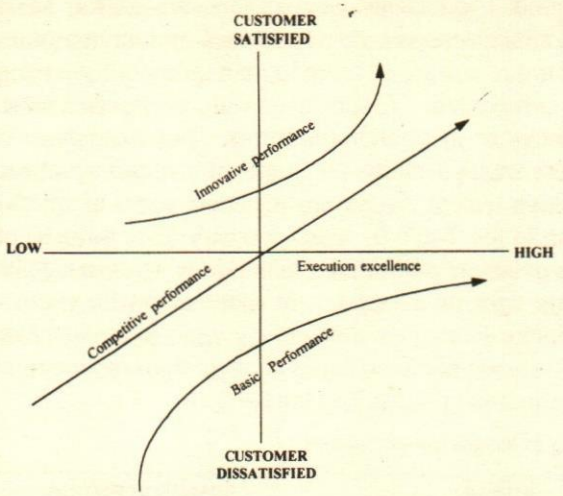

Fig. 2. Customer Satisfaction and Execution Excellence

any innovative features which have been included in the competing offerings.

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A famous example for product benchmarking has been found to be the one used by Ford Company during the development of their "Taurus" model of automobile. Ford learned that competitive product analysis can provide perspective and guidance on critical design and development issues.

In India, no firm is known to have used product benchmarking by comparing customer-perceived-quality. In fact, the author and his colleagues in NPC have used such benchmarking in a limited number of product and service businesses. The method developed has been found to be quite feasible even when Indian farmers with low education level are customers. It can be forseen that the use of such benchmarking will become popular with increasing competition.

By such benchmarking, one can easily identify critical attributes of products and services, not delivered to customers better than competitors, resulting in loss of market share. A matrix which is quite often used as a part of product benchmarking is given in Fig. 3. The matrix

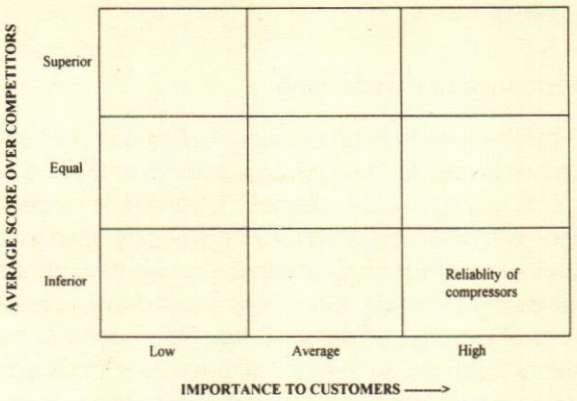

Fig. 3. Customer-Perceived-Quality Score against Importance

plots importance to customers on the X-axis and relative perceived quality score on a specific feature along the Y-axis. All the features are mapped on this matrix table. Individual position of an attribute in the map shows what kind of action is necessary for further improvement. For example, a feature like reliability of a compressor in a particular model of domestic refrigerator has been shown in the bottom right side of the matrix table. It indicates that this is a very important requirement from the customers. But the product as provided by the firm in question has been perceived to be equipped with a lower reliability of the compressor. Therefore, this aspect should be immediately taken up by the engineering department to investigate and improve.

Products and services from many Indian firms are of much lower perceived quality compared to the world class offerings.

Products and services from many Indian firms are of much lower perceived quality compared to the world class offerings. The gap is very high. Under this situation, one can easily perceive use of product benchmarking to identify immediate priority areas for improvement. This should be done on a continuous basis so that all the important attributes as sought by the customers are supplied thereby increasing the relative customer-perceived-quality and, in turn, increasing market share.

Though some of the marketing departments of Indian firms have been doing some forms of product perception analysis, many such analysis fall short of requirements as mentioned above. Further, it has been found that product benchmarking should be done by an inter-disciplinary

group instead of marketing departments alone, to provide maximum benefits.

Performance Benchmarking

Performance benchmarking refers to comparison of indicators related to a business as a whole or to the group of critical activities or processes. Business level performance benchmarking which was previously used under the banner of 'Interfirm Comparison' done through a set of well defined financial ratios, has again drawn attention of world class organizations. It has been found to be a very important tool to identify different functional areas where scope for improvement is greater. However, such business level comparison now includes many performance issues like innovativeness of the firm, customer satisfaction from the product and services delivered by the firm etc. Performance benchmarking at process/functional levels includes comparison of process indicators in terms of those issues which are critical to the implementation of a business strategy. These indicators relate to resource efficiency, resource allocation and many other issues which are relevant for the processes. Performance benchmarking is an important technique to secure external feedbacks to the concerned persons involved in the processes or in any of the constituent activities. Though improvement is implicit in both kinds by performance benchmarking, there is no explicit attempt to design new courses of action as a part of performance benchmarking.

Alternatively known as 'Result Benchmarking' or 'Benchmark Studies', the technique often includes business or process outcomes. Performance benchmarking is also termed as 'industry benchmarking' as participants of such a study belong often to a single industry. For this kind of benchmarking, all kinds of system performance variables like efficiency, effectiveness, productivity, quality, quality of worklife, flexibility, innovativeness and profitability could be measured and compared either for a whole business or for any of the constituent functions or processes (Nandi, 1993). Criticality in a business context decides which variables are relevant and of common interest to all the participating organisations in a performance benchmarking study.

Performance benchmarking which was used to be known earlier as 'Interfirm Comparison' has been in practice in India since 1960's. In some of the industries like Textiles, Fertilizers etc, performance benchmarks were in vogue. However, such comparisons included mostly financial ratios at aggregate levels and were often used for management control purposes. Performance benchmarking which has been recently promoted by the National Productivity Council includes all the strategic and critical issues both at business and functional levels that are of current concern to managements of participating companies. These issues are expressed either in financial or in operational terms. For example, in two recent studies made for sugar and pharmaceutical industries typical issues are included some of which are given in the Table 2. Each industry does have different sets of issues and related activities which are significant in the light of conditions of external environment and business strategies pursued by various firms. Appendix 1 shows some selected findings from recent industry benchmarking studies by the NPC.

Table 2: Critical Issues Covered

SUGAR	PHARMACEUTICAL
Profitability	Profitability
Asset Utilization	Asset Utilization
Product Efficiency	Downtime Analysis
Manpower Structure	Quality Performance
Sugarcane Efficiency	Marketing Performance
Energy Consumption	Production Innovation
	Human Resource Development

It is also necessary that measurement and comparison are made at tactical levels i.e. functional or process levels to find out the efficacy of different work practices and enablers used for carrying out such functions. For example, marketing department of a pharmaceutical unit should be concerned about:

(i) Deployment of medical representives
(ii) Productivity of marketing employees.
(iii) Division of effort between rural and urban markets
(iv) Training efforts for marketing employees

Some observations that could be made from table 3 are:

Table 3: Selected Areas for a Marketing Function

Sl. No.		High	Average	Low
1	No. of medical representatives for			
	100 chemists in urban	2.0	0.8	0.0
	100 doctors in urban	7.3	1.1	0.1
2	No. of medical representatives for			
	100 chemists in rural	4.0	1.4	0.4
	100 doctors in rural	1.0	0.7	0.2
3	Training days spent for marketing employee	12.5	3.3	0.0
4	Sales per marketing employee (Rs in lakhs)	32.1	21.3	8.0

(i) Efforts are directed more on doctors in urban areas whereas chemists are the preferred targets in rural areas.

(ii) On an average, one medical representative handles about 100 chemists or doctors. But more aggressive firms assign only about 14 doctors to be dealt with by a medical representative.

(iii) Though many of the firms provide about 3 days training, on an average, to each of their marketing employees, some firms provide about 2 weeks training to employees.

(iv) Marketing employee's productivity varies considerably from Rs 8.00 lakhs to Rs 32 lakhs per head and thus indicating considerable scope for improvement.

All the above mentioned observations, are important for the marketing head to plan and control his functional performances. Firms having productivity lower than the average may examine the possible sources for improvement.

Performance benchmarking may not explicitly identify exact improvement actions but it provides clues for identification of areas for improvement. In fact, improvement oriented management should have feedback discussions with a specially constituted group to find out scope for improvement after benchmarking results are obtained. Our experience show that Indian firms are yet to recognize such follow up actions though they do discuss informally.

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Process Benchmarking

Process Benchmarking refers to comparison of processes. A process is a set of sequential activities as performed on an item to increase its value to its customers. There are 3 major categories of processes—business process, support process and management process — depending upon nature of customers served. In a developed country where competition in product market has become fierce, business process benchmarking is fast becoming a standard management tool to maintain market share. Process benchmarking requires explicit conduct of all the 3 elements of benchmarking as mentioned earlier. In other words, it leads to the redesign of new processes which is to be implemented by the management.

It is now realised that it is not enough to know 'where' some company is but it is also essential to know 'how' and 'why' it has reached that stage. Process benchmarking provides us with a more effective and efficient process to be implemented. Process benchmarking is a complete method containing all the elements of ideal benchmarking process i.e. analysis, comparison and synthesis. It is, thus, an essential tool when an existing process is to be re-designed or re-engineered.

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There are many models available in the west regarding the methodology to carry out process benchmarking (Zairi & Leonard, 1994). But NPC team has evolved a 8-step process to suit Indian conditions. According to the NPC model, process benchmarking methodology consists of following steps:

Step 1: Identify the object or process to be redesigned or improved.

Step 2: Map and measure the existing process in its entirety in terms of relevant critical dimensions.

Step 3: Identify the partner where the same process is known to be between performed.

Step 4: Analyse the partner's process and find out the differences. This often requires collection of data through a checklist/questionnaire and/or physical visit to the partner's site.

Step 5: Redesign the process and put up the proposal for management approval.

Step 6: Implement the re-designed process.

Step 7: Monitor the performance of the redesigned process

Step 8: Recalibrate the process.

Benchmarking partner could belong to the same company or to the same industry. Major change in the process performance could be achieved when the partner

is drawn from an organisation whose products and services are quite dissimilar. However, in such benchmarking, acceptance by the company personnel could be an important factor.

Re-engineering experts recommend that a new process should be visualized from a scratch. However, the vision of a new process could be created not out of vacuum but only through some kind of references formed out of earlier experiences or of formal efforts put in during the study. Thus process re-engineering involves process benchmarking. Many organaisations today have several kinds of process improvement programmes, but often these efforts find limitation due to mind blockage of concerned people. Improvement through process benchmarking creates an environment where a better performing process witnessed in partner's organisation provides confidence and commitment to the change as well.

Thus process re-engineering involves process benchmarking.

Several studies have shown that almost all the leading American and European firms have gone for process benchmarking. In India, each process provides the scope as it has been established based on traditional management thinking. Business process linking the organisation directly with customers is a high priority area for benchmarking in a highly competitive situation. But quite often an improved business process like distribution, customer service provision, etc. could not be sustained over a long time if supportive processes are not equally efficient. So, support processes like procurement, manufacturing, machinery maintenance, etc. are required to be improved or reengineered before an efficient business process is fully functional to its optimum performance level. In the Indian circumstances, support processes should be priority areas for improvement. These also include management processes.

In one of the recent applications in a sugar mill in India, NPC team carried out process benchmarking on sugar cane procurement process. The existing process as shown in Fig. 4 is not only costly but also causes lower sugar recovery which is a critical success factor for sugar industry. After a thorough benchmarking study, a modified process has been found to be more simple and effective in quality control. Similarly, a large number of support processes that have been undertaken by NPC in

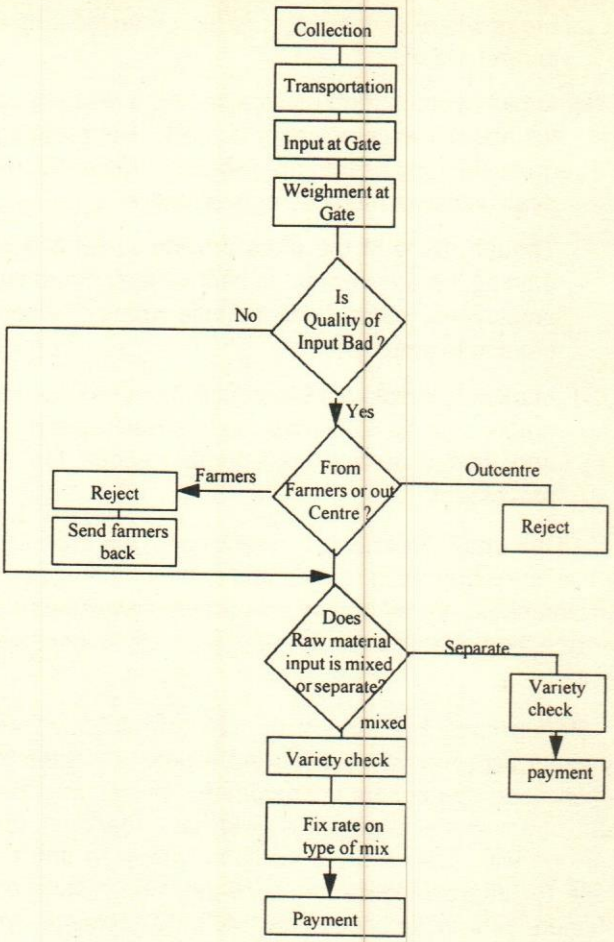

Fig. 4. Goods Receiving Existing Process

recent times have shown considerable scope for improvement. A management process—a customer satisfaction measurement methodology used by a leading Indian high tech. service company—has also been improved substantially by the application of process benchmarking. All the studies including those made on smaller work processes have been pointing out tremendous potential in application of process benchmarking in process improvement and innovation which are gradually getting recognized as real sources of competitive advantages.

Strategic Benchmarking

This refers to a study of corporate level or business level strategies perused by some of the selected companies reputed for reformulation of strategies or policies in recent times.

Many of the top managements have been constantly reviewing business portfolios of their companies.

Benchmarking corporate strategy of other successful companies could give some additional insights in their efforts. Business strategy refers to the direction in which a specific business is moving to ensure its attractiveness to customers and other stakeholders. A company could study business strategy of other successful businesses and identify those kinds of attractiveness and sources of building up such attractions. Such kind of strategic benchmarking will gain more and more significance as markets become competitive.

Although benchmarking of all the above types is being done by all organizations in informal way, formal benchmarking process requires organizations to have certain amount of management maturity and preparedness besides conducive market environment. It will be easier for a multi-divisional organization which has been working in a competitive market situation to make best use of strategic benchmarking. It is for the same reason that General Electric Company, U.S.A. could embark upon strategic benchmarking programme sometimes in 1970's. On realization of steady falling of market share in automobile sector, Ford Company, U.S.A. went for product benchmarking during later part of 1970's. With declining market share in the product market which was originally created by themselves, Xerox Corporation, U.S.A. introduced aggressively process benchmarking during the end of 70's. It was subsequently accepted by the then Chairman of Xerox Corporation that process benchmarking contributed a lot towards their turn around during 80's. Many of the process industries like refinery, pharmaceuticals, paper and pulp industries etc. have been carrying out both business level and process level benchmarking since 80's to learn impact of various functional management practices and tools and techniques in their respective industries.

Formal benchmarking process requires organizations to have certain amount of management maturity and preparedness besides conducive market environment.

All the above mentioned types of benchmarking have not been practised today to an equal extent in many of the countries. In fact, benchmarking itself is a developing tool. Product benchmarking especially through reverse engineering was the first which has been in use in many countries, that has been followed by performance benchmarking, process benchmarking and strategic benchmarking in that sequence as shown in Fig. No. 5.

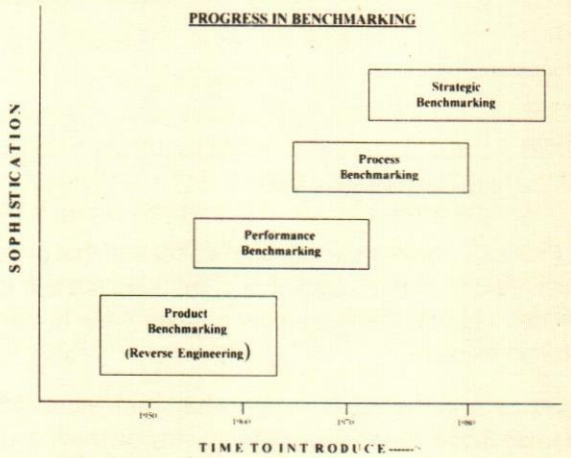

Fig. 5. Progress in Bench Marking

Based on the organizations against whom one is benchmarking, the methodology could again be categorised into 5 following types:-

(i) Internal Benchmarking—comparison between department, plants, subsidiaries etc. within the country or among the countries through collaborations.

(ii) Industry Benchmarking—comparison of performances among the organizations producing same class of products and services.

(iii) Competitive Benchmarking—Comparison of performance against direct competitors.

(iv) Best-in-class Benchmarking—Comparison with best practices prevalent in an organization irrespective of products and services.

(v) Relationship Benchmarking—Comparison is made with a company with which the benchmarking company already has a relationship like customer-supplier relations, joint venture arrangements etc.

All these bechmarking do not have necessarily same depth of process coverage. Performance benchmarking often carries out 'synthesis' only in an implicit manner. Often it is done among organizations belonging to same industry and thus could be alternatively categorised as industry benchmarking. Process benchmarking covers all the elements. It could be also done with all kinds of organizations. Inter-relationships between the different types of benchmarking and depth of process coverage are shown in Table 4.

Table 4: Linkage between Types of Benchmarking

Types of Benchmarking	Partner based categories					Process Depth		
	Internal	Industry	Competitor	Best-in-class	Relationship	Analysis	Comparison	Synthesis
Product	0	1	1	0	0	1	1	1
Performance	0	1	1	1	1	1	1	0
Process	1	1	1	1	1	1	1	1
Strategic	0	1	1	0	1	1	1	1

0-Not commonly involved
1-Often involved

From the above table one can easily see that process benchmarking and strategic benchmarking are the most developed benchmarking tools and thus have maximum utilitarian values.

Strategy is the ability to see where one wants to go, and to do those things necessary to stay on track and get there. Using this definition, strategy is both forward-looking (pro-active) and side-looking (re-active). Looking around and learning from others are thus important enablers for such strategy planning.

Strategic thinking in business is the matching of a business's opportunities with its resources in order to develop a direction. Such thinking is often reflected in a strategic plan that specifies goals and objectives and areas for resource allocation. Strategic benchmarking addresses all the pertient issues involved in above mentioned strategic planning.

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It is only during 90's that many of the Indian firms have been seriously pursuing strategic planning and carrying out competitor's analysis as a part of strategic planning. Such competitor's analysis is often qualitative in nature. An established quantitative method of strategic benchmarking has been developed with the application of PIMS (Profit Impact of Market Strategy) model containing up-to-date strategic information of 3000 business units. None of the Indian companies has been known to be using PIMS model at present.

Alternatively, strategic benchmarking could also be carried out by the application of process benchmarking techniques and methods. Many strategic consultants in the west have now observed that strategic benchmarking is similar, in application, to benchmarking of work processes, but it is different in scope. Some of the important issues which are now-a-days addressed are:

- —Building core competencies that will help in developing sustainable competitive advantages.
- —Selection of key business processes for improvement
- —Identification of areas for technology development
- —Developing an organisation that is capable of learning how to respond to the uncertain future.

Watson (1993) cites a valuable illustration on strategic benchmarking as made by the General Electric Company of U.S.A. In mid 1980's, when Jack Welch, a forward-thinking CEO of General Electric, wanted to position his company for the coming decade, he asked his strategic planning group to study how successful companies positioned themselves for continuous improvement. The General Electric benchmarking team conducted internal interviews of leading GE divisions and visited nine companies in the United States and Japan. They found that the companies that had set aggressive goals (such as halving the product development cycle time, or tripling the level of productivity) had high levels of sustained improvement. These leading companies viewed productivity as a combined issue of customer satisfaction and competitiveness. The benchmarking team also observed a common approach to change driven by top-down changes in the management system, the emphasis was on process rather than on programmes (or, in their words, input over output). The conclusion of the study provided an operating definition of a company that is a world-class competitor.

- Knows its processes better than its competitors about their processes;
- Knows the industry competitors better than its competitors know them;
- Knows its customers better than its competitors know their customers;
- Responds more rapidly to customer behavior than do competitors;

- Uses employees more effectively than do competitors;
- Competes for market share on a customer-by-customer basis

NPC had been involved in one of the challenging strategic benchmarking studies till now known in India. The study related to formulation of strategies and approaches to be adopted by a large Govt. owned Research and Technology Organisation (RTO) in making it more industry oriented. A team of scientists was formed to benchmark strategies and practices of RTO's in South and South East Asian countries. After getting acquainted with the benchmarking methodology as developed by NPC, the team identified the following critical issues and processes along with their details:

(i) Organisation structure (Mission, vision, funding, services mix etc.)

(ii) Marketing Capability

(iii) Project Management

(iv) Human Resource Development and Management

(v) Networking

After developing a comprehensive questionnaire, the team went round all the benchmarking partners and collected the relevant information. Some of the findings that the team had finally arrived at are as follows:

(i) Although attachment to government appears to be necessary, minimum interference from government in the form of less representation of government in the governing body and also a governing body constituted of target clients help avoid government bureaucracy on the one hand and sharpen focus on the clients' needs on the other.

(ii) More dependence on income from clients (or less dependence on routine grants from government) make RTOs more pro-active.

(iii) Departmentalisation based on technology help $ RTOs provide comprehensive services in a generic technology group. One of the RTO's success in electronics technology appears to be the best example.

(iv) Providing comprehensive service helps build up clients' confidence on RTO's capability.

(v) Comprehensive arrangement for marketing with separate budget, infrastructure and trained manpower helps to become proactive—an essential characteristics to become more client oriented.

(vi) Identification of types of services required by the target group of clients through taking inputs from researchers, board (which is heavily represented by target client group) and market research is the most comprehensive arrangement.

(vii) Devolved structure of authority and responsibility sharing help develop leadership and simplification of decision making process.

(viii) The Governing Body or Advisory Committee which directly and actively participate in RTOs activities, and which have substantial representation of clients helps proper identification of areas for future capability building.

(ix) Linkages with universities and other institutions through representations in faculty or getting young students to work in the RTO helps getting the academic inputs and also access to pool of expertise available in the market.

Close interaction with clients through representation in the RTO governing body and other means on the one hand, and through linkages with institutions of excellence on the other, brings the clients' need and RTO capability closer to each other.

This example clearly indicates that substantial benefits could accrue to Indian organisations if they undertake a structured method of strategic benchmarking.

Conclusion

In order to complete successfully in the emerging competitive market, an organisation should always be concerned with its business strategy, processes and products. It has to continuously review these aspects and improve and sometimes re-engineer them to bring in line its capabilities with market requirements. Benchmarking if carried out systemaitcally provides outside views and ideas and thus triggers off creativity of the group to strengthen its competitive capability.

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Benchmarking consists of analysis, comparison and synthesis. All these elements are present in all the types

of benchmarking except performance benchmarking. Omission of any of these elements does cause sub-utilization of potentiality. For example, use of database for the best practices does not generate enough commitments with the concerned personnel as a full scale study of benchmarking does. Several examples as given here demonstrate feasibility as well as usefulness of benchmarking. As India enters late in the global competitive arena, benchmarking may facilitte Indian organisations leapfrog to catch up and surpass others at the earliest possible.

Acknowledgement

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APPENDIX I
Industry Benchmarking Studies
— Some selected findings —

Machine Tool Manufacturers

10 of the major companies took part in the study. The following performance areas were identified for significant improvement potential and for subsequent process benchmarking:

	high	low
– delivery delay time per order	120 days	20 days
– WIP inventory holdings	90 days	20 days
– material costs	58%	34%
– labour costs	29%	8%
– productivity (value added per employee)	7 Lakhs	1 Lakh
– profitability	27%	6%

Electronic Components Testing Laboratories

In this service industry study 10 laboratories took part. Suggested performance areas for improvement were:

	high	low
– capacity utilization	79%	10%
– no of training courses conducted	67	12
– cycle time	102 days	30 days
– productivity (jobs per technician)	60	12
– Cost coverage	65%	23%

Sugar Industry

20 mills from 4 sugar growing areas took part in this first national benchmarking study. Suggested areas for improvement were:

	high	low
– productivity (tonnes per employee)	100 tonnes	20 tonnes
– energy consumption per tonne	360 kwh	140 kwh
– hours lost	30%	5%
– engineering and maintenance employees (per 100 tonnes of licensed capacity)	23	4
– profitability	31%	3%

Pharmaceutical Industry

20 firms have signed up for this benchmarking study, However, only 14 firms have provided the relevant data. Suggested areas for improvements were:

	high	low
– investments over last 5 years	25%	3%
– sales growth	30%	8%
– productivity (value added per employee) (Rs)	6.5 Lakhs	0.8 Lakhs
– domestic formulation sales per rep.	18 Lakhs	57 Lakhs
– general overheads	14%	2%
– profitability	3%	20%

□

Interfirm Comparisons: Conceptual & Application Problems

H.W. Palmer

In conducting interfirm comparisons, problems must be overcome concerning the purpose of the comparison, the selection of companies, the choice of ratios and the definitions of terms used. The article emphasises that comparisons must be carried out in a highly disciplined way, taking care of the quality of data and delivering reports to participants that show them exactly where their strengths and weaknesses lie. Special steps must be taken in international comparisons if they too are to be valid and useful. Some particular case studies are included to show IFC problems in practice.

H.W. Palmer is Director, The Centre for Interfirm Comparison.

Interfirm Comparison (IFC) has been in existence as a management technique for more than 35 years and during this time it has constantly evolved in order to keep pace with the ever-changing business environment. In 1959 when the Centre for Interfirm Comparison was set up in London to provide a service in this new technique it was seen mainly as a tool for the manufacturing industry. Whilst this is still extremely relevant, IFC has now been employed in an enormous range of other situations, both nationally and internationally — in the public sector, the private sector and the voluntary sector; in services, in professions and in discrete functions.

What is Interfirm Comparison?

Interfirm Comparison does not imply any comparisons that are carried out between firms or other organisations. Each day the financial press publishes a record of the movement of share prices; leading management journals regularly publish league tables showing which companies have performed best over the preceding year or quarter; specialist commercial companies compile lists of firms in the same industrial sector and then calculate performance ratios based on their most recent published accounts. All these involve some degree of comparison; but they are not what we call Interfirm Comparison.

A true interfirm comparison is a carefully organised activity in the course of which firms in the same industry or trade make certain of their data available on a voluntary and confidential basis to a specialist organisation which can analyse the data so as to show the management of the firm how its performance compares with that of similar enterprises and draws the management's attention to areas of comparative strengths and weaknesses. The purpose is to give the management an objective basis for judging the firm's progress and effectiveness

and for improving the firm's performance by concentrating action on areas where it is most needed and by setting targets which are based on results achieved by their peer group.

A true interfirm comparison is a carefully organised activity which firms in the same industry or trade make certain of their data available to a specialist organisation which can analyse the data as to how its performance compares with that of similar enterprises.

Interfirm comparisons are normally intended primarily for top management and therefore concentrate on an overall review of performance, but they are usually backed up by a wealth of information about every important aspect of the company's operations. This structured approach enables the managing director or financial director to see how the company measures up and then, if there be problems, to find out exactly where, to talk to the people with line responsibility and to work out policies for overcoming the weaknesses.

Interfirm comparison is a diagnostic tool; it provides answers to questions which may not always have been asked, but which perhaps should have been, and it enables the individual firm to find out what the real standards of success are that it should be able to attain for itself. If a company has traditionally used its own past experience as a guide to the standards it sets for itself, then it has no means of knowing whether these standards are the right ones. By going outside the company and looking in detail at the performance of other companies, objective targets can be set that are based on standards that have already been achieved.

Conceptual Problems

Interfirm Comparison, when conducted properly, can bring immense benefits to participating companies but there are of course a number of difficult questions that have to be addressed and problems that have to be solved before you can even start. Typical questions frequently raised are:

- No two companies are ever identical; they are bound to have different products, different methods and a different structure. How can you compare them validly?
- Companies keep their information in quite different ways and use different terms to define the same basic functions or activities. Doesn't this mean you're making false comparisons?
- Comparisons only tell you that you are doing badly. They don't tell you how to improve.
- Some companies' objectives are short-term. They want good profitability now; other companies prefer to invest in long-term growth. How do you cope with this?
- Is a high level of expenditure always 'bad'? What about marketing costs? Shouldn't they be maximised?
- In international comparisons, surely the differing standards of living to be found in a number of countries invalidate proper comparisons?

These are some of the issues that are addressed in the following paragraphs.

Operational Problems

A proper interfirm comparison is not always a straightforward operation. There are usually problems to be overcome in setting it up and a number of important criteria must be met:

- The companies themselves must voluntarily choose to join the comparison from a common desire to improve their own performance.
- They must agree to remain anonymous.
- They must agree to use a common set of definitions for measuring their costs, their profits and their assets.
- They must all pool their figures with a central specialist organisation which will collect the right information and interpret it for the companies.
- The results of the comparison remain confidential to participating companies and cannot be bought by outside firms or organisations.

The comparison process often starts with an approach from a single company that has expressed interest in the idea but probably is not at all sure how to take the matter forward (Figure 1). Other key companies in the same field then have to be contacted to see whether further interest in a co-operative venture is likely to be generated.

Sometimes it can be a slow and time-consuming task to get sufficient companies to the starting point simul-

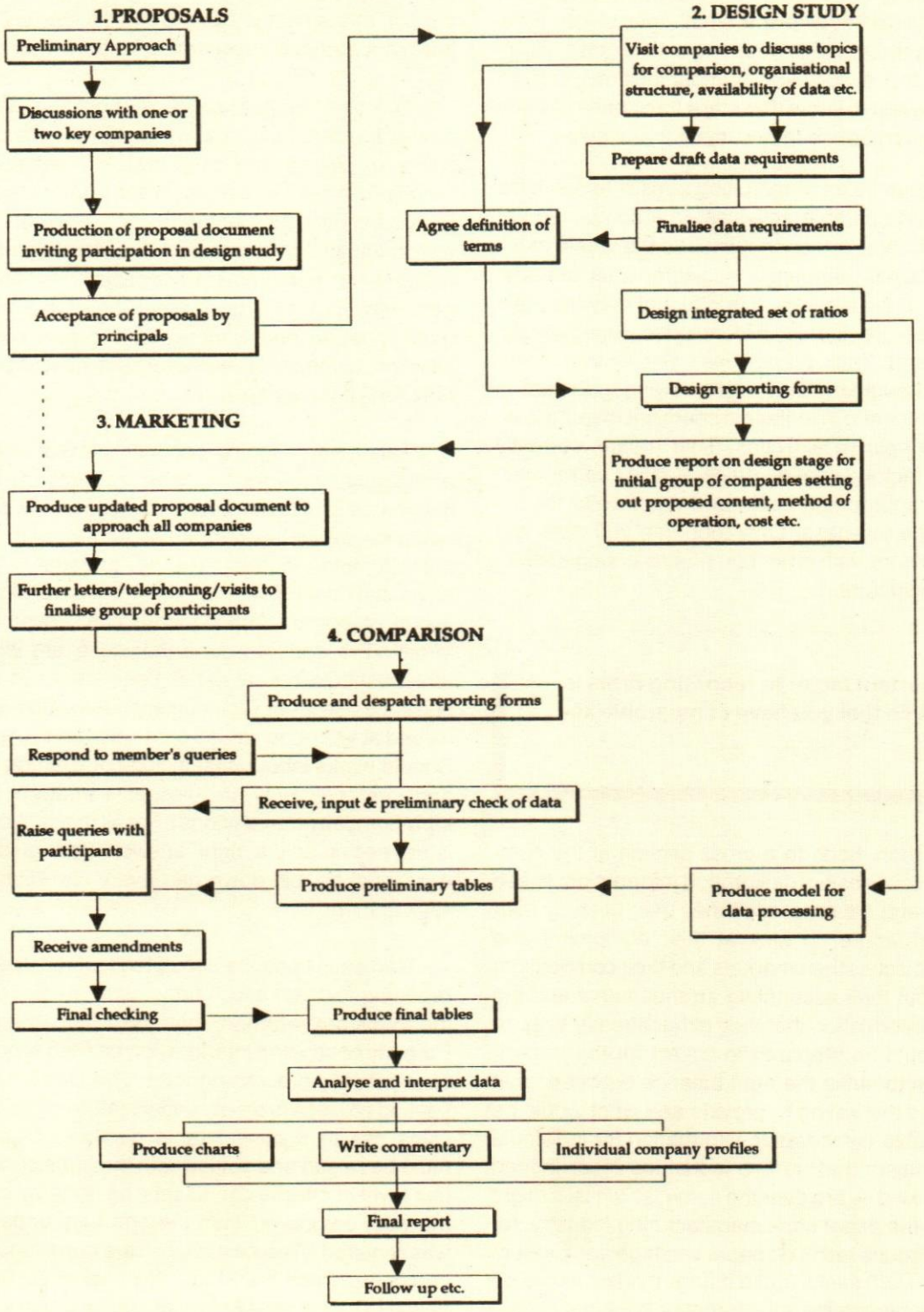

Fig. 1 Planning Flow Chart for Design and Operation of Interfirm Comparison

taneously. Usually a set of formal proposals is prepared for the key companies but nevertheless even when modern marketing techniques are used it takes some time to reach the point where a small core of key firms agree to take part. Once this happens critical mass usually takes over and a sufficient number of firms can be recruited. Firms like to know that other firms have already agreed to take part before they commit themselves.

One important factor in recruiting firms is to establish that you have comparable activities. In a comparison of paint manufacturers, you cannot include the whole of ICI or the whole of BASF although these companies are both very important in the industry. It is vital that only the paint divisions of these companies are included, together with their assets and their employees. Similarly a more modestly-sized company that might be engaged both in paint manufacture and in industrial chemical manufacture would have to split its activities. That means correctly allocating its factory space, office space, warehouse space and all appropriate costs and employees for the paint side of the business. Only then can you carry out proper comparisons with other companies engaged solely in paint manufacture.

One important factor in recruiting firms is to establish that you have comparable activities.

Visits are then made to a cross-section of the companies to gain some basic background information; to see their products and the processes they use; to study their organisation structure, to look at their equipment and machinery; to discuss their markets and their competition; to enquire about their accounting arrangements and the management information that they either already keep or which they would be prepared to collect for the project. The art here is to strike the right balance between what people can and are willing to provide and what would be the most valuable comparative information for individual firms. It is a truism that no two industries — or indeed sectors of any kind — are ever the same; so whilst it might be relevant in the paper sack manufacturing industry, for instance, to produce ratios on paper wastage and production hours per 1000 sacks, quite different ratios would be appropriate for bicycle manufacturers or for sugar mills.

It is important to get full co-operation from the firm. Some companies can be very wary of a comparison; perhaps they feel that they will be exposed to too much scrutiny and that somehow their competitors will find out too much about them. In a properly organised comparison this is not the case. Certainly they will come to no harm but perhaps they need to be convinced of this.

The other main purpose is to discuss with the companies the definitions that will be used in the comparison. However, willing and co-operative companies are, the comparison will be useless unless proper steps are taken to overcome the problem of different accounting methodology. Every company has its own conventions in drawing up management accounts; they are not being perverse, they are doing what they have always been used to doing and what suits their own company. For interfirm comparison however it is essential that every firm does it the same way.

This means finding common ground in the industry and persuading firms that their interests are best served if some parts of their management accounts are redrafted into a format that everyone can agree upon. Thus, in the manufacturing industry it is not unusual to have to lay down firm definitions for such terms as 'fixed assets', 'value of stock', 'works labour cost', even 'sales' and 'profit'. The sort of issues that arise are whether fixed assets should be valued at book value, at depreciated current value or at replacement value. Should stocks be valued at year-end values or at a monthly average value? Should works labour cost include or exclude supervisors and foremen? How are discounts treated? What about intra-company transactions? For all these questions there is not necessarily a 'right' answer; clear guidelines however must be laid down and every firm must be able to stick to them.

The definitions are circulated to firms, together with a reporting form on which firms' data are collected. When the forms are returned, they must be carefully checked. Properly conducted interfirm comparison is not a question of uncritically processing data. The checking and investigating process is an essential feature of IFC and usually gives rise to a considerable number of queries which must be raised and settled with the firms concerned. The first level of checks can usually be done by inspection. Is the data complete? Has the firm fully understood what was required? The next checks are done automatically by computer. Does it add up? (Not usually). Does it make sense? Do the answers to certain questions fall between credible parameters? If it is a regular annual comparison, how do the answers compare with the previous year's data?

Properly conducted interfirm comparison is not a question of uncritically processing data. The checking and investigating process is an essential feature of IFC.

The third level of checks is done when the ratios are calculated. Do the firm's ratios fall within the range of other firms' ratios? If they don't, and some of them certainly won't, is there a proper explanation for this? Would the firm like to reconsider a particular figure? In practice, if information is wrong, it is usually spotted easily and quickly corrected. In our experience, firms never send in wrong figures deliberately; it would be a pointless exercise with no benefit to them at all.

In most comparisons the names of participating firms are kept entirely secret. Their identity is masked behind code numbers — a levelling process which tends to reduce famous name companies to the same status as the latest arrival on the block. In some cases however an agreement, involving every participant, might be made whereby each firm knows which other firms are represented in the comparison, although of course their individual figures remain anonymous.

This is often done when there is only a small number of participants. Successful comparisons can be organised for as few as four participants or for as many as several hundred. In some trades, the UK retail drink trade comes to mind, the market is dominated by a very small number of companies so they probably need to be reassured that each of the other major firms is taking part. Each firm will then have a powerful voice in setting up the groundrules for the comparison so that they can be sure they will get the maximum benefit with the minimum disclosure of their own competitive position. With as few as four participants special arrangements have to be made for displaying information, perhaps involving each firm seeing its own ratios together with the average figures of the other three firms collectively.

At the other end of the scale there might be several hundred firms of lawyers, surveyors or accountants taking part in a comparison of their own profession, perhaps organised in regions or by size categories. In this case it is more usual to display the individual ratios for each anonymous participant, together with a summary which shows the range of results and the average result for every ratio.

Perhaps the most important aspect of any comparison — and potentially one of the greatest difficulties — is the choice of ratios that is appropriate for the particular group of firms. It is usual to start the comparison by looking for a measure of the company's overall performance, a ratio which answers the question 'How are we doing?'

In a manufacturing industry the best ratio is very often the measurement of 'Return on assets employed' because this indicates what the company has earned from the resources that are available to it. In a professional firm however it might be judged that the best measure of the firm's success is 'Profit earned per partner'. In the voluntary sector it might be the measurement of how low the expenses have been kept in relation to the income that has been raised.

In a manufacturing industry the best ratio is very often the measurement of 'Return on assets employed'. In a professional firm however it might be 'Profit earned per partner'. In the voluntary sector it might be of how low the expenses have been kept in relation to the income.

Although the prime ratio answers the question 'How are we doing?' it is probable that some firms will wish to qualify this by saying 'but we also have other objectives, such as growth, or the size of the return to shareholders'. The latter is probably outside the scope of most interfirm comparisons which tend to be about operational performance. Questions concerning the source of finance can be addressed too but it is not often a topic that is requested.

Growth however is usually examined. By looking at costs, revenue, profit and the number of employees for each of the previous five years and indexing them against the base year, it will be seen very clearly whether a company is expanding, contracting or remaining stable. If this is looked at in conjunction with profit or return on assets for the current year, then it will be seen whether long-term objectives are being sacrificed in favour of short-term aims.

The next ratios must answer the question 'Why?' Why is our figure better or worse than that of the other organisations in the comparison? Which areas are responsible? What factors have contributed? This means

a very detailed examination of costs, of productivity, of staff employed, of assets used, of markets served so that performance can be analysed systematically and conclusions can be drawn about which areas are responsible for good and bad performance.

These first 20 or so ratios can usually be combined for convenience into a pyramid shaped diagram which shows the relationship between the first ratio, at the top of the pyramid, and the next ratios further down. If any improvement is made in the ratios at the foot of the pyramid then this is reflected in the size of the ratio at the top. Thus the pyramid can be used as a planning aid for internal use as well as the structure for external comparison.

The question of the 'right' level for Marketing costs (Ratio 9) introduces other questions. Is it desirable for this ratio to be high or low in relation to revenue? It probably shouldn't be either amongst the highest or the lowest of the firms in the comparison. Marketing has to be effective and this can be another benefit of seeing other firms' ratios. At what level are the most successful firms' ratios? Is there a pattern? Again the ratios that back this one up will help identify the size of the department and the staff's contribution.

These and many other aspects will probably result in a further 80 or so ratios being calculated. In addition, it is necessary to have some background information about each company — for instance, its product range, the

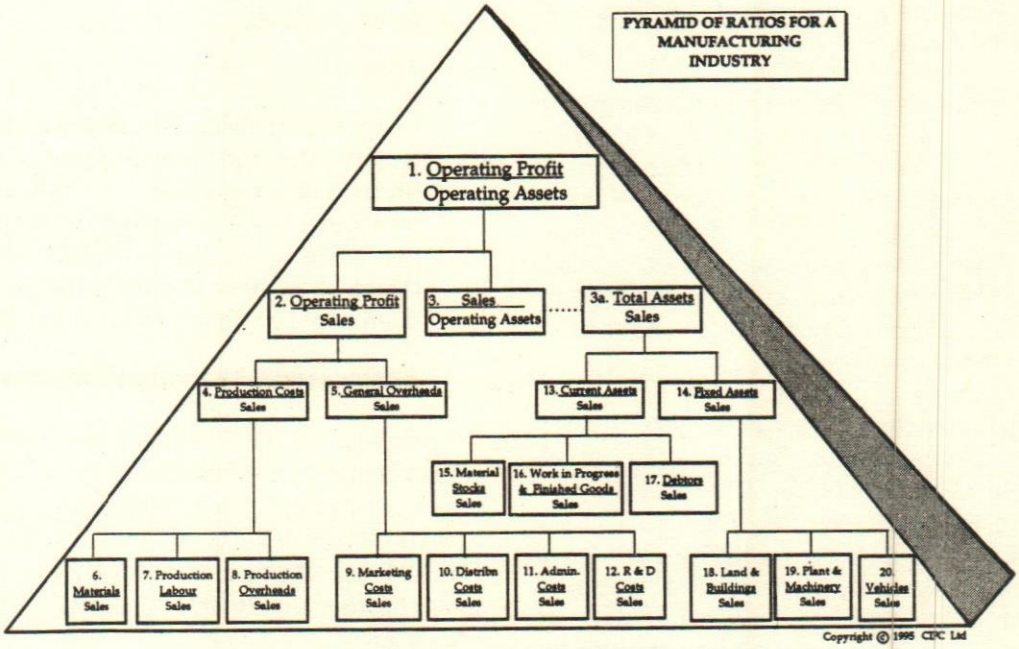

Fig 2. Represents the status of a typical manufacturing company.

The pyramid of ratios provides the framework of the comparison, but is by no means the end of the story. Each one of these ratios at the base of the pyramid must in its turn be explored further so as to track down the specific areas of the company's operations which are responsible for differences in overall success. For instance, if a company has higher labour cost ratios than other firms (Ratio 7 on the pyramid) then they will need to have supporting ratios concerning:

- the number of people employed
- the level of their wages and salaries
- the extent of overtime and absenteeism
- the output per employee, by category of staff.

markets it serves, the composition of its work force and its distribution methods. This has to be handled particularly sensitively. If these factors would be likely to identify companies then of course they cannot be used in a direct manner. Instead it may be possible to place companies in different bands of activity or bands of size without complete disclosure.

The full set of ratios for each company, under their respective code numbers, are tabulated in order of overall success, together with the summary ratios. This is done so that when the participating company receives the tables it is able to compare its own ratios either with those of the average, or with the most successful firm or with any firm that is particularly similar to itself.

In addition to the tables, there will also be a report on the main conclusions of the comparison and a detailed guide to the use of the ratios. The company may also opt to have a special report prepared on its own performance in relation to that of the group as a whole, pointing out its main areas of weakness and strength, explaining the reasons for them and indicating the most fruitful lines of action and the targets they should set themselves in order to improve performance. This report remains absolutely confidential to the company and is not seen by anyone else. It might also be followed up by a detailed discussion between the firm and the organisation conducting the comparison.

Almost certainly nowadays both this report and any special report will be illustrated by numerous charts and graphics which show the comparative figures in a more accessible format. In a report prepared for one individual company it is often useful to be able to show the management graphically how far ahead of or behind their competition the company's performance lies. This will be backed up by numerous other charts showing, for instance, how their labour costs compare or what their accommodation costs are in relation to their revenue and whether this is influenced more by the amount of space they allocate to each employee or to the rent that they pay for their premises.

One particular chart that is often to used summarise performance for senior management is the profile (Figure 3). This chart shows the company its relative position for a number of key ratios in the comparison. The chart is arranged so that all the 'best' ratios are at the top of the page and the 'worst' ratios at the bottom. Thus the company can see at a glance which are its good points and which are the weak ones on which management time and effort must be spent.

One particular chart used to summarise performance for senior management is the profile. This chart shows the company its relative position for a number of key ratios in the comparison.

International Comparisons

Interfirm comparisons need not be confined to one country. International comparisons provide an extra dimension and are particularly useful when there is a limited number of companies working in any one country but a thriving international industry exists. There are, however, a number of special problems to overcome with international comparisons that do not arise within a national comparison.

Firstly, ways must be found of overcoming differences in taxation arrangements, both direct and indirect taxation. Social security charges differ between countries, so ratios concerning labour costs must take this into account. There must be common standards for valuation of machinery and buildings and, of course, proper translation of the technical terms. This is not to say that companies must change their system of accounting overnight before taking part in a comparison. Far from it; there are already enough difficulties without imposing this on a company too. On the other hand, they must have the flexibility to select the right figures and background information from their management accounts or from their normal business records so as to enable proper comparisons to be made.

Secondly, there is the problem of exchange rates. In fact, this is not such a big problem as it might at first appear. Most ratios can be constructed within a country's own currency so that the relationship of production costs as a percentage of revenue remains just as valid whatever currency is used. Even asset ratios are often expressed as 'value of plant and machinery (in rupees) per 1000 rupees of revenue'. The ratio is the same value whether it is calculated in pounds or dollars. In practice it is sufficient to say 'per 1000 units of currency'.

The ratios that can cause difficulties are ones comparing employment costs per head. Differing standards of living are often reflected in quite different levels of remuneration. This is one of the few instances where it is best to nominate one currency, say $US, and calculate each firm's costs per head in this currency. There will certainly be wide differences in the ratios, especially if the firms span several continents, but this is the reality and the figures will help explain many other ratios in other parts of the comparison.

When productivity or output performance is being measured internationally, a further device can often be used to overcome compatibility problems. If the ratio is of the kind

Value of Output (in $US) per production worker

and labour is an important ingredient of the cost of output, then sometimes it is better first to state the

Average Salary Cost (in $US) per production worker

PRINCIPAL COSTS AS % OF REVENUE				OVERALL PROFITABILITY			REVENUE RATIOS			
Overheads	Direct costs	Admin. staff	Operational staff	Profit Margin	Overall Profit per partner	Revenue per partner	Revenue per staff member	Revenue per fee earner	Revenue per £ of staff costs	Charge-out rate per partner
%	%	%	%	%	£000	£000	£000	£000	£	£
19.6	2.0	9.4	26.0	26.9	127.7	475.0	72.0	157.9	2.77	175
20.7	3.0	9.4	26.2	23.4	111.6	441.4	63.8	132.7	2.47	150
24.2	5.1	9.5	27.4	22.8	100.2	427.2	59.2	128.8	2.45	125
25.7	6.6	9.9	28.2	19.6	85.1	401.1	57.9	120.0	2.16	125
27.0	6.7	10.2	28.6	16.8	70.4	381.1	50.5	116.7	1.93	115
27.6	9.3	11.1	29.2	14.2	67.2	355.2	46.8	106.3	1.92	110
29.0	9.8	11.6	30.4	14.1	54.8	341.0	42.3	90.4	1.90	105
29.2	10.2 Median	12.1	31.5	13.6	45.6	330.4	39.4	89.0	1.90	100
29.3	10.5	12.6	32.6	13.1	42.1	305.6	36.4	87.6	1.89	95
30.6	11.7	17.3	34.8	12.1	32.1	297.1	33.9	75.0	1.85	90
30.8	12.7	17.7	36.1	11.8	25.0	294.7	31.4	67.7	1.78	80
32.9	12.8	18.0	37.4	11.6	22.6	287.6	30.4	66.0	1.62	75
36.0	16.3	23.5	39.6	9.4	17.3	207.4	29.6	62.6	1.67	70
37.0	18.0	26.4	41.2	8.6	10.1	118.6	28.4	55.9	1.51	50
43.6	18.1	27.0	44.6	5.2	8.2	91.6	18.4	41.0	1.35	50

Fig. 3 Profile of key results for firm F

and then to express the value of output as

> Value of Output is the equivalent to the salary cost of 2.87 production workers.

This last ratio makes international comparison valid again.

Experience in international comparisons over the last few years has shown that the level of employment costs *in relation to revenue* may well be fairly similar between companies in a number of different countries but that the combination of factors producing these levels of costs will almost certainly be very different. Actual wage levels in the USA can be very high; the cost of social charges and employee benefits in France has a very large influence on total employment costs; in South America labour is often cheap but one consequence may be that the number of people employed for a particular task is greater than in other countries. Perhaps the hours worked in one country may be longer than in another; in Norway at one time it seemed quite normal for female workers to be absent from work for over 20% of the time!

All these factors provide the reasons for differences, or similarities, at the top of the pyramid, but of course it is essential to provide these explanations lower down in order to quantify the major differences between them.

IFC in Practice

If there are theoretical problems in conducting inter-firm comparisons there are certainly practical ones too and no two comparisons ever follow the same pattern.

One comparison amongst the 120 or so different topics on which The Centre for Interfirm Comparison has carried out comparisons concerned the maintenance function. Maintenance is a subject that an enormous

number of companies and organisations are involved in; every vehicle fleet needs maintenance; every factory contains production machinery that needs maintenance and every warehouse or depot contains equipment that needs maintaining. The problem was how to compare this function.

The basic pyramid of ratios was expanded to highlight maintenance costs. Normally the latter would be one of the grass-roots ratios to explain unusual production costs. In this instance the costs were related to assets — not all assets, but those assets needing to be maintained. Thus the key ratio became maintenance costs per £1000 of maintainable assets and these costs were explored in great detail between the cost of maintenance labour, the cost of maintenance materials and the cost of maintenance overheads. Much of the comparison was devoted to an examination of hours worked to find out whether their time was spent on *preventive* maintenance, that is planned work to prevent machinery going wrong, *corrective* maintenance, to restore machinery that is no longer in an acceptable condition or *emergency* maintenance, to rectify machinery that had already broken down. Similarly machine hours were measured too, together with such factors as wastage of maintenance materials.

Firms were divided into types of activities e.g. engineering, food industry, vehicles. The reports covered establishments with over 67,000 employees. There were of course detailed lessons to be learned by each individual establishment but there were also one or two interesting general conclusions. For instance, there didn't appear to be any relationship between the *size* of the companies and the *level* of maintenance costs. That is to say, relatively speaking, large firms did not carry out more or less maintenance than small firms.

Another conclusion was that there were very great similarities in the ratios that emerged for quite disparate types of organisations and this confirmed that it is quite valid, when considering a function, to make comparisons across a wide variety of industries.

There were very great similarities in the ratios that emerged for quite disparate types of organisations and this confirmed that it is quite valid to make comparisons across a wide variety of industries.

Another functional comparison was Distribution. In this case there were a number of companies which were all involved in transferring goods from factories, through warehouses and depots, to retail outlets, in some instances big supermarkets, in others small village stores. Many of the products were food or drink but some of the companies were distributing hardware and toiletries. The problems the companies faced were on the one hand similar but at the same time dissimilar. They all used fleets of vehicles, large ones for trunking between factory and warehouse and smaller ones for deliveries between depots and retail outlets. It was easy enough to compare vehicle costs and utilisation; driver costs and productivity; the hours they worked; the time that the vehicles were in service and out of service; the speed of delivery from order initiation to order completion but what the companies had difficulty in was agreeing what their prime ratio should be. It was felt that it should be a measure of the cost of distributing a certain quantity of goods. Canned goods manufacturers who ran into payload difficulties before space difficulties in their vehicles wanted the unit to be a *tonne;* cornflake and paper tissue manufacturers were more interested in limitations of space so they favoured a *cubic ft.* as the measure; on the other hand, nearly everyone who had a substantial involvement in warehouses and the stacking and handling problems there felt that a *case* was the best unit. Our view, which prevailed, was that we should have 3 joint prime ratios and then everyone was happy.

Quite different considerations were involved when The Centre was working with an international service company based in the USA. The company had 26 subsidiary companies, each one operating in a different country, and although there was a family resemblance to the work each company was doing in their own country, each in practice had gone their own way. Our role was to devise an international comparison that brought everyone back on to the same basis and allowed each one to set new targets based on the *Best Demonstrated Practice* for each separate function. BDP was not necessarily the best ratio. There are nearly always reasons why the 'best' ratio can be considered to be due to special circumstances and so BDP had to meet stricter criteria.

The biggest challenge was to devise definitions that could be applied in every operating company. That meant dividing up each stage of their operations into separate packages and looking in great detail at the component parts before welding them back together as complete businesses; it meant identifying for each function the number of employees, their equipment, the assets they

used, the costs they incurred. Productivity measurements then had to be devised that could be translated effectively across the world.

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One of the advantages of working with one big group was that the comparison could be in very great depth and there was good support from the US Headquarters. If we made a sound case for collecting certain pieces of information on a world-wide basis, then central management co-operated very closely to ensure that it happened.

The comparison was a great success and after starting relatively simply, it went into progressively greater detail over a period of years until by the seventh year, a massive amount of data was compared annually and fresh targets were exceeded each year. The comparison had become an essential part of corporate management information and very quickly the gap between the larger and older-established companies and the newer smaller companies diminished. As new technology was introduced, fresh benchmarks were established. By the end of the programme, the US company calculated that the comparisons had saved them $15 million in direct cost reductions and improved productivity.

Comparison in itself is no instant panacea, even when all the problems are solved; but it is the means of getting to know one's own company a great deal better and it is the catalyst for making change.

The real benefits of an IFC come ill the weeks after the receipt of the report when the management has studied the findings and is thinking constructively about remedies for the weaknesses that have been exposed. It is at this stage that further visits are usually paid to the companies to discuss the results and to help them develop a strategy for the next stage.

Comparison in itself is no instant panacea, even when all the problems are solved; but it is the means of getting to know one's own company a great deal better and it is the catalyst for making change. As one participant wrote after taking part. "We are presently planning the policy of the company for the next five years and the interfirm comparison has proved invaluable in removing any feeling of smugness we might have had; now we have solid facts about our company rather than uninformed opinions. We are planning to reshape our distribution facilities and also our manufacturing layout; our plant utilisation ratios have confirmed our own fears but at least we can now begin to tackle our problems with a greater awareness of our relative position in the industry." □

'Our Competition if our sense of excellence. We are alone ... because we plan ... ten times harder than anybody else and twice as hard as we do.'

— Edwin P. Land

Inter-relationship Between Benchmarking & Performance Measurement

Carl G. Thor

Benchmarking and performance measurement are subsets of each other. Benchmarking which involves external comparison cannot be made without careful measurement of performance parameters, states the author and goes on to elaborate on their interrelationship.

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Many newcomers to benchmarking use the word in the sense of establishing new performance measurement systems in their organization, the "benchmark" being derived from their own internal historical performance. This is approximately the way the word is used in surveying, but the modern science/art of benchmarking, while making use of internal performance measurement, covers a great deal more. Some organizations have used benchmarking in a broader sense as the central improvement strategy for their whole organization.

On the other hand, some modern performance measurement specialists have failed to see the great value in using the results of external benchmarking for goal setting and improvement stimulation inside their organizations. They are so accustomed to determining the improvement trend to feed "continuous improvement" campaigns that they fail to worry about the relative adequacy of the performance level newly obtained.

In the interest of clarifying these ambiguities, it becomes necessary to understand, first, how measurement fits into benchmarking and, secondly, how benchmarking fits into measurement.

What is Benchmarking?

Benchmarking is the systematic comparison of elements of performance in an organization against those of other organizations, usually with the aim of mutual improvement. The comparison is systematic as opposed to accidental or opportunistic. Those involved have organized the project, gathered data and interpreted it with care.

The elements of performance to be compared can vary widely. Some organizations are looking for lower costs, others for better customer acceptance, more durable product design, reduced cycle time, or a balance

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of all these and more. The participating organizations can be whole companies or agencies, divisions or branches, cross-departmental business processes or even small work groups. Mutuality is what differentiates benchmarking from marketing research and corporate espionage.

Four types of benchmarking will be considered here; financial, industry (strategic), product/service, and generic process. All four make use of specific types of performance measurement, but in all four cases the ultimate purpose of benchmarking is to find in the outside world proven ways of better performance or at least ideas that lead the analysis team to invent an even better way of operating.

Performance Measurement in Benchmarking

Financial Benchmarking

This form of usually involuntary benchmarking is typically done by experts associated with financial investment organizations. The measures of organizational performance have already been chosen through tradition, and are usually highly aggregated financial ratios plus a few large-scale marketing research results. The means of data gathering and analysis are already prescribed, and both the data suppliers and analysts are aware of the possible "tricks" that can be brought in. "Value" is measured relative to other organizations, mainly in the same industry, and comes almost entirely from the recent past. The time period chosen for review is critical, and may in fact constitute one of the highest yielding "tricks" to fool the unwary.

Trying to predict the future by analyzing the past is difficult even using the right tools. Unfortunately, most financial benchmarking uses some of the wrong tools. Those familiar with productivity analysis realize that the basic health of the organization can best be interpreted by separating the "price effects" from the "quantity effects" in the income statement and the balance sheet. Observing the trend in physical labor productivity (physical output per labor hour or inflation-adjusted value added per labor hour) is a very useful exercise. Even better, but unfortunately rarely calculated, is total or total factor productivity which subdivides both price and quantity effects by the associated factor of production (labor, materials, energy, capital, and business services).

Balance sheet comparisons are even worse than income statements, at least in countries like the US where inflation effects are ignored in determining the current level of the shareholders equity and the capital employed. In effect, an apparent advantage may be obtained by having older plant and equipment, by leasing assets and by farming-out work to contractors even if that does not make long-term business sense.

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Industry or Strategic Benchmarking

Though these intra-industry comparisons may also be done involuntarily by outsiders, more typically they are done by contracted middlemen such as trade associations, consultants, productivity centers or by government or quasi-governmental agencies in order to learn about the industry as a whole as well as to provide information on the relative standing of each participant within the industry. There are many good examples around the world of this activity, notably in Canada and India.[1]

The normal practice is to break down the financial analysis into components and bring in physical data that allows substantial interpretation of the range of performances demonstrated for each parameter. A key technique is to collect "sorting" information, so the ranked results for each parameter can be analyzed with possible explanatory variables that hide underlying performance excellence.

For example, in trying to compare maintenance cost as a percent of sales, sort data might also be collected on machine "complexity", seasonality of operation, order lead time, level of training of mechanics and finished inventory turnover. Any one of these could help explain why the industry members "perform" differently in maintenance cost as a percent of sales.

The typical third-party who organizes and runs a comparison usually develops a detailed questionnaire with the advice of industry experts who can help guide the

1. The Canadian experience is described in Christopher and Thor (1993). The Indian experience is described in Nandi, (1992).

choice of sorts and also give guidance as to what types of findings are of most interest to the industry. Much creativity is possible in measure selection in contrast to financial-only benchmarking. The possibility of a large number of willing respondents helps make these studies especially valuable and accurate. As with financial benchmarking, the time period selected is crucial and a longer-term point-of-view is advantageous.

But there are problems in industry studies too. The confidentiality issue must be handled. When the financial benchmarkers use only public domain data, there is no issue. But cooperative industry studies usually require the middleman to disguise or aggregate the data in ways that individual respondent results cannot be identified by outsiders. There will also be questions about the accuracy and validity of the data. It is hard to find a universal wording that everyone will interpret in the same way. Errors can occur, either intentionally or unintentionally. Government sponsored studies have the force of law behind them to eliminate intentional errors. Computerized "sanity checks" can eliminate some but probably not all of the accidental error. Regarding intentional error in private studies, usually the error-providers end up losing more than the "victims" in most cases.

Though benchmarking appears to be a search for "world-class" performance, a good industry study not only helps the "good" set accurate goals to become "excellent", but it also helps the "poor" to become "fair" (and, later, good). In many developing countries, stimulating the bottom half toward basic improvement may be more important to the economy than stimulating the already-good to become slightly better.

Product/Service Benchmarking

The benchmarking of products and services is done by testing laboratories and comparison shopping organizations. In most industries the desired characteristics have been predetermined. The types of specifications and standards are traditional, but the expected levels are ever-improving. The benchmarker must measure precisely, often in a statistically controlled environment, which product or service is best in each pre-determined characteristic.

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The overwhelming challenge in this sort of benchmarking is to know enough about the customer to be able to weight accurately which characteristics of the product or service mean the most to him. Your product may "win" in the first five of the six characteristics studied, but one whole class of customers is most interested in characteristic number six! The customers are not always truthful when questioned; they may talk about durability or style but secretly make their buying decisions based on price or *vice versa.*

Generic Process Benchmarking

This type of benchmarking has become very popular around the world. Because business processes of a generic nature are compared, organizations from different industries can cooperate effectively with each other. The confidentiality issue is not nearly as important as in industry benchmarking.

Classical benchmarking, is between two organizations. (Camp, 1989) One organization is known to have a world-class safety program but has a poor record in customer service and the other is strong in customer service documentation but has not done much in formal safety programs. Each organization helps the other with their specialty subject in order to get help in their area of shortcoming.

Though there are many good examples of this simple cooperation, there is not always a "perfect" partner waiting around the corner for such a project to be proposed. Consultants and Benchmarking Clearinghouses have taken the lead in organizing "one-way" benchmarking in small groups. Instead of the "pay-back" being in reciprocal advice, it is an entry fee paid to the organizer.

Five or ten different organizations may all be interested in a subject, say customer service documentation. The organizer helps each organization develop data on their own practices, leads the search for "best practice" organizations either within or outside the study group, and arranges for site visits and presentations to the study members. It is typically up to the study participants themselves to select the parts of best practice to incorporate and to install these in their own organization, although consultants volunteer to help with that also.

The measurement problem in this type of benchmarking is to define what is meant by "best". Though all the participants are interested in locating the best documenter of customer service, some are interested in lower cost documentation, others want faster response, higher accuracy levels weighted combination.

If all these issues are discussed at the beginning and the proper measures are selected, each organization will get what it needs and make the specific applications it chooses. But inattention or vagueness about what is best at the beginning can render the study largely useless at the end.

Measurement issues to be considered at the beginning are:

- If cycle time is important, what are the starting and ending points?
- If cost is a focus, do we want a theoretical variable cost, fully-loaded cost including design, rework and overheads, or some kind of "life cycle" of customer cost?
- If quality is an issue, is the focus on internal error rate or only errors that go "outside".
- If customer satisfaction is an issue, is it current-perceived only, longer-term and cross-measured, or actually "loyalty" as variously defined.

Generic process benchmarking is largely a "words" exercise. The issue is how (and why) do you do things. But the numbers and accompanying precision are needed to force proper definitions and to assure a level playing field if "best" judgements must be made.

Benchmarking in Performance Measurement

Performance measurement is directed at the question of whether the organization is improving sufficiently. Organizations look for a balanced improvement in several performance indicators. The "family of measures" at the top priority of a typical organization might include measures of productivity, cost, internal process quality, customer satisfaction, safety, market share or penetration and other more industry-specific issues. The author has described complete families of measures in detail elsewhere. (Thor, 1994)

The "family of measures" at the top priority of a typical organization might include measures of productivity, cost, internal process quality, customer satisfaction, safety, market share or penetration and other more industry-specific issues.

The key point in this context is that most performance measurement emphasizes improvement trend and does not sufficiently consider whether the current level is adequate for the competitive situation. There is a good reason for this. Trend data is easy to capture inside the organization. But level comparison data has to come from outside the organization, and that sort of data gathering is not only outside the control of an organization, but until the advent of benchmarking studies was just not done by most organizations except informally and accidently. A new employee or consultant might have fragments of information about how another organization does something, for example.

As strategic planning and goal setting have become more popular, the interest in setting goals in a non-arbitrary manner has been one of the driving forces in the growth of benchmarking. Managers are tired of making every goal "10% better" or some convenient round number, rather than setting goals rationally based on a thoughtful combination of what is needed competitively and what is possible with projected resources and capabilities. Often two-stage goals can be set; what is possible with current capabilities and what can be done after obtaining increased capability through investment in machinery, employee skills or product development.

To complicate matters, benchmarking can be an important tool in defining the measures themselves, not just their target level. When an organization enters a new field or drastically shifts emphasis, it can benefit from learning what other organizations in that field or orientation measure in addition to what is the "normal" and "best" level of that measure. The International Benchmarking Clearinghouse is currently conducting a benchmarking study (with 20 participating organizations) on Corporate Performance Measures, and one of the key questions being compared is simply what are the measures being used. But this study will also investigate how the measures are used, by whom, how often and how they are communicated. Other major topics are how the corporate measures link with lower level measures and how they fit into the strategic plan and improvement strategies at various levels.

Conclusion

Thus benchmarking and performance measurement are sub-sets of each other. Benchmarking, which is systematic external comparison, cannot be done well without ensuring the comparisons are "fair" through carefully measuring the desired performance parameters. Measurement is quite different in each of the types of

benchmarking, but all types are greatly facilitated by good pre-study understanding and discussion of the exact study definitions and goals.

Benchmarking provides a new and relatively convenient source of information for rational goal-setting and analysis of performance levels to add to the normal information on performance trend.

Performance measurement emphasizes the rate of improvement of a balanced set of performance indicators. Whether a rate of improvement is adequate is a function of the validity of goal-setting, which is generally not done well. Benchmarking provides a new and relatively convenient source of information for rational goal-setting and analysis of performance levels to add to the normal information on performance trend.

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'A theory need not give us answers, but it should, perhaps, question the questions until they bleed a little.'

— Paraphrased from *Anthony Boucher*

Benchmarking in R&D

Mohamed Zairi

Although benchmarking as a strategic tool has started to gain momentum and raise a lot of interest on a global basis, there are still reservations about sharing information and learning outside one's organisation. This problem becomes even more apparent when one considers areas of high sensitivity such as R&D. This paper argues, that R&D is not unique and can be subjected to benchmarking in many ways. The author demonstrates the ways in which R&D processes can be effectively benchmarked and information shared on a win-win situation. The paper concludes by presenting a list of criteria found in leading organisations to facilitate effective and successful R&D management.

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Research and Development (R&D) is perhaps the only area often found difficult to manage although always recognised as vital for business's survivability and prosperity. Product life cycles are shortening, development in material science and technology is accelerating, customer sophistication is growing and concern with the environment and its resource is becoming a key issue in the 1990s. All these put pressure on organisations to be more innovative, to reduce cycel times and work and increase quality. What are the problems of R&D if it is recognised to be essential?

The Western Malady of Short Termism

Western companies have long been known for their inclination towards fulfilling the needs of the shareholder first and the customer last. As argued by Motteram (1991).

> "On the one hand, a company cannot afford not to develop new products, on the other, to provide such investment would damage cash flow and start to concern investors."

Typically, the key measures used in the West to assess a business strength and its performance in the market place are the following:

Dividend Yield: Short term return, also providing funding for the future investment.

Earning per Share: Comparative to other companies also indicates trend, an indicator of performance against previous years.

Price Earning Ratio: Used by analysts for comparisons across companies.

Return on Capital Employed: A measure of efficiency on how the business is being managed.

Current Asset Turn: The lower the turn the more risk of obsolescence.

Quick Ratio: Organisations' ability to meet current debts from liquid current assets.

Current Assets vs. Current Liabilities: A ratio for determining liquidity.

Capital Gearing: Potential for borrowing power to fund new projects and new investments.

PV & R&D Charges: Indicate whether sufficient funding is being ploughed back into the business — an indicator of growth.

Captial Investment Level: How well is the business without stretching the resource strategy?

Order Cover: Confidence in future business.

R&D Decision: This is carried out very subjectively, varies from industry to industry, business to business and fluctuates in quantum from year to year.

The Management of R & D

Senior managers are trained to manage all the key functions of business organisations such as marketing, HR, finance, sales, distribution, manufacturing, maintenance, etc. They are not, however, trained at managing R&D activity. Very few textbooks refer to R&D as a complex process that requires proper management. H.A. Schneiderman, Vice President of R&D, Monsanto Company, Stated in 1990:

> "Although most technology-dependant companies recognise R&D as a necessary business experience, their executives usually do not understand it as well as they do manufacturing, sales, marketing, finance, human resources, or even legal and regulatory affairs. Yet, R&D fuels these companies' earnings growth."

Typically, these are the questions that senior managers have to wrestle with:

How long should it take and how much does it cost? — priorities are often given to incremental innovation with clear, tangible and quick payback.

How to inspire more productive R&D? — senior managers look for winners and successful projects without trying to understand how R&D functions can deploy the right resources for its management.

How to integrate R&D with the rest of the company? — R&D is considered very often as a cost centre rather than as a profit centre. It is not integrated to functions such as marketing, production and sales.

R&D is considered very often as a cost centre rather than as a profit centre. It is not integrated to functions such as marketing, production and sales.

How to pick winners? — Lack of understanding of how R&D should be managed and lack of management means that it is not linked to corporate strategy and corporate goals are not translated in terms of innovation activity.

When and how to terminate failures? — Lack of strategic direction, poor resourcing, poor management, means that many projects are allowed to drift, absorbing resources and finishing as complete disasters.

Benchmarking R&D for Best Practice

One of the problems associated with R&D is the level of secrecy surrounding what takes place inside laboratories and R&D departments. R&D is often referred to as 'the black box' containing all the information on future prospects for business organisations. The R&D scoreboard initiative was introduced by the Department of Trade and Industry (DTI) in the UK in 1991 as part of a strategy encouraging innovation in the UK. The benchmarking framework developed used the following indicators for establishing comparisons:

- Current spend
- R&D spend per employee
- R&D as % of sales
- R&D as % of profit
- R&D as % dividends
- % sales per employee

Benchmarking R&D Management in Japan

Figures published in 1991 from the R&D scoreboard indicate that based on international comparisons using aggregates of the top 100 R&D spenders per country:

- Britain spend £ 5.9 billion, with £ 1530 per employee
- America spend £ 27.7 billion, with £ 3730 per employee
- Japan spent £ 20 billion
- Germany spend £ 14.7 billion, with £ 4320 per employee.

Japan, therefore, lies second in R&D expenditure behind the USA, demonstrating high commitment for long term survivability and prosperity.

- In Japan it is thought that the competitive threshold from R&D work is further downstream, at design or prototyping of products and processes. This is not, however, the case of the USA where all R&D activities are considered to be proprietary and competitive sensitivity starts much earlier in the R&D process at applied research stage (Hellwig, 1991).
- Table 1 illustrates the various stages used in New Product Develolpment. This model referred to as 'Taxonomy of Product Genesis' (Hellwig, 1991) was used for benchmarking R&D activity between Japan and USA.

Table 1: Taxonomy of Product Genesis

Category	Subcategory	Objective
Research	Fundamental Research	Enhancing Knowledge/ Understanding
	Generic Research	Supporting One or More Engineering Disciplines
	Applied Research	Support & Specific Engineering Area
Development	Product/Process Conceptualization Product/ Process Design Product/ Process Prototyping	Generating Product/ Process Options and Alternatives, Selecting Product/Process Option(s), Verifying Performance/Cost Objectives
Commercialization	Production/Processing Testing/Acceptance Marketing/Selling	Making (Cost-Competitively) a Quality Product Verifying Quality/Performance, Generating Revenue, Profit and Marketshare

- Japanese companies believe in co-operation and sharing of development work, until prototyping stages. Co-operative projects extend to the involvement of foreign firms as well.

Table 2: Comparison of Business Strategies in the US and Japan

	Traditional Strategic Approaches	
Strategy Element	In Japan	In the US
Employee Attitude	Team/Cooperation	Individual/Competition
Risk/Reward	Learn from Failures	Punish Failures
Innovation Manufacturing Focus Product Objective	Incremental Improvements Process Quality/Utility	Breakthrough Product Performance/Novelty
Product Introduction Business Focus	Sustain Market Presence Marketshare/Customer	First to Market Bottom Line/Shareholder

- Table 2 illustrates a tentative comparison between the USA and Japan, trying to explain the differences in competitive outlook that often lead to differences in the management R&D activity.

7 elements were used for establishing the differences between the two countries concerned. The practices that were found to be different in Japan and which often lead to better R&D management, include the following:

- R&D activity is based on team co-operation and deploys synergies and levels of creativity in the same direction.

Failures are considered as opportunities for improvement.

- Experimentation and creativity are strongly encouraged. Failures are considered as opportunities for improvement.
- The management of innovation is through incremental improvements; optimisation of learning, enhancing capability and effective utilisation of resources available are the goals.
- Focus is on the process, sustaining capability and consistency to deliver successful products and services.
- Focusing on the customer through sustaining high competitive standards, quality, responsiveness and market presence.

This brief benchmarking exercise demonstrates that competitive advantages have to be determined through:

- A thorough understanding of business processes, their capability, consistency.
- An understanding of business priorities, desired goals, their communication and translation throughout the business.
- Attempts to manage *all* activities with the same degree of focus unequal attention means a dilution of efforts, effectiveness and a misuse of availab!e resources
- Harnessing creativity through people involvement — teamwork would lead to better R&D output.
- Uniqueness is not necessarily associated with the *technology*/prototype, but the way it is applied within business operation. Success is not in inventing but innovating and achieving total cus-

tomer satisfaction, increased market share and significant growth.

The drivers of Innovation

Figure 1 illustrates the key drivers of R&D and the major determinants of success in the market place by

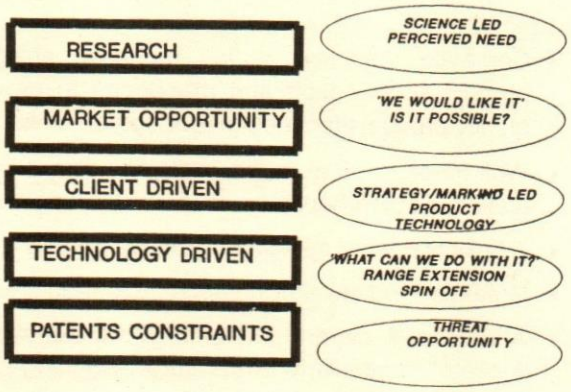

Fig. 1 Key Drivers of R&D

establishing superior performance levels. Traditionally R&D tended to be driven heavily by:

- Pure/applied research
- Technologies
- Defensive and offensive patents

More increasingly, however, technical success in the protection of prototypes and blue chip technologies is not considered enough. It is the conversion of technical innovation into commercial success that is the sought end result and therefore starting with a good understanding of market conditions and knowledge on customer requirements is of utmost importance.

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As figure 2 illustrates, more companies are demanding more successful innovations or translation of technical success into commercial success. To reduce the lead time in the development of technical innovation into successful launches calls for an integrated approach to the management of innovation. An integrated model for

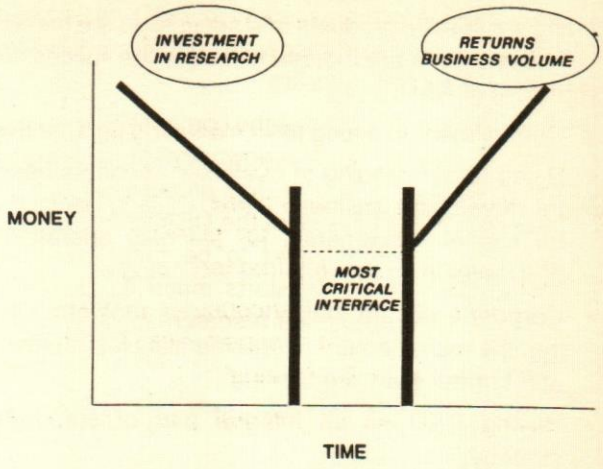

Fig. 2 The Transplation of Technical Success to Commercial Success

managing best practice R&D would start with a customer-focused strategy and the integration of all key activities (figure 3) including for example:

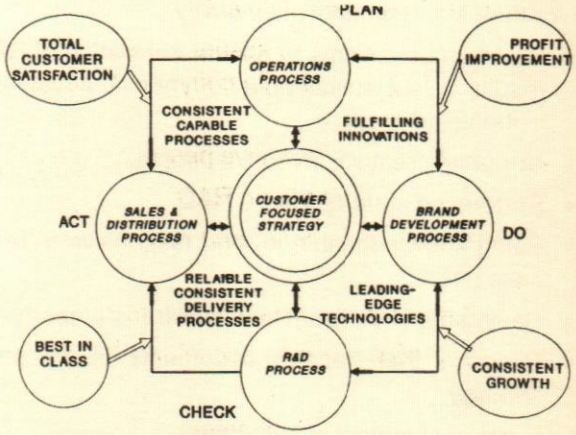

Fig. 3 An Integrated Model for Managing Best Practice

- Operations Process
- Brand Development Process
- R&D Process
- Sales and Distribution Process

The key contributions of each would be to:

- Manage consistent, capable processes
- Deliver fulfilling innovations
- Develop leading-edge technologies
- Manage reliable, consistent delivery processes

Best Practices in R&D

The following criteria are often found in successful organisations, recognised for their track record of

launching successful products and services in the market place. These criteria are thought to lead to the successful management of R&D:

- Commitment to a long term marketing perspective
- Using understanding of customer needs as basis for developing business plans, making decisions for capital investments, for planning operations and developing the required technologies
- Corporate culture that encourages problem-solving, the management of opportunities for improvement rather than 'fire fighting'
- Having R&D as an integral part of corporate strategy
- Having a strong leadership.

Best Practice in R&D

In addition, the following list of excellent practices was extracted from model companies recognised worldwide for their superior innovative ability :

- Having mechanisms to assure translation of R&D results in to a sustainable commercial advantage in identified areas
- Nurturing creative, inventive people
- Performing state-of-the art R&D
- Being knowledgeable in, and responsive to business needs
- Having multifunctional technical transfer teams
- Ensuring that transfer documents fit company strategy
- Early involvement of customers
- Ensuring continuity and developing good personal contacts
- Having realistic goals, timescales
- Subjecting R&D to quality principles and a never ending improvement ethos.
- Professional approach to safety with agreed ceilings and line responsibility
- Dedicated people/teams on projects to provide focus
- Complete objective setting process, including product specification and milestones to provide quality products/technologies at agreed times
- Well-trained and qualified staff, including a complete suite of in-house courses and training plans
- A flexible reward system for achievement
- Creative/Problem Solving apprach to problems
- A balanced department/team of 'cookers' and 'lookers', particularly in the core technologies of polymers, colloids and coatings
- Good Characterisation Capability — equipment and people
- (Some) focus on big goals, e.g. Refinish and Automotive, Aquabase and NAD/SPC.
- (Some) leverage from suppliers/academics
- Strategic Research linked to Product Research and focussed on core businesses

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Benchmarking of Best Practices: Case of R&D Organisations

Pradosh Nath & N. Mrinalini

Benchmarking as logical extension of strategic planning has found wide application in varieties of business practices. The methodology is also considered as having application in R&D organisations. Technology being heralded as the most important ingredient of economic development, attention has been drawn towards best practices for a technology supply system i.e., R&D organisation. The present paper discusses the possible application of benchmarking methodology for a more market responsive R&D organisation. Core processes of an R&D organisation have been identified and with the help of the cases in S&SE Asia, an indicative benchmarking methodology for R&D organisations has been suggested.

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After taking over charge on 1 July, 1995 the new Director General of CSIR, a chain of 42 R&D Laboratories in India, has declared his intention of making CSIR Laboratories more responsive to market demand and also less dependent on government grants (The Pioneer, 1 July, 1995). This is not a simple task, because market oriented R&D has not generally been the culture of CSIR laboratories. On the basis of the recommendation of the Fourth Review Committee Report, (CSIR, 1986) CSIR laboratories have been asked to earn at least 1/3 of their total cash flow. But generating a percentage of cash flow and being market oriented could be two different propositions and most of the CSIR laboratories are discovering that pursuit and generation of knowledge for the pleasure of it and the same for the purpose of the market are very different cultural categories. Market orientation requires a clear idea about the market segment which is the target of the organisation and institutionalisation of the market demand in the selection, management and delivery of R&D projections and project output. Transformation of any organisation to become responsive to the market, therefore, needs fundamental changes in the existing form of the organization.

Transformation of any organisation to become responsive to the market, therefore, needs fundamental changes in the existing form of the organization.

The question, before the new DG, therefore, is how to locate the areas where changes have to be brought in and how to institute those changes? Benchmarking (BM) could be made useful for planned organisational change.

Two important issues need be clarified: a clear understanding of the activity called R&D and innovation, and the game called market orientation and how different, if at all, is the market orientation of R&D with that of any other business approach.

R&D & Technological Innovation

R&D is a process of knowledge generation for addition to the already available accumulated knowledge base. R&D is an inventive activity based on experiment and forms the core of technology supply system. A technology is a body of knowledge about the art of combining a set of inputs for producing a product. Apart from a specific R&D, a technology is generally an outcome of many parallel and previous R&D activities or accumulated knowledge. A technology, through diffusion process, when used in production is called technological innovation (Evenson & Kislev, 1976).

Present day technological inventions are distinctly different from those of pre-modern period. The pre-modern period technological invention was the result of experience based trial and error method; a spontaneous activity, peasants and artisans performed in the course of production. The invention thus created was virtually free and no accountable cost or price could be attached to it. In contrast, present day experiment process (what is called R&D) has a specific purpose and use attached to it. A planned investment is done and activities are organised in a particular way with an explicit expectation of the outcome, or return. (Lin, 1995).

The main problem with R&D activity as an investment proposition is that its outcome cannot be forecast (except in cases of minor R&D) at the level of trouble shooting or quality control. As a result profit oriented private enterprises are likely to shy away from investment in R&D which does not ensure certainty of out come, more so in the case of developing countries where Schumpeterian technological competition is not the rule of the game. Here come the role of government in augmenting the investment in areas of R&D where profit oriented private enterprises will not easily venture into. And here begins the dilemma and confusion regarding the role of public investment in industrial R&D. The crux of the problem is that being situated outside the realm the production activity, how do publicly funded R&D institutions select R&D projects, organise R&D and productionise R&D results?

Market Orientation of R&D

Market is a notional space where demand and supply meet and a set of relative prices is determined for a set of commodities put on exchange. R&D being the supply system and production system being the user, technology is also conceived as a commodity and, therefore, having a market. As an art of producing a commodity, technology is there behind the production for every commodity. A commodity can be for production of other commodities, it also can be for final consumption. It is at the level of consumption (for production or for final consumption) of a commodity that the need for a new technology is felt in the form of a process or product technology. If the R&D system (technology generation) is a part of the production system then the felt demand can immediately be communicated to the R&D system, which on the basis of available knowledge, identifies the knowledge gap, generates new knowledge for the development of technology and productionisation of the same. In those cases where the R&D system is away from the production system or geared to future technology areas, problem arises in establishing a communication channel between the two systems. The absence or presence of a communication channel, in fact, determines the very style of organising R&D. Keeping the specific problem of CSIR and government funded R&D in mind, the problem lies not only in establishing a communication channel between CSIR Laboratories and industrial production system but also in the choice of R&D projects from areas where profit oriented private enterprise will not enter; that is, not to enter into the domain which naturally should be left to the industries.

Market orientation of technological innovation means instituting a communication channel between the production system and the R&D system and also building up a complementary organisational structure for carrying out R&D.

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While one hand of R&D is extended to the production system, another hand has to be extended to science. The relationship between science and technology can not be over emphasised. The basic difference between technological innovation in the pre-modern era with that the modern period is that in the former, innovation used to be

guided by experience whereas modern R&D activity is guided by science. Market provides the clue to R&D problems; science provides the clue to solution. An important part of market oriented R&D is market's confidence in the R&D capability of an RDO. The capability of an RDO is reflected in its command over a scientific knowledge base.

Benchmarking (BM) as a Methodology

Benchmarking is an example of housewives' wisdom in use for solution of managerial issues; of complex decision making process of modern industries. Learn "how" from some body who has done it better than you — is the basic message of BM. Rest of it is only a systematic dissection of identified activities which have to be changed or improved. Identify an Organisation or a set of Organisations which are considered as the best in the trade. Look for the activities where differences exist. Analyse if those differences are critical for the projected achievement. Select how many of them are possible to be replicated in your activity. Implement required changes. This is the crux of BM. It is to be noted that BM has to be seen and practised as a continuous activity.

BM is, in fact, the logical extension of strategic planning — the much talked about management 'must' in 1980's which fell into disrepute by the end of the same decade. In effect long range planning is nothing more than handsomely bound bunch of papers which has rare relevance to actual business planning (The Economist, 1993). It has been argued that competitive strategic planning is useful in decisions such as: whether the company should enter or exit a particular market segment; what will happen if price is chosen as a strategic variable for market expansion etc. What strategic planning does not deal with is at the operational level where strategic decisions are executed and the fate of the strategy is decided (Walleck et. al, 1991). However, BM as viewed as a logical extension of and complementary to strategic planning — strategy is broad directive guidelines, BM is the details of execution of the identified core activities of a strategy; i.e. tactics. (Rock, 1987)

As tactics BM is not limited to competitors. Boxwell (1994) elaborated that it was not necessary that best practices were found only in the competitor who was the best in the trade. What is important is the generic similarity of activities; to look for similar activity even in a totally dissimilar trade. (Brelin, 1993). This way "BM is plain and simple learning from others. Identify them, study them and improve based on the learning". (Bemowaski, 1991, p. 19). The aim of BM is to tap into that tremendous pool of knowledge so that the collective learning and experience of others can be used by those who wish to improve their own organisations. The essential benefit of BM, is that it replaces the old trial and error method of learning which many a time results in the reinvention of the wheel. With BM it is possible to quickly learn and adopt processes which others have already proved effective. (Bemowaski, 1991).

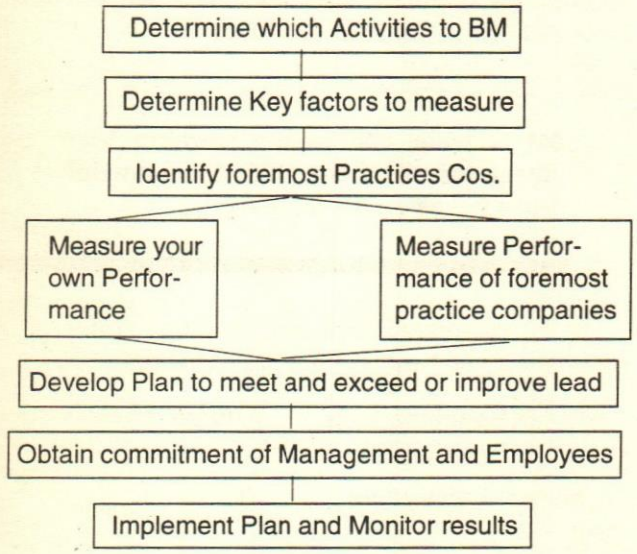
BM is plain and simple learning from others. Identify them, study them and improve based on the learning.

In his celebrated book on BM, Camp (1989, p. 30) summarized the benefits from BM as follows:

Without Benchmarking	With Benchmarking
Defining customer requirements	
Based on history or gut feel	Market reality
Perception	Objective evaluation
Low fit	High conformance
Establishing effective goals and objectives	
Lacking external focus	Credible, unarguable
Reactive	Proactive
Lagging industry	Industry leading
Developing true measures of productivity	
Pursuing pet projects	Solving real problems
Strengths and weaknesses not understood	Understanding outputs
Route of least resistance	Based on best industry practices
Becoming competitive	
Internally focused	Concrete understanding of competition
Evolutionary change	New ideas of proven practices and technology
Low commitment	High commitment
Industry best practices	
Not invented here	Proactive search for change
Few solutions	Many options

Average of industry progress	Business practice breakthrough
Frantic catch-up activity	Superior performance

Boxwell (1994) suggested an eight step BM process which can be applied to all situations.



"The applications for benchmarking are infinite. Assuming some finite amount of resources to devote to benchmarking projects, however, most organisations do well to establish some guidelines in determining what function, activities, or processes will be studied as part of their benchmarking programs." (Boxwell, 1994, p. 22)

Benchmarking R&D Institutions

BM studies on R&D institutions are rare. Following the general guidelines the foremost task is clear understanding of the organisation's future strategy and the major constraints on the way.

As reflected in several press interviews of the New DG CSIR, the main concern is effectiveness of R&D in the market place. There is a common method in understanding what constitute, the R&D effectiveness, (Szakonyi, 1994); those steps are: identification of the market need for R&D, good R&D planning, competent management of R&D personnel, appropriate criteria for evaluation of R&D, good team work between functions in exploiting R&D, and effective transfer of technology. All these aspects can be grouped into following major processes:

- Marketing of the capability of R&D institutions. This includes both making the capability of the R&D organisations known to prospective clients and also identification of the needs of the clients.
- Project Management which includes project initiative, operation, monitoring and evaluation and transfer of R&D output.
- Capability development which includes both human resource and facility development.

These three processes are inter-linked. Any R&D organisation has to continuously strive toward capability building in frontier areas of its activities particularly in this age of globalisation when the technological frontier is being widened very fast. Organised R&D in today's world entails huge cost. How is an RDO going to raise the required resources? How far can an RDO mobilize its own resources for funding its capability building activities? The answers lie in the RDO's efficiency in marketisation of its present and future capability or to put it in other words the market's faith on the RDO's capability in providing various technological services i.e. management of its R&D and related activities.

These processes work within an environment defined by the overall Organisational Structure. Organisational Structure as a process broadly means the governance of an RDO, and the nature of commitment from the ownership for its sustenance. BM as a methodoloy suggests that the best way to find out what is the best way of doing something is to learn from the accumulated knowledge of other RDOs. The task therefore is to dis-aggregate the main processes in to several sub-processes and identify practices for each sub-process for different RDOs. As argued above, it is not necessary to compare practices with another RDO. It is quite possible that the best practice may be found in organisations out of the trade of RDO. However, for the present purpose we are restricting our comparison only among RDOs.

Once practices are identified, the next task is to determine the best practice. An exercise of practice level BM has to set metrics for each practice. On many occasions it is simply not possible. Setting quantitative goals, often called metrics, through BM is arguably the best way to set goals, but it is to be kept in mind that setting goals comparable to or beyond those of the best in-class without understanding the underlying processes that enable the best-in-class to achieve their results can be useless or worse. (Boxwell, 1994). Understanding how the companies under study achieve their results is usually more important and valuable than obtaining some precisely quantified metrics. You benchmark the most important, not the easiest to measure". (Sprow, 1993). Setting quantifiable metrics at practice level becomes more difficult in case of RDOs where market interaction is not direct. It is to be noted that demand for R&D or technology is always a derived demand.

Understanding how the companies achieve their results is usually more important and valuable than obtaining some precisely quantified metrics. "You benchmark the most important, not the easiest to mesure".

Demand for R&D or technology by a firm is actually the firm's understanding of the state, pace and nature of development of the future market and the long term strategy of the firm. As a result it is not always sensible to set quantified metrics for practices which are supposed to result in high R&D effectiveness. The problem can be tackled by identifying the best RDO (instead of best practices of RDOs) in terms of certain generally acceptable macro level indicators. The practices of the best RDO, therefore, can be compared with other RDOs and as suggested by Boxwell the underlying process can be logically elaborated to examine whether the practices of the best RDO qualify as the best practice.

Benchmarking of RDO: An Exmaple

As an example of the actual study of RDO best practice, we present the salient aspects of BM methodology adopted in a paper 'Best Practices of Selected RTOs in South and South East Asian Countries'. (Nath et. al, 1995). Following RDOs had been covered by the study which is being cited here:

The Automotive Research Association of India (ARAI), Pune, India.

Central Leather Research Institute (CLRI), Madras, India.

Ceylon Institute of Scientific and Industrial Research (CISIR), Colombo, Sri Lanka.

Singapore Institute of Standard and Industrial Research (SISIR), Singapore.

Thailand Institute of Scientific and Technological Research (TISTR), Bangkok, Thailand.

Standards and Industrial Research of Malaysia (SIRIM), Kualaumpore, Malaysia.

Regional Testing Centre (RTC), Calcutta, India.

National Chemical Laboratory (NCL), Pune, India.

From the list of the core processes and sub processes listed in the paper we select the following for our present purpose:

Core Process	Sub Process
• Organisational Structure	— Ownership pattern — Constitution of Board — Sources of Core fund
• Marketing of RDO Capability	— Identification of needs of the clients — Informing the prospective clients about capabilities of the RDO.
• Project Management	— Project Selection — Selection of Project Leader — Functional Authority for Project Execution, Monitoring and Evaluation.
• Capability Development	— Identification of Areas for capability building — Identification of need for Facility Development. — Resource Mobilisation for — Capability Development. Career opportunities for Personnel.

In the study under discussion an effort was made to rank RDOs under consideration in terms of the following factors:

- Growth of income from clients over 5 years (1989-90 to 1994-95)
- Dependence on government grant measured in terms of share of govt. grant in total revenue - average over 5 years (1989-90 to 1994-95)
- Expansion of RDO activities over 5 years (1989-90 to 1994-95)
- International and national recognition of the RDO measured broadly in terms of international patents, publications in international journals, representation in various technical committees (national and international) etc.

Scores of different RDOs for the above mentioned four indicators have been added up to calculate the rank of a particular RDO-highest scorer given rank 1.

Of course the method is not fool proof for several reasons. First, it is possible that averaging over longer years (instead of 5 years) may change the relative scoring of RDOs. Second, there is a scope for subjectivity in

judging the value for indicators like "Recognition" and "Expansion". However, for the present purpose, the method could be considered only as indicative. What is important is that overall ranking arrived this way matched the general impression derived by the BM team in the course of their interviews and interactions with the RDOs which are being compared.

On the basis of this ranking, the following practices for the sub processes listed above have been identified as the practices of the best RDO. We also try to elaborate the underlying process to examine whether practices of the best RDO can be called as best practices.

Core Process: Organisational Structure

Ownership: A non-profit government enterprise with full functional autonomy.

Particularly in the context of less development countries, the RDOs (i.e., the technology supply system), cannot be left to the vagaries of the market. One of the recognised characteristics of less developed countries is underdeveloped market forces. Also, as Arrow (1962) argued in his celebrated paper for major innovation some kind of institutional innovation is necessary. Attachment to the government provides RDOs with the necessary financial cushioning, and also the legitimacy and statutory authority for undertaking varieties of technological services.

Constitution of Board: The governing body of the RDO is mainly represented by clients from relevant industries. The government body is actively involved in taking strategic decisions and mobilisation of resources.

Attachment to government along with minimum interference from government help make the governing body more active. It also helps insulating the RDO from government bureaucracy and lends sharper focus to the client's needs and priorities.

Source of Core funding: No core funding from any source. Government funds the projected deficit between revenue and expenditure.

More dependence on income from clients (or less dependence on routine grants from government) make the RDO more pro-active. In fact the RDO has to develop a strategy of mobilising resources from non-government sources for its regular and future activities.

Marketing of RDO Capability

Identification of Needs of Clients: Through a regular survey of technological needs and strategies of target clients. Also through regular visits and other forms of interactions (like workshops, training programmes etc. organised by the RDO) with clients. Such activities are organised by a separate department/division.

As mentioned, the key to the success of market responsive R&D is to build up an effective communication channel with the industry clients. Again referring to the typical scenario of less developed countries where industries are not technologically dynamic, a pro-active action by RDO is essential. Instead of expecting clients to approach the RDO with their problems, it becomes necessary for the RDO to educate the client of the potentiality of new technological ventures and also build up the client's confidence on the RDO.

In this regard, another practice of an RDO (one among the first four, but not the best according to the macro level indicators mentioned above) has been found unique and potentially effective. The RDO runs a full fledged faculty in a University for Master level degree course in its own field. As a result a large number of technologists trained by this RDO, get placements in related industries and work as crucial link for interaction between the RDO and the industry.

Informing the prospective clients about the capability of the RDO: In addition to the common practice of promotional and awareness building activities through circulation of brochures, news letters, pamphlets etc., arranging workshops and training programmes on particular technological issues in the RDO's areas of strength is the main focus.

The RDO also encourages its personnel to contribute publications in trade journals and popular magazines on emerging technological issues and possibilities.

The emphasis is on workshops and training programmes for clients. Also to be noted is the emphasis on publications in trade journals and popular magazines. These are in sharp contrast to many RDOs which organise workshops for the academic community and encourage publications in highly rated academic journals. While need for academic excellence of an RDO should definitely not be undermined, RDOs have to clearly set the priorities between academic excellence and industrial research. Industrial research may also bring academic accolades but if it is to be made more market responsive, then the focus of workshops and publications has to be the industrial clients.

Project Management

Selection of Projects: The divisional head selects and approves projects.

A devolved structure of authority and responsibility sharing helps develop leadership and simplification of decision making process.

Selection of Project Leader: The common practice among all RDOs under consideration is that the head of division/department selects the project leader. However, in the second best RDO it is the head of division/department who is generally the project leader.

If we follow the argument in favour of the efficiency of a devolved structure of authority, responsibility delegated to the head of division/department appears to be the best practice.

Functional authority for project execution, monitoring and evaluation: All RDOs have the common practice of decentralised authority at division/department level.

Capability Development

Identification of Areas of Capability Building: Governing Body identifies the strategic areas where capability building is needed.

A Governing Body with substantial representation of prospective clients and also with substantial autonomy helps reflect the market need in the choice of areas of capability building.

Mobilisation of resources for capability development: Through creation of surplus fund for undertaking projects for capability building. Representation of important clients from industries in the board (which also takes decision on areas of capability building) helps mobilization of resources from clients.

General practice is to access various government and non government (national and international) agencies for resources for capability development. Apart from the tied nature of such funds, in many cases the market perception of areas of capability building may differ from that of funding agencies. Another danger of dependence on funding from external agencies (particularly in a situation when the RDO is under pressure for increasing its external cash-flow) arises when the RDO chooses areas (for capability building) where funds are available. Such actions may not only lead to a total mis-match between market need and RDO capability, but also result in lack of synergy in diversified RDO activities.

Career Planning and Training for RDO personnel: The RDO has full autonomy in deciding the compensation package for its personnel. Promotional policies are based on the performance evaluation in terms of the capability of earning one's own salary along with leadership quality, technical capability etc. Every employee has to undergo training on interaction with clients. Human Resource Development is done through engaging persons in in-house projects in areas of capability building and also by sending people for external training in identified areas.

Autonomy in setting its own compensation package gives the RDO the much needed flexibility in recruiting the right persons. The RDO which works within a typical government set-up can not exercise such flexibility. Another important aspect observed for the best RDO is an evaluation system for its personnel which is consistent with market oriented approach. The inconsistency arises when an RDO expects its personnel to become more market responsive, but evaluates their performance on the basis of non market categories of academic excellence reflected in publications in international journals.

Inconsistency arises when an RDO expects its personnel to become more market responsive, but evaluates their performance on the basis of non market categories of academic excellence.

Implementation of Best Practices

Implementation of the findings of any BM study could be much more complex than the identification of best practices. Once the underlying principles of a best practice are delineated, the complexity in implementation. For example, let us take the best practice in the governance of RDO. We have suggested that functioning like a govt. enterprise help RDOs to become more responsive to market needs. Adoption of this practice has to be aligned with the general policy of government . An equally important issue is whether the employees of the RDO are committed to such a change over and if not how to win over them. In such cases the concerned RDO can learn from the RDOs who have successfully transformed themselves with cooperation from their employees.

Another important aspect of implementation is to discern the synergy among practices. Practices do not exist independently, or in isolation; instead, they exist or sometimes emerge as complement or conjoint to other practices. Practices, therefore, have to be seen as parts of a whole and always have to be understood with reference to the whole. If market responsive R&D is the mandate of an RDO, practices within every process have to be dovetailed in such a way that they do not become

contradictory to each other. Referring to the study discussed, it is to be noticed that practices of the best RDO for all sub-processes are structurally consistent for market responsive R&D activity. On the contrary, if practices are seen and adopted piecemeal, benchmarking could be self defeating. An example of contradictory practices could be a mandate of becomining market responsive without any autonomy in deciding compensation package, or career opportunity for its personnel (that is makes the best skill in the market inaccessible to the RDO). Similarly, if the expectation from the RDO personnel is that they will build up a close interaction with industry by articulating and solving their technological problems, but their performance is evaluated in terms of their publications in internationally recognised academic journals, the RDO would probably achieve neither academic excellence nor credibility with industry.

Practices have to be seen as parts of a whole and always have to be understood with reference to the whole.

Last but not the least is the socio-cultural milieu within which an RDO has to function. The RDO which is interested in benchmarking its practices has to consider this as something externally given and beyond its command. It is simply not possible to transplant a set of practices from one socio-cultural milieu to another. In fact, for a BM study, lest the whole exercise becomes futile, organisations to be compared to practices should be chosen only from those which belong to the same socio-cultural category.

Many of the prefecture laboratories in Japan have shown remarkable technological achievements. Most of them are not only fully funded by government but also work within a government structure like a government department with very limited career opportunities for the individual employee. And these RDOs are not less responsive to the market needs. As generally perceived, social relations are important ingredients in Japanese style of management. The same is generally true for the government funded RDOs in Japan. The commitments of the employees for the task entrusted to them is, therefore, ensured by social forces. In a typical western society, commitment of employees has to be obtained through a formal contract between the employer organisation and the individual employee. The contract is to be governed by the prevailing norms of the market ensuring the commercial (professional ?) interest of both the employer and employee. These are two different socio-cultural categories. Now, if practices of a very successful Japanese RDO are adopted in a cultural configuration which is broadly western, the resulting mis-match may make the whole system non-functional.

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The State of Benchmarking

Robert C. Camp & Bjorn Andersen

A survey was conducted to assess the current status of benchmarking with a view to projecting the future development. Mechanisms for the transfer of best practices within the organization were found to be the highest priority issue.

Robert C. Camp is from the Quality Network. Bjorn Andersen is from the Rochester Institute of Technology. *This article is reprinted with permission from Continuous Journey, Summer 1995.*

Interest in benchmarking has virtually exploded since 1979 when Xerox first introduced it. Today, benchmarking, as a tool, is widely used. It has spread geographically to large parts of the world and proliferated in a variety of manufacturing and service businesses, including health care, government, and education organizations.

Along with the increased use of benchmarking, some changes in its practice have occurred. The focus of bench marking studies has gradually shifted. in early studies, the focus tended to be on performance measures, competitors, and ambitious targets. Recent studies have examined how non-competitors and industrial outsiders learn to improve business processes. Comparison of performance measures has developed into learning about best practices.[1] In fact, some authors have used the term *benchlearning* (*Karlof & Ostblom*, 1993).

Comparison of performance measures has developed into learning about best practices.

There also has been a trend to use benchmarking in a more coherent fashion and to more closely link it to an organization's strategy. Some large organizations have established formal benchmarking efforts.

Assessing and Projecting

To understand the current state of benchmarking and attempt to project its future developments, a survey was conducted among a cross-section of organizations.[2] The

1. The development of benchmarking, from competitive bechmarking focused on performance measures to functional and generic benchmarking focused on business processes, has been described by several authors. For example, see, Watson 1993; Zaire & Leonard, 1994.
2. Robert C. Camp developed this survey, which was conducted from March through May 1995.

survey questions and respondents were purposely structured to gain insight into emerging benchmarking developments. Among these were the capture, sharing, and dissemination of best practices and the influence of technology—including computers, databases, and networks–on benchmarking.

A two-page questionnaire was designed and mailed to a sample of 59 organizations known to be active in benchmarking. The sample was composed to display large differences among the businesses in terms of size and type of industry. included in the 59 organizations were both large, medium, and small companies, ranging from manufacturting and service industries to health care and government institutions.

Thirty-nine percent responded to the survey. Of the 23 returned questionnaries, five were excluded from the analysis for not being properly completed. Of the remaining 18, 12 were from manufacturing companies, five from service groups, and one from a government institution.

Survey respondents were asked about the current and future use of benchmarking. Questions covered areas such as the existence of a formal benchmarking effort, benchmarking training, mechanics for transfer of best practices, and the use of PCs, software, and on-line services for benchmarking.

The questions were selected and sequenced to first ask about the current and easy-to-implement procedures and then question the future and difficult-to-implement benchmarking practices. Questions were grouped into eight topices, and respondents were asked to rate the importance of the issues raised in the topic. A 10-point scale was used for this purpose, where 1 represented the least important and 10 represented the most important.

Furthermore, the questionnaire instructed the respondents to force rank the topics from 1 (high priority) to 8 (low priority). This exercise was included to reflect where additional benchmarking efforts and resources were likely to be spent or believed worthwhile.

To illustrate the differences between the importance rating and the priority force ranking, consider the following example. The quesitons covering benchmarking training are rated 9 for highly important to an organization; but benchmarking training, as a topic, was ranked only 6–that is, having a rather low priority. Such an outcome would probably mean that respondents regarded training as essential for benchmakring success. From the low ranking, however, it can be interpreted that training is already sufficiently covered and would not receive any further resources.

Overall Findings

The eight topics were sorted according to ascending mean importance rating. This resulted in the chart shown in Figure 1. All eight topics rated fairly high–the lowest being 5.6 on a scale from 1 to 10. The highest rated item scored 7.8. Thus, the difference between high and low was a mere 2.2 points. Some of this evenness could probably be attributed to the fact that such rating scales are rarely fully utilized.

An equivalent chart, displaying the mean ranking of each topic, is shown in Figure 2. Compared to the importance ratings, a higher degree of discrimination was found in the ranking data. The highest-ranked item scored 2.9, and the lowest scored 5.9. This was expected, however, as the questions had to be force ranked.

Formal Benchmarking Effort–Looking closely at the importance ratings, two issues stand out on the high-importance end. The existence of a formal benchmarking effort was perceived as essential. This issue also was ranked high, which was a little surprising, as about three-fourths of the organizations said a formal program had already been established. On the other hand, many of these were said to have been just recently formed, which might explain why it is an area considered likely to receive additional resources.

Transfer of Best Practices–The other highly rated topic addressed mechanisms for transferring best practices revealed through benchmarking. About 75 percent of the respondents indicated a need for a formal process in this area. This question also elicited the strongest wording in the entire questionnaire, including, terms like *tremendous need* and *one of the top three priorities of the organization.* The issue ranked highest, 2.9, which probably represents one of the most significant findings in the survey. Developing a process and mechanisms for transferring best practices is an area of high concern. Some work has been done to address the issue, Gabriel Szulanski, 1994, but there is clearly a need for further development.

Other initiatives ranked as moderately important topics, included total quality management (TQM), business process management, benchmarking training, and the use of networked PCs for benchmarking.

Issues on the low end of the importance rating included requirements before proceeding with benchmarking and the use of on-line database and dialogue services. These, however, were ranked higher than the respective importance ratings. These services were said to be used infrequently and of medium usefulness, which might explain the low importance. The higher ranking might reflect an expected increase in the use and benefits of such services as they are further improved and extended.

Findings

The following observations were made after reviewing the survey answers, question-by-question, and the ranking order.

Transfer of Best Practices–As noted, an overwhelming majority of the respondents indicated a compelling need for establishing a formal process for the transfer of best practices. This is to avoid duplication and replicate best practices globally. It's viewed as a top priority that has not been seriously addressed.

No respondent claimed to have sloved the problem, however. Mechanisms that organizations currently use include informal exchange during meetings and other networking activities, Louts Notes, newsletter, and stored documents. As this is a priority issue that many organizations indicated they would put resources into, this is an area within benchmarking that is likely to be further developed during the next few years. This belief is also substantiated by the fact that academia has taken an interest in the issue. (Syulanski, 1994).

Formal Benchmarking Efforts–With regard to formal benchmarking efforts, again as much as 75 percent claimed to have formed them, albeit some just recently. For those without a formal effort, benchmarking activcity was reported to be sporadic, part of a larger initiative, and used when needed, often as a fact-finding tool. In the organizations where formal efforts had been established, some sort of central competency functioned as a driving force. Tasks completed by such a competency included benchmarking training, search for and maintenance on best practices, and implementation of incoming benchmarking requests. The high ranking might indicate that the practice of formal efforts will be further developed, thus more strongly linking benchmarking to strategy and other improvement efforts in organizations.

Training–Most of the respondents claimed to have established formal benchmarking training programs. Two major types of training included manager awareness training and benchmarking team training. Most of the training was of two days' duration and given on a just-in-time basis. About half of the organizations had developed training course material in-house, while the rest mainly relied on external consultants for training delivery.

On-Line Services–Another medium-ranked question pertrained to the use of on-line, interest-type services for internal or external dialogue on best practices. Only

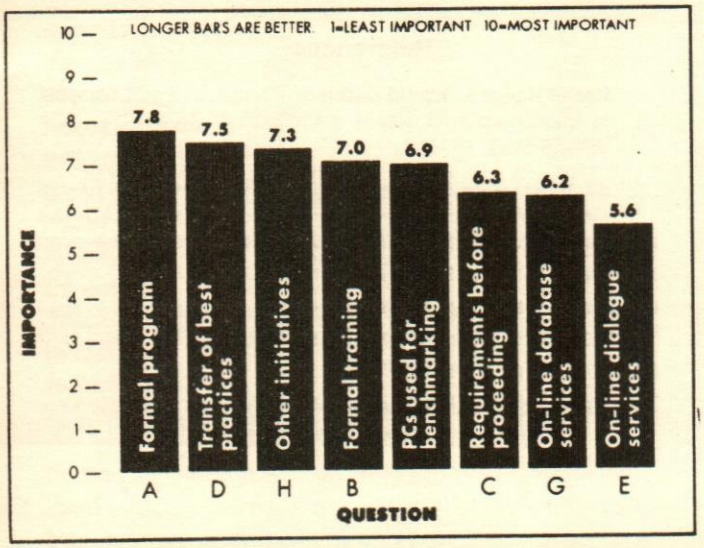

Fig. 1 Importance Ratings for the Survey Questions.

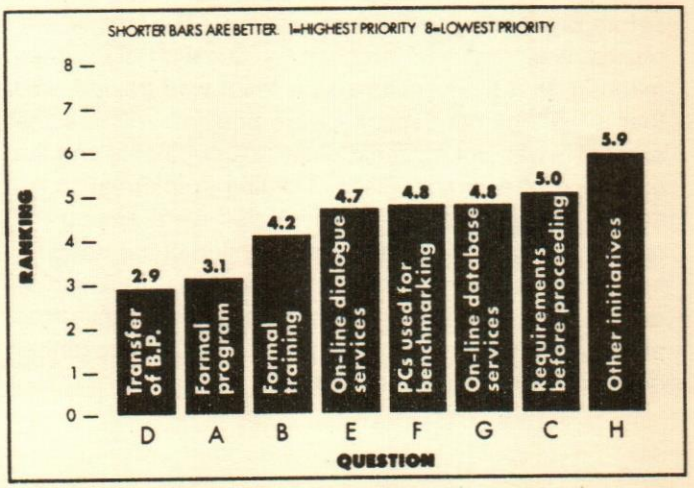

Fig. 2 Forced Ranking of the Survey Questions.

four respondents reported not using any such services, 13 accessed the International Benchmarking Clearinghouse Network, nine used The Benchmarking Exchange, while five had access to other internal or external services. Many organizations, however, pointed out that these services were used very infrequently. The relative high ranking of this issue could indicate an expected increase in the use of such services, perhaps as a consequence of an increased need to find benchmarking partners for various business processes.

The next question in order of ranking covered the use of networked PCs for benchmarking. A predominant finding revealed most organizations had a high number of PCs connected to both internal and external networks. About half were using some groupware software, mainly Lotus Notes, but some were using Mosaic and E-mail systems. Furthermore, approximately two-thirds were, in some capacity, using these items for benchmarking–mainly for information sharing and dialogue handling, information requests and responses, and outside information searches.

When asked about the use of on-line databases, only one-fourth of the respondents answered they were not using any such services. The predominant use included the International Benchmarking Clearinghouse database and The Benchmarking Exchange, mainly for contacts, partnering, and data searches. Many people have expressed doubts about the benefits of such best practice databases, and the low ranking seemed to confirm that this is not an area of high importance to benchmarkers.

Other Requirements Before Benchmarking–The second-to-last ranked issue dealt with requirements, other than benchmarking training, that had to be satisfied before proceeding with benchmarking. The major emphasis was that the process in question had been mapped, that the benchmarking team was trained, and that a management sponsor was present. Also, some emphasis was put on confidentiality agreements and the existence of a project plan. Training in information research and project management also were among the requirements. There was some mention of the need for information searches, cycle time analysis, and survey design. The low ranking probably reflects that resources already have been committed to this area, and no further developments have been predicted.

Conclusions

The most significant conclusion of the survey found the mechanisms for the transfer of best practices within an organization is truly a high-priority issue. Large organizations seem to have experienced major problems in disseminating best practices found in benchmarking studies to other areas of the organization. Such problems limit the outcome of benchmarking and result in a less-effective use of resources put into benchmarking studies and a loss of opportunity for the adoption of best practices throughout the organization. This is obviously an area for further work and research.

The use of computers in benchmarking, both for information sharing internally and externally, and for partnering and searching for best practices, seems to be growing. On the other hand, direct contact with other companies and firsthand observation of best practices still seem to be the preferred methods. Some development within this area does, though, may be expected.

The use of computers in benchmarking, seems to be growing.

Formal efforts for benchmarking in general, and for benchmarking training specifically, were also highly important areas likely to be further developed. These might be signals that bechmarking is about to be increasingly institutionalized and become an integral part of business.

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A Pilot Benchmarking Study

Vicki J. Powers

Its' not often that an operating group hits a home run in its first time at bat. But in the process benchmarking "ballgame," General Motors Service Parts Operations did just that. The author recounts the experiences the company went through and the lessons learned after a pilot benchmarking study.

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General Motors Service Parts Operations (SPO) is a 26-year-old operating group under General Motors (GM) with roughly 14,000 customers and nearly 13,000 employees world-wide. It primarily provides parts and service to GM dealers for vehicles produced in North America. It also provides parts and service, through AC Delco, to the independent aftermarket that services GM vehicles outside the GM dealership.

SPO's beginnings with benchmarking trace back to the strategic planning organization that was the impetus to benchmarking.

The Forefront of Benchmarking

SPO selected the Product Release and Change System (PRCS) as its pilot benchmarking study in late 1991. This horizontal process begins when each vehicle division communicates the parts used in a vehicle to SPO and ends with the creation of a schedule to suppliers. In non-GM terms, it refers to the process of introducing a replacement part.

The process and system that SPO utilized for replacement parts had evolved into a patchwork system over time. The process was completely sequential with a long cycle time, significant redundancy between activities, poor performance monitoring tools, and a poor expediting system. Specifically, there were four reasons why SPO selected this process as its pilot study:

- High systems/operations cost
- High level of customer dissatisfaction
- Area of weakness from a competitive standpoint
- Key success factor for SPO.

Customer dissatisfaction was a big issue, because they were unable to get service replacement parts on new vehicles when they were introduced. This became a real throttle from their perspective. The late '80s, averaged 50 percent readiness on parts, which has improved to 91 percent readiness in 1994 after benchmarking.

Benchmarking-at-a-Glance

The benchmarking team started the benchmarking process by documenting the process as is before the study. Based on the sequential nature of the old process, the team could visually see the snag — one step in the chain could not begin processing parts until the previous one completed its tasks.

From left, Joel Cuttitta, engineering; Amy Cannello, strategic & business planning; Bill Moorehead, EDS engineering; and Dave Hanson, materials management, review the findings of a benchmarking study on the product release and change system

Next, the team set partner criteria — one of which was to select partners outside the automotive industry. This proved a worthwhile decision, because they say a high-level focus they wouldn't have seen from their competition. Sometimes it's an advantage not to be intimately involved in the process.

"They selected three organizations outside our industry as benchmarking partners after looking at about 10 companies,". They realized that their whole focus was wrong. They were trying to improve cycle time. While in fact, the issue wasn't how fast the part is turned through the system — it's having new parts ready when the product is introduced. As a result, they changed the focus to measure how 'ready' we are when the product is introduced."

After the benchmarking team's first site visit, the team leader/facilitator, realized the team needed a data collection tool to ensure a consistent methodology for collecting data. In response, she created a site visit binder to help organize team members and keep the data together. The partner's binder was sent one month before the site visit with the following information: SPO information, project mission, code of conduct, quantitative information, agenda, and topic list. SPO team members receive a binder with the same partner information and a few additional pieces: partner and SPO questionnaires, selection matrix, and topic lists.

Enablers

After the benchmarking team conducted its site visits, it recognized four enablers companies need to effectively manage the process of introducing new replacement parts. These included:

- Focus,
- Structure/Responsibility,
- Culture,
- Communication.

First, SPO recognised its partners had a consistent focus on product introduction date and didn't consider internal customer cycle time as a critical measure. The best organization used one report to manage the process, while SPO used 45. Some best practice com-

panies even held product introduction until the service parts were available. The team also discovered culture was a critical factor that helps companies achieve a higher level of performance. This is accomplished by greater interaction between service and manufacturing who team together throughout the life of the product.

Culture was a critical factor that helps companies achieve a higher level of performance.

Implementation

Throughout the entire benchmarking study, which took about seven months before the implementation phase, implementation was drilled as an important part of the benchmarking process. The goal was to implement as many enablers as possible, so SPO broke implementation into two phases: short-term implementation and long-term implementation.

Short-term implementation gives people energy to implement log-term findings, especially for a pilot study.

With the site visits complete in August 1992, the short-term implementation began in Fall 1993. The organization was not ready to implement key enablers right away because the organization was commodity focussed, rather than vehicle focused. SPO required organizational changes that took time to put in place before implementation could begin.

The majority of implementation for the pilot study was completed in the first year. In two years, 15 of 25 enablers have been implemented for the replacement parts process. The other enablers are considered "out-of-scope", since GM is structured differently from the benchmarking partners.

Some of SPO's impressive results go beyond dollar amounts. Many culture changes took place as a result of the benchmarking pilot study. These include:

- Increased acceptance for process improvement
- Increased willingness to look outside the industry for best practices
- More focus on process rather than systems.

Regarding the dollar savings, SPO has dramatically improved in many areas from 1992 to 1994:

- Cycle time has decreased from 54 days to 20 days,
- Service readiness, the new measure SPO captures, has improved from 73 percent in 1992 to 91 percent in 1994. The slogan in 1995 is "95 percent in '95".
- Optimum cycle in hours has dropped from 240 hours to 24 hours
- Dealer satisfaction has improved from 92.5 percent to 96.8 percent.

Overall, SPO has saved nearly $2 million from its first benchmarking study: $1.8 million in operations savings and $48,000 in system costs savings.

SPO currently has 10 benchmarking studies in various stages. SPO also is developing a User's Guide to encourage team leaders to take more ownership in the facilitator role.

Lessons Learned

- Utilize a facilitator with benchmarking experience.
- Use an expanded benchmarking team, rather than separate benchmarking & implementation teams.
- Designate an executive champion empowered to make changes.
- Assign roles to team prior to site visits.
- Include debrief time during site visits.
- Develop a process before the system.
- Incorporate changes into the business plan. □

Internal Benchmarking — "Kodak Class"

A.T. Enustun & J.M. Madigan

Benchmarking has gained recognition as a valuable management tool for assessing the performance of an organization. This article summarises the lessons learned from an internal benchmarking venture in Kodak. At the conclusion are some recommended approaches for senior managers embarking on a similar learning journey.

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Since early 1990 at Eastman Kodak Company's manufacturing locations around the world, the film and the sensitized paper operations have been conducting "internal benchmarking" studies among themselves to identify and learn from the leaders in quality, unit cost, inventory, delivery levels and the like. Richard Bourns, senior vice-president of world-wide manufacturing, referred to the "top-guns" in each category as the "Kodak Class". He then challenged each manufacturing location to be as good as the best among them. Now in its fifth year, this internal benchmarking effort has spread into other areas within the company.

Measurement of discrete process performances and functionality within an organization, by comparing similar business units, product performances of business processes, with the intent to identify superior performers, and learn from them, is the definition of the term benchmarking as practised by the company.

Measurement of discrete process performances and functionality within an organization, by comparing similar business units, product performances of business processes, with the intent to identify superior performers, and learn from them, is benchmarking.

Lessons Learned

In the past five years of carrying out internal benchmarking within the company, many valuable lessons have been learned some of which are obvious and others not so obvious. Here are some of the key learnings:

- Must have a driver - (leader, champion)

At Kodak, Richard Bourns, Sr. VP - Manufacturing led the "Kodak Class", internal benchmarking initiative with a directive to comply. Very little resistance was experienced and all units complied.

- Must establish a common criteria for measuring operational performance.

  For internal comparison to be successful, everyone must measure a metrics, identically. This will ensure apples to apples comparative analysis possibility. Otherwise the total effort of trying to compare similar items being measured by a rubber yardstick will be a nightmare.

- Must measure operational performance.

  Having a criteria alone is not enough. One needs to constantly measure against the criteria. It should include leading and lagging measures.

- Must track performance.

  At regular intervals the performance measurements need to be studied and course corrections rendered.

- Must feedback results to driver (leader), and keep driver involved.

  Performance tracking results must be reviewed with the sponsor (driver/champion/leader) on a regular frequency. Must understand the differences among the component units and get on with the learning process.

- Must re-inforce and recognize significant achievements.

  Organisations who lead certain measures need to be recognized and singled out. They need to be showcased.

- Must require leaders to share.

  Leaders must be asked to teach lagers (not-visa-versa). We often ask lagers to go and learn from leaders. However, lagging unit managers will not go and ask a leader: "tell me how to improve."

Success Accelerators

Our experience shows that if the following guidelines are observed in an organization, the learning potential markedly improves:

- Leadership role

  Identify the process owner. Ask the process owner to sponsor the internal benchmarking.

- Know your own operations

  A process flow charting or process mapping of your own organization's operation is a must. Benchmarking of any kind or level should not be initiated until you know your own process fully.

A process flow charting or process mapping of your own organization's operation is a must. Benchmarking of any kind should not be initiated until you know your own process fully.

- Existence of an internal champion.

  Either an implied or expressed "ownership" of the business process, or the network across the company is essential for success.

- Commitment to a full mission.

  Many learnings will surface in the course of the study. Commitment to fully adapt/adopt findings is a must. Otherwise, we just accumulate knowledge, and no real learning takes place.

- Linking to existing processes.

  For example, the implementation plan needs to be linked to the annual AOP planning cycle so that funding will be naturally pursued and not be a "special" case.

Concerns

For internal benchmarking to be a great success, the sponsor level senior managers must keep in mind the following significant aspects and make provisions to overcome them.

- Plan to deal with internal competition.

  Often, people are rewarded for achieving individual deeds and not group goals. It is not natural to aid competitors to our next job.

- Value sharing

  In many organizations, there is no rewarding of people who share the secrets of their successes. Training one's peers must be considered an ultimate reward!

- Must focus on the Results, not Metrics.

There will be a tendency to focus on the measures. However the results to be achieved must be always targetted.

- Some leaders will not be able to teach.

  Hence the company may have to invest in leaders who can be good teachers. Not every successful manager is a good teacher.

Recommended Approach

For those managers who will be embarking on an internal learning journey in their organizations, we have some recommendations.

- Establish "Sharing Culture" as a pre-requisite for an organization to ensure proper alignment of the units with the corporate objectives.
- Initiate the Internal Benchmarking effort in a business process that currently has a wide range of performance results. (i.e. where the opportunity to learn from leaders, exists)
- Apply the "Lessons Learned" and "Success Accelerators" suggestions, while keeping a special eye on the "Concerns" articulated.
- Motivate the "leaders" of a given process to share with others how they got there.
- Train senior managers on the essentials of Benchmarking, i.e. "Learning from others and applying that knowledge." (If necessary, conduct this training when managers are less busy, 5:30-7:30 pm! At Kodak this is called "After Hours Learning"!) □

'There is nothing more difficult to take in hand, more perilous to conduct, than to take a lead in the introduction of a new order of things, because the innovation has for enemies all those who have done well under the old conditions and lukewarm defenders in those who may do well under the new.'

Machiavelli

Feature

Higher Performance & Enhanced Productivity in Nigerian Organizations

P.B. Johnnie

This paper examines the factors that could induce higher performances and enhance productivity in public and private sector organisations in Nigeria. Factors such as motivation, work socialisation and control, leadership and management, work coordination systems, effective conflict resolution mechanisms and goal setting have been identified as important aspects of the management of work. All these issues are part of the Human Engineering Culture needed to bring about the accomplishment of the mission of the organisation.

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One of the primary goals of modern organisations is the maximisation of profit. In fact profitability has become the overriding goal of organisations and return on investment (ROI) has become the single criterion in practice to reflect organisational performance (Kolay, 1993) even in public sector organisations, the profit motive seems to have taken the front seat. Corporate executives have turned the organisation into a stage on which to act their 'profit' dramas, sometimes at a painful cost and to the detriment of the health of organisational members. Human problems of organisational members and the problems of the society in which organisations operate and transact have become less and less an issue.

Productivity and performance improvement schemes are important strategies in the agenda of most Nigerian organisations. But have Nigerian managers and administrators actually devoted enough time and resources to such programme? What they have attempted to do are patch works of programmes — they cannot possibly claim to have introduced any measures that would lead to higher performances at work if they are unable to identify the importance of the human factor at work (Johnnie 1988, 1988c). As managers, more often than not their focus and centre-piece for action had been inanimate objects such as plant, equipment and other tangible materials. Any form of declining productivity and lower performance levels in industry and the public sector can be traced to the fact that there does not exist a reliable Human Engineering Culture (HEC) in most of the organisations.

Developing Human Engineering Culture

There is a growing body of evidence which suggests that Science and Technology (S&T) will advance more rapidly from now to the year 2000 than in all recorded history. One way in which S&T has to manifest itself is

through the development of appropriate Human Engineering Culture (HEC) in the organisations. HEC is the process and form in which knowledge of the social sciences, gained by scientific study, experience and practice is applied with careful judgement in developing ways to manage the social and economic needs of the human resources to the benefit of the organisation, individual workers and the wider society. HEC is concerned with the conditions at the workplace. An appropriate HEC attempts to compare past, present and future management of work behaviour. HEC could be described as the application of scientific knowledge to the solution of practical human problems at work. It is nothing other than the application of those techniques and principles that are relevant in structuring emotions, thoughts and general behaviour patterns toward fulfilling the mission statement of the organisation. HEC is an organised system of identifying and using appropriate processes at work to stimulate organisational members to move in directions outlined and visualised by the organisation.

HEC is the process and form in which knowledge of the social sciences, gained by scientific study, experience and practice is applied with careful judgement in developing ways to manage the social and economic needs of the human resources to the benefit of the organisation, individual workers and the wider society.

Contemporary writers (Maslow 1943; Herzberg, 1959; Khandwalla, 1986; Johnnie, 1988e) see the behaviour of organisations as a direct response to the HEC adopted by managers at the workplace. Ahiauzu (1985) and Johnnie (1989), argue that the level of efficiency and effectiveness exhibited by the worker is directly related to the type of HEC designed and used by managers at work. Organisational effectiveness therefore, has a symbiotic relationship with individual effectiveness in the organisation. Whereas there have been a large number of studies relating to organisational effectiveness and the underlying processes that lead to their functioning (March, 1965; Nystrom & Starbuck, 1981; Pfeffer, 1982 and Khandwalla, 1985) there has been very little or no work done on the Nigerian organisation as a separate analytical category.

An important factor that could induce better performances and enhanced productivity in Nigerian organisations is the existence of strategic individuals and groups. Khandwalla (1986) identified "owners, managers technocrats, fieldworkers, client representatives and union leaders" as some of the strategic individuals that could be found in organisations. He went on to argue that groups such as "the top management team, the corporate planning group, the research and development group, the human resource development group, the market research group, and the spearhead team" that control or manage a particular area of activity in organisations are strategic groups that bring about advancement and profitable exploration of the client system, directed towards the accomplishment of socio-economic developmental mission. In the Nigerian situation, the Vice Chancellor, the Bursar, the Registrar of a University, the Managing Director of a company, the Chief Medical Director of a Teaching Hospital, the Head of Research and Development team in organisations are examples of strategic individuals. These are so described because they conceptualise ideas and spearhead the concretization of these ideas. These individuals give the organisation the 'will and directing mind'. They are the fountain on which the 'life stream' of the organisation flows. They are usually an embodiment of diverse knowledge and skills. Whereas strategic individuals in organisations form concepts and give direction and meaning to organisational plans, strategic groups fashion these concepts and ideas into definite and identifiable goals.

Whereas strategic individuals in organisations form concepts and give direction and meaning to organisational plans, strategic groups fashion these concepts and ideas into definite and identifiable goals.

A recent pilot survey conducted amongst a cross-section of Nigerian organisations shows that the most critical element in Human Engineering Culture in Organisations is the forced response of workers to work organisational processes. In other words, the striking feature identified in all the organisations we surveyed, is the ineffective organisational processes used by the individuals and groups who control the activities of these organisations. Infact, in some of these organisations, the ineffectiveness of their operations was exemplified by the negative reaction of workers to the human engineering programmes. This has made the Nigerian organisation

suffer "loss bearing capacity, despite the fact that it is known to enjoy a high social priority and legitimacy in raising resources". It is pertinent to add here that, the resource dependency of Nigerian organisations on the control environment has made them imbibe the more familiar negative attributes of the bureaucratic organisation. Experts have identified these negative attributes as, "rigidity in their management styles, sub-optimization and interfunctional conflicts, close supervision and employee alienation and the emergence of a conformist bureaucratic staff personality." Nigerian organisations could therefore be described as highly politicised, because their chief executives, and in some cases top management staff do not engage in their basic functional needs of planning, organising, directing, leading and coordinating but are used as political weapons to propagate the ideas, whims and caprices of those who control political power that influenced and determined their appointments.

Nigerian organisations, more often than not, have access to large government resources and subventions and do venture towards making entrepreneutral moves. But these bold moves, most of the times have been unsuccessful, as a result of the human engineering culture problem associated with these organisations. Because some of the beneficiaries of the activities of Nigerian organisations thrive on these poor organisational work cultures, they (the beneficiaries) make conscious attempts to frustrate or resist the introduction of change. It is right therefore, to accept Khandwalla's (1986) argument that the root of the ineffective management of Nigerian organisation may lie in issues of lack of motivation, rigid work control, uninspiring leadership and management styles, paucity of work coordination systems and conflict resolution mechanisms and setting goals that are unreasonable and unachievable.

Employee Motivation

One of the issues that has occupied the agenda for boardroom and top management discussions in organisations is the question of motivating employees at work. Statistically, executive time devoted to motivational matters at work in modern organisations occupy a large part of the work schedules of most chief executives. The importance of motivation as a managerial process and tool has been analysed in a large number of studies carried out by scholars (Johnnie 1988e; Lawler 1973; Salancik, 1975). The results show that the introduction of appropriate motivational instruments at work leads to enhanced performances and productivity. However, the motivational instruments introduced at work must be relevant to the needs of the employees. In a previous study (Johnnie 1988e) involving public sector organisations in Nigeria, it was found that motivational instruments introduced by managers do not coincide with the needs of the workers. In a situation like this, instead of the instruments enhancing performance and productivity, the opposite could be the outcome. This aside, instruments of motivation designed for Nigerian workers should take into account the precepts and traditions of the workers.

However the motivational instruments introduced at work must be relevant to the needs of the employees.

One important reason why motivational instruments or techniques adopted by managers in the industrially advanced countries may not produce the same level of results, is the different orientation towards work and the relatively indigenized thought-system of the African "industrial man". Orpen (1979) studied 96 Xhose machine operators, storemen and book-keepers in South Africa, in an attempt to test "the effects of Western versus 'tribal' orientations on the relationship between enriched work and job satisfaction and performance". He found that "the relationship between enriched work and job satisfaction was higher for the Western-oriented workers than for tribal-oriented ones". In a similar vein, Otite (1978; p. 2) has also argued that "the behaviour of a people cannot be fully understood unless one knows their systems of thought". This simply goes to emphasize the point that "the form in which men cast their speculations is no less than the ways in which they behave; and this is the result of the habits, thoughts and actions which they find around them". The relevance of these studies to the identification of what motivates the Nigerian worker is the ostensible relationship between the thought system of the Nigerian and his work environment, and the need to understand the Nigerian worker while designing motivational instruments in workplaces. The beliefs, norms, rituals, traditions and sagas of the Nigerian worker determine what motivates him at work.

Although motivational theories developed around Western norms may not necessarily be a panacea for solving problems of low productivity in Nigerian organisations, the fact still remains that these theories are widely used at work in most Nigerian workplaces. But because of their strong bonds of attachment to the control environment, most Nigerian organisations have not been able to

offer attractive condition-hiring terms, to dismiss staff at will, or to pay employees fair and reasonable remunerations which would have led to higher performances. In fact, as Johnnie (1988e) has argued the ability of Nigerian organisations to offer attractive extrinsic motivators is limited, compared to the handsome salaries and conditions offered by multinational firms operating in Nigeria.

On a general level, it may be plausible to argue that Nigerian organisations may not be seen as places where attractive salaries are paid, nor are they meant for the individual that has a strong instrumental orientation towards work, but they are institutions for those with a "high need for socially relevant achievement". Organisations that insist on creating the relevant environment for challenging work, create appropriate conditions for learning on the job, and stress on the introduction of socially relevant work are likely not only to attract but retain a good crop of dedicated employees. But most Nigerian organisations are unable to offer these attractive conditions for self development of the employee. To induce higher performance levels from employees, it is important that Nigerian organisations introduce not just attractive salaries and perks but other motivational instruments which are intrinsic in nature — the non tangible items that boost the ego of the employee and gratify him.

The control of job performance of workers is another important aspect of the activities of organisations. Control of work performance could be done through hierarchical supervision, budgetary and quantitative targets and the observation of well defined rules and procedures. Nigerian organisations could also rely on these methods of control. But regimentation and rigidities are to be avoided in the introduction of control mechanisms in respect of work performance.

Control of work performance could be done through hierarchical supervision, budgetary and quantitative targets and the observation of well defined rules and procedures. But regimentation and rigidities are to be avoided.

Apart from the work performance control mechanisms, there are additional means of control that are at the command of managers in Nigerian organisations. The first mechanism should be pre-entry socialisation. Pre-entry socialisation is important because it serves as a necessary pathway for professionals. In most professions, there are prescribed rules and standards to meet before one qualifies to practice. This period is usually characterised by internship, group problem solving syndicates, games and other group participative activities which help to fine-tune the individual for professional practice. A second measure which Nigerian organisations could adopt that would induce higher performances is selection of staff members whose interest and identity are inextricably tied to the mission of the organisation. Another measure relevant for including performances is through peer group control. because developmental tasks are often accomplished through work teams. These fundamental motivational and control issues naturally lead to the question of leadership at work, as a means of inducing higher performances and enhancing productivity in organisations.

Effective Leadership

Most Nigerian organisations have not had the privilege of being managed by those who are trained in the art of management. They have been managed by public bureaucrats or politicians or military personnel with limited knowledge in the management of men and material resources. The situation has often led to inefficiency and declining performances and productivity. On a comparative basis, Nigerian organisations have generally performed worse than those found elsewhere.

In a recent Nigerian study (Ani, 1983) it was revealed that there exists in most Nigerian organisations "bureaucratic administration, tradition-oriented and leader-orinted" leadership styles. The bureaucratic administration-type according to Pavlin (1989) focuses on "informal structures of management". Who becomes the leader in bureaucratic administrative type of organisation according to Ani (1983) is usually determined by who knows whom, and who is best able to "cooperate" or who is well "connected". Those who are given positions of leadership in most Nigerian organisations are those belonging to the same religious group, secret cult or society, club or those sharing identical political views with the person making the appointments. Appointments made under the aegis of such parochial group interests have often ended on the slippery slope of failure. In the tradition-oriented chieftaincies, Ani (1983) has argued, leadership or power goes down from father to son, whether or not those assuming positions of leadership have the competence to lead. This situation appears to be common in those parts of the country where the system of rulership and leadership is based on principles of primogeniture or feudalism. Competence and skill are not

the basis for the determination of the suitability of appointment of a leader. This situation runs contrary to the enduring contributions made by scholars of the "great man" school of thought.

Mmobuosi (1986) in a phenomenological analysis of the leadership experience of fifty senior Nigerian manager has shown that there exists creativity-stifling factors. He identified unsupportive leadership and colleagues, rigid adherence to rules, absence of reward for creative behaviour, risk avoidance, ignorance and inappropriate training and development, structural factors, lack of financial data and expert resources, corruption and faulty placement of staff as the reasons for the inability of Nigerian organisations to perform efficiently. If account is taken of contributions made by other eminent scholars (Ani, 1983; Fubara, 1984; Ahiauzu; 1986; Ejiofor, 1987; Johnnie, 1993) it is evident that Mmobuosi's analysis carries with it a badge of empirical truth.

Productivity improvement efforts embarked upon by Nigerian Organisations are unlikely to achieve the desired goals if we fail to do first things first-instituting appropriate organisational structures at work. An important factor that led to improved performance indices in most workplaces in developed societies is the ability of those who control critical material, financial and human resources to use these resources in the correct mix. There exists a symbiotic relationship between leadership skills of managers and their ability to be involved in issues of work coordination in organisations.

Effective Work Coordination System

The peculiar features of some Nigerian public and private sector organisations tend to make them susceptible to problems that border on size, hierarchy of authority, extensive formalisation and functional and role specialisation. Arising from the formal nature of their operations, most organisations also have the problem of setting ambitious goals and programmes. Sometimes by their very character and nature, these organisations become highly bureaucratic, and are unable to provide the much needed capital and financial outlay to pursue their programmes. Because of the environment in which most of these organisations exist and the philosophy and ideology behind their creation, they have often been managed by individuals with inappropriate educational and professional qualifications. Even when the educational and professional qualifications of those who manage these organisations conform with the requirements of the necessary experience and training are lacking. These and other issues, have created coordination difficulties for most Nigerian organisations.

Most Nigerian public sector organisations, and some private organisations too are generally large in size. When organisations grow in size they become differentiated and a great deal of resources is needed to accommodate the various functional specialisations that may develop. The sheer size of these organisations has on a number of instances made operations difficult. It is important to reduce the amorphous size that characterises and epitomizes Nigerian organisations. When organisations are smaller in size their members become easily reachable and their activities can best be coordinated.

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Participative Management System

Participation as a system of work organisation is a fairly familiar organisational issue, but a concept that has often been misunderstood. Most lower level employees argue that they want to participate more in the activities of their organisation. But managers feel "as if participation were some kind of fringe benefit to be given or withheld". Conflict of interest has often resulted in the inability to truly understand the concept. Participation, in real terms, simply means, involving lower level employees in the management of the activities of the organisation.

As Katz and Kahn (1978; p. 766) state:

> ... managements almost universally agree on some forms of organisational participation — regular attendance, punctuality, vigilance in performance of assigned tasks, responsiveness to authority, and turning out work of substantial quality and quantity.

When workers fail to "participate" sufficiently in the terms mentioned above, management calls it lack of motivation. But Katz and Kahn (1978) were rational in their analysis to also present the concept of participation from the point of view of lower level employees.

> When the rank and file speak of participation, however, they are more likely to stress their competence and interest in other kinds of set-

ting allocating rewards, choosing among methods of work; and the like.

Both managers and lower level employees attempt to interpret the concept of participation to their advantage. But one point that comes out, is the fact that participation involves the allocation of human resources to roles. It is an issue that centres on the division of labour in organisations, both functional and hierarchical in form and nature. It also borders on issues of job design and system design. What has become an issue of contention between management and workers in organisations could in fact be described as "under participation, under utilisation of human resources". But in large bureaucratic organisation there had often been pressure from management for workers to improve their performance, within a very narrow range of activities.

Participation as a system of work organisation is a relatively new phenomenon in developing societies. The idea however, has had a fairly long history in Western societies, particularly in Europe. The idea of involving workers in taking decisions in certain issues that affect the day-to-day work activities of the worker is important; and a lot of interest and concern had been shown in this aspect by the Nigerian workers. Managers may see the new vigour for participation shown by the Nigerian workers as a situation where they are asking for too much. But our analysis of contemporary work organisational practices adopted by Nigerian managers shows that they (managers) are not ready to relinguish power. The concept of participation in its true form does not really go too far in power sharing as most managers tend to interpret the situation. In fact, the Nigerian worker who advocates participation at work may simply be asking the employer to involve him (employee) in taking decisions that affect him directly, particularly, those issues that touch on the day-to-day work organisational activities of the organisation.

The enhancement of performance and the improvement of productivity in Nigerian workplaces is a function of the introduction of generous participative systems. The performances of employees are likely to improve if structures that allow workers to be involved in taking decisions that affect them directly are introduced. This is likely to create a situation where the worker would see the organisation as a psychological home. The worker would see the organisation as a place where his (worker) views are also represented and taken seriously by managers. This is likely to motivate employees. A well motivated employee is likely to always perform at efficiency level at work. And if workers perform at efficiency level, the organisation is likely to meet its profit goals and targets.

The enhancement of performance and the improvement of productivity is a function of the introduction of generous participative systems.

Reliable Conflict Resolution Mechanisms

One contentious issue in modern day organisations is the problem of conflict, its pervasiveness and possible functions. If two organisations are engaged in a price war or if there is a strike at work involving labour unions as a result of the "intransigence of management", we can describe those actions as constituting conflict. It does not matter who started the action first. What is relevant and fundamental is the fact that two groups, have competing interests. Conflict can only be resolved if the antithetical interests of the two parties converge. But because of the divergence of interest of both parties, it takes quite a lot of effort to resolve conflicts.

Conflict is endemic in all human organisations. In fact, some writers (Coser, 1956; Mills 1959) have argued that conflict may not necessarily be a bad phenomenon. They opine that conflict is functional. In other words, certain conflicts are necessary in organisations because they help organisational members to "iron out their case" so that a balance or equilibrium could eventually be achieved. But some scholars argue that conflict in all its ramifications is destructive, therefore should not be tolerated in organisations. Viewed against the background of its functionality, it is possible perhaps, to tolerate some form of mild conflicts at work. When the magnitude of a conflict gets to destructive level, no business would thrive. But one thing is certain; there is a burning need for organisations to establish effective mechanisms for resolving conflicts if and when they occur. Any organisation that avoids the establishment of good and reliable conflict resolution mechanisms may simply be laying its foundation on sandy grounds.

The relationship between the institution of reliable conflict resolution mechanisms and improved organisational performance is not a tenuous one. Organisational performance and productivity are to a large extent dependent on the existence of a good conflict management system. If conflicts are poorly managed, it will greatly affect the productive activities of the organisation. Time

and energy spent on intercine warfare, quarrels and use of "the poison pen" between organisational members or groups hamper productivity. This time, time may not only be money, but the energy expended by individuals and groups to straighten issues may be debilitating as well as harmful to both their physical and emotional welbeing.

In an attempt to reduce conflicts and improve performances at work, it is important that organisations should adopt certain strategies. A strategy that could be adopted is Walton and McKersie's (1965) distributive bargaining based on their behavioural theory of labour negotiations. This is in a situation where those activities instrumental to the attainment of one party's goals are in basic conflict with those of the other party. The function is to solve pure conflicts of interest. In game theory; distributive bargaining is a fixed-sum game — a situation where one party's gain becomes a loss to the other party. It is a case of "winner takes all".

A integrative bargaining technique can be tried in a situation where those activities instrumental to the attainment of objectives are not in fundamental conflict between two parties. These objectives define an area of common concern; a problem that by its nature permits solutions that benefit both parties, or atleast, the gains of one side do not represent equal sacrifices by the other. In game theory, this technique is known as variable-sum game. The two parties share both the gains and losses arising from the conflict that is resolved.

It is also important to adopt attitudinal structuring techniques in resolving organisational conflicts. The two parties should make conscious efforts at influencing one another. Both parties should attempt to use their knowledge of the behavioural sciences to alter or change the behaviour of their opposite number to fall in line with their perception of the situation. You can use friendliness or hostility, cooperation or competitiveness as ways of structuring the attitude of the other party. The importance of the whole exercise is for each party to bring about peace and to inaugurate and reenact a normative order in an organisation.

It is important to adopt attitudinal structuring techniques in resolving organisational conflicts.

The two parties could also be involved in intra-organisational bargaining. This is an in-house conflict resolution technique. On this occasion, each party is conducting an in-house exercise by negotiating among themselves so as to clarify and understand the issues at stake before proceeding to meet the other party. Group members should be able to understand themselves and the bargaining issues at stake. The parties should be able to work out operational plans and details as to how best to tackle the issues at stake. This gives each party some mesure of confidence and consensus building amongst members of each of the two parties.

The importance and implications of introducing reliable conflict resolution mechanisms at work cannot be over-emphasised. If not for anything else, the fact that there exists industrial peace and harmony at the workplace gives both management and employees some measure of joy. Because the workplace is peaceful, the possibility exists for employees to be more dedicated and committed to jobs assigned to them. The level of commitment expected from employees by management is also likely to stimulate employees to be more purposeful. The peace is likely to improve communication between the parties at work. An effective network of communication would in no small measure enhance performance and improve productivity at the workplace.

Goal Setting

Locke's (1968) theory of goal setting as a seminal study deals with the "relationship between conscious goals or intentions and task performance". The central postulate of the theory is that an individual's conscious intentions regulate his performance. A goal in simple language is defined as "what the individual is consciously trying to do". According to the theory, goals that are hard, result in a higher level of performance than goals that are easy, and goals that are specifically hard, results in a higher performance level than a situation where there are no goals at all or a generalised goal of "do your best". In addition to the above arguments, the view has also been advanced that "a person's goals mediate how performance is affected by monetary incentives, time limits, knowledge of results (i.e. performance feedback), participation in decision making and competition". Goals that are assigned to a person (e.g., by a supervisor) have an effect on behaviour only to the degree that they are consciously accepted by the person. Thus Locke (1968 p. 174) states:

> "It is not enough to know that an order or request was made; one has to know whether or not the individual heard it and understood it, how he appraised it, and what he decided to do

about it before its effect on his behaviour can be predicted and explained".

Locke's theory is based on several controlled laboratory experiments he carried out in the United States. In each of these experiments he was able to establish a strong relationship between goal setting and performance. Goal setting has become part of the frontline activities of most successful organisations. The conspicuous position which goal setting has assumed in modern organisations makes the concept a very popular option in the management arsenal of most modern managers.

Organisations set different kinds of goals ranging from short, medium, to long-term in nature. A well managed organisation should be able to set all three sets of goals simultaneously. The reason is to ensure that each of these goals feed from one another. There is usually the synergistic effect if all three goals are set at the same time. One goal complements the other, and this leds to a situation where there does not exist any form of "goal vacuum". Goals generally are expected to serve as indices to measure performance. Organisations, therefore, make very serious efforts towards achieving these goals, based of course, on some set of predetermined courses of action.

Another aspect of goal setting that should concern practising managers, both in industry and public sector is the concept of goal difficulty and its relationship to performance. It has been established that the more difficult the goals are, the higher the level of performance. This proposition is supported by a number of laboratory studies reported by Locke (1968). In one of these studies (Stedry and Kay 1966) it was discovered that when goal difficulty was manipulated for two different performance criteria: productivity and rework cost, performance improved substantially.

Goal setting has become a very important tool for management. Goals have assisted many managers in establishing a path and direction in the organisation of work. For some managers, goal setting ensures that work is organised according to some predetermined standards. Goal setting is seen both as a mediator and modulator of performance and standards — a way of ensuring that managers organise their activities systematically using some objective criteria to measure performance. Goal setting has become the "rod for divination".

Goal setting ensures that work is organised according to some predetermined standards.

Epilogue

Performance and productivity improvement schemes are the most important goals to modern organisations. But contemporary work organisation methods are often inhibited by the absence of certain important work organising principles. There also exists the inability of some managers to call into play their full potentials to improve upon existing performance and productivity levels at work. For modern organisations seriously in search of a way forward, in terms of improved performances and productivity, it becomes imperative to develop appropriate Human Engineering Culture that would lead to mission accomplishment and ensure that performance and productivity standards are improved.

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'Man-evolved decision-making paradigms must be amplified rather than replaced, understood rather than ignored, respected rather than degraded.'

Milan Zeleny

Feature

Quality Circles in the Factory of the Future

Subrata Chakraborty

Advanced manufacturing technology appears to be all set to replace the technology of the past and almost eliminate human interference. Nonetheless there is a realisation that for every task transferred from man to machine, a corresponding new task gets created which is to gainfully deploy the enhanced machine capabilities. It is in this backdrop the future of quality circles has been assessed in this paper.

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There is a growing body of opinion that the industry is on the threshold of a new era in manufacturing. Many believe that the advanced manufacturing technology or the computer integrated manufacturing will transform the world of work beyond recognition. Creation of an "unmanned factory" taking a technocentric approach seems to be the ultimate goal the scientists and technologists are seeking to achieve. While there are divergent views about the possibilities of being able to ever achieve an unmanned factory, it would, *prima facie* seem that in such a possible factory of the future, human skills would play a rather minor role. Putting it differently, this appears to be taking the Taylorism to its very extreme, making vast pools of unskilled and semiskilled labour almost totally redundant and hence dispensable. Whether or not it is technologically possible to achieve an unmanned factory is another question. The issue under examination is: what happens to the human centred approach of quality circle in a factory of the future. That is to say, whether quality circles go away with the view that human beings are unnecessary as they are essentially of nuisance to a production system; or the circles receive further boost from the factory of the future.

In seeking an answer to this question, analysis has been made on the patterns of work in present and future factories, the changing nature of work force and their value profiles, and the type of involvement that will be required and responded to by the future workmen in the so called factory of the future. Putting these analysis together it appears that the future of quality circle kind of intervention should in fact be brighter rather than bleak, eventhough, on the face of it there may be the impression that systems like computer integrated manufacturing, being away from the human centred approach, may not have any need for such activities.

The future of quality circle kind of intervention should in fact be brighter rather than bleak, though there may be the impression that systems like computer integrated manufacturing, may not have any need for such activities.

Future Factories

One of the main premises on which the so called high-tech factory of the future is gaining ground is in its "myth of deskilling", the idea that, as a general rule, new generation of equipment have permitted and will permit reductions in skill requirement. This myth is a major obstacle to effective planning for the implementation of new technologies (Adler 1986). The deskilling view while being fairly strongly embeded in the minds of managers, is in competition with what Adler calls the "upgrading hypothesis". That is to say, while on one hand, the belief is about reduction of skills, interpreted in another sense, the same may mean a broader span of tasks as far as the impact of new technology on work methods is concerned. The reason behind this is: for every task transferred from man to machine, a corresponding new task gets created which is to gainfully deploy the enhanced machine capabilities. And it is this particular aspect that has profound effect on additions and subtractions to the worker's task set. A major new task arising out of automation is system monitoring and control. Adler identified three qualitative changes in the type of skill associated with this new task. These are: new types of task responsibility, a new degree of abstractness of tasks and new level of task interdependence.

For every task transferred from man to machine, a corresponding new task gets created which is to gainfully deploy the enhanced machine capabilities.

These observations would imply that there has to be a rise in the level of skills of the so called shop floor workers eventhough some of their present skills may become obsolete as the new requirements go far beyond simple machine – tending.

Bessant and Senker (1987) point out the following differences with respect to the present patterns of work and those in the future factories.

Present Pattern	*Factories of the Future*
Single skills	Multiple skills
Demarcation	Blurring of boundaries
Rigid working practices	Flexible working practices
Operation mainly by direct intervention	Mainly supervision of advanced operations
High division of labour	Moves towards teamwork
Low local autonomy	High local autonomy and devolution of responsibility
Training given low priority	Training and organizational development given high priority

Going beyond the narrow context of job design, skill requirements and similar areas, we must also note that to be effective, high technology organizations should be able to deal with many conflicting demands. Some of these are: complexity, uncertainty, ambiguity, risk, invention, change, learning, renewal. Thus the factory of the future will be a learning organization where the distinction between the beginning and end will be diffused. Winners will be those who develop their organization into one that can constantly learn, invent, adapt and change; traits very different from today's learned organization loaded with people each one of whom are masters of their own narrow task. In other words, to be successful in tomorrow's complex and fast changing environment, an organization would be required to lead the change curve rather than merely developing coping up strategies. And to lead, an organization has to function as a cohesive team with its team members playing multiple roles and not confined to a single specialised function. For day to day running of an organization, there may still be broad division of responsibilities. But to cater to contingencies of environmental dynamics, technical uncertainty, technical interdependence, growth as well as social needs, the work design has to be much different from the traditional Taylorian type.

Thus the factory of the future will be a learning organization where the distinction between the beginning and end will be diffused.

Changing Nature of Work Force

Many authors would have us believe that the nature of the workforce too is changing. With gradual induction of the so called new breed of people into the workforce, the face of the workman is changing fast. Though it may be difficult to exactly pinpoint the nature of such changes, interesting research reports are available that point out quite a few aspects of change. According to Peterfraund (1988) the new breed of workmen as perceived by their bosses in supervisory and managerial levels consist of people who:

- — Challenge authority, don't follow orders
- — Have no loyalty to their employer, no commitment to their company
- — Are overly ambitious, impatient to get ahead
- — Care only about money, are less dedicated
- — Don't care how they look
- — Are arrogant and rebellious

Peterfraund further observes that, while the above constitute the perceptions of many managers and supervisors, some of the most astute management as well as the new breed of workers themselves view things quite differently. In their opinion, the new breed consists of people who:

- — Have no patience for meaningless work
- — Are committed to "doing their thing"; if they can't find satisfaction doing it in one place, they'll go somewhere else to do it
- — Want to get ahead. Never have so many been so interested in continuing their self development, or felt so strongly that it's sinful for talent to be underutilised
- — Have a broader span of interest in outside affairs, in the world around them and in the environment in which they work
- — Come to work no less motivated than their predecessors, but are more likely to become demotivated by what they see and experience than any work group before them.

Jackson and Mindel (1988) while drawing out a strategy towards motivating the new breed had compared the traditional and contemporary values on nine factors. These are summarized in figure 1.

From the figure, it is apparent that the value profiles of a contemporary worker is sharply different from those of their predecessors. The traditional workers showed a high level of loyalty, being not particularly keen to have downward communication or recognition and were reasonably indifferent to nature of work, or opportunities to take part in decision making. The new breed, on the other hand, probably expects these almost as a matter of routine rather than an occasional one shot kind of event. Unlike their older counterparts the new breed does not value job security. This will mean that, it may be of no use telling these workers to behave in a manner similar to the traditional ones. Therefore, managing the contemporary employees would not only require a whole new set of skills, but also, a radically new approach towards job design and employee involvement. With more and more of the contemporary employees joining our work organizations, tomorrow's value profile is likely to be closer to those exhibited by these groups. Therefore, sooner we find ways to manage our work organizations with contemporary employees, better equipped we shall be to face the challenges of tomorrow.

Subtleties of Quality Circles

Specialists in the area of human resource management talk about several models of managing human resources. Some of these are the clerical model, the legal model, the financial model, the managerial model, the humanistic model and the behavioural science model. Quality circles, when judged through these frameworks seem to best fit the humanistic model. In fact, it is the humanistic model that attempts to establish a positive corporate culture leading to employee growth and satisfaction. Further, the humanistic model advocates development of people and provision of satisfying and challenging work—the elements which are at the core of quality circles.

The humanistic model advocates development of people and provision of satisfying and challenging work–the elements which are at the core of quality circles.

It is well known that quality circles were initiated to tap the latent talent available in every human being. Providing a departure from oppressive supervision, quality circle came up with a changed line of thinking for the managers. It attempted to bring home the message that there are several matters for which "men on the job" can contribute as much, if not more, when compared with their counterparts at the remote control room—the managers. Thus,

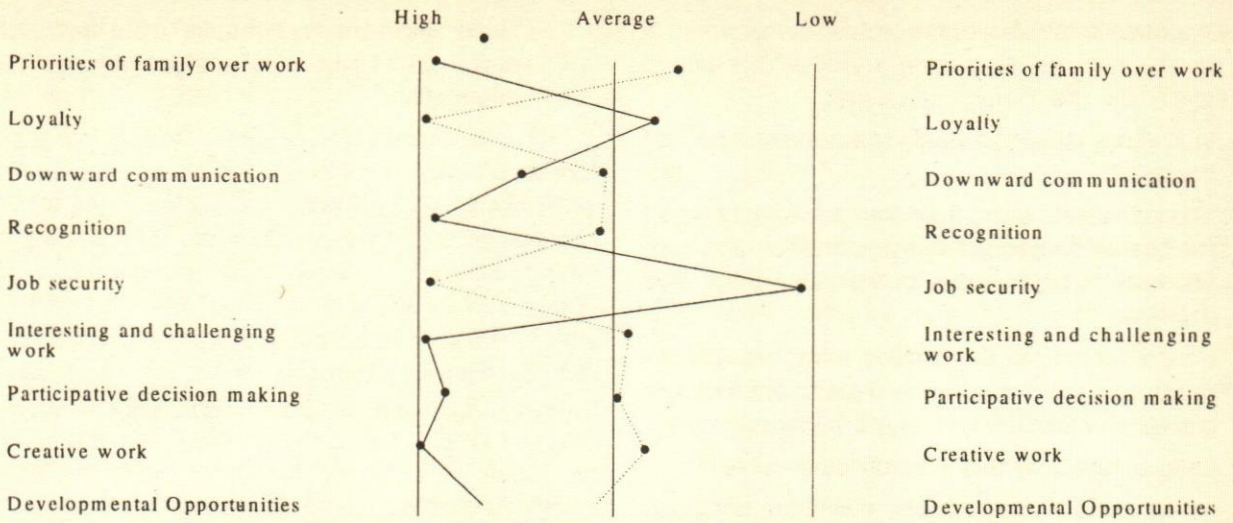

Fig. 1 Comparison of value profiles between contemporary (–) and traditional (·····) employee

there may not be a need to tell the workforce how they should go about doing a job with all its minutest details. The attempt in quality circle was to leave these to workmen themselves, who with their education, experience and creativity could come up with the right choice of work methods in the narrow confines of their own jobs. This, in a way, sought to bring a significant change in the mentality of the managers and the workforce. To what extent the quality circle philosophy has been successful so far in bringing about the intended changes is another question, the answer of which is not independent of the setting in which quality circles are tried. Organizations where quality circles could take their roots do exhibit a shift from "Do as you are told" mentality of the managers and "I am not paid to think" mentality of the workforce.

As a matter of fact, the entire philosophy of quality circle rests on deriving organic outputs through organic inputs and not the inorganics as much of the literature on the subject make it out to be (Chakraborty 1989). In figure 2, the subtle differences are presented to have a comprehensive picture.

The shaded portion in the figure is really the area where quality circles were born marking a departure from the all too familiar inorganic style characterised by the following:

- Money or money convertibles are the chief motivators
- Decisions are taken at a considerable distance from the point of action
- Controls may begin to be seen as ends in themselves
- Efficiency is measured more through compliance of rules and procedures than achievement of organizational goals
- Channel of communication is generally the official channel of command.

	Organic	Inorganic
INPUT	Motivation Emotion Aspiration Skill	Machine Material Power Money
OUTPUT	Membership Identity Recognition Output	Volume Profit Turnover Market Share

Fig. 2: Comparison between organics and inorganics

As opposed to the above, the organic components in an organization focus on people and their behaviour. More specifically, the characteristics are:

— Individuals behaviour being rewarded and not just the results

— The individuals being their own pathfinders within the overall direction of the organization and continuously trying to excel in the goals they have achieved.

— People identifying themselves more with the organization and not with the department they are placed in or with the task they are entrusted with

— Level of hierarchy that is hardly perceptible

— An all round ownership feeling with the organization and people taking pride in their membership of it.

Researchers may not be unanimous in agreeing that quality circles have all these, but very few will disagree that quality circle type of intervention, if managed in the right earnest, could lead an organization in a direction that can help inculcating these qualities in due course.

Managing the Factory of the Future

Managing a factory of the future would involve effective management of such diverse and apparently conflicting aspects like complexity, uncertainty, ambiguity, risk, invention, change, learning, renewal on one hand and contemporary employees on the other. Eventhough this may seem to be a formidable task, the same becomes inevitable if one has to continue in the business of tomorrow. Ways have to be found to handle this difficult and challenging task as simpler coping up strategies are unlikely to work. Many of the hurdles may prove much easier if the contemporary employee is managed well as these people themselves are likely to pull the organization in the direction of making the impossible look very much possible.

As Von Glinow and Mohrman (1990) put it, an effective high technology organization must be able to deal with the following:

- The organizational needs of creativity and invention
- Efficient and timely usage of information
- Simultaneously cooperating and competing with many other organizations in its environment
- Having a clear, well understood structure without eliminating informal and quasi-formal structure and communication to integrate the various parts and keep them working in the same direction
- Good decisions that require input from various stakeholders who hold relevant perspective and information.

To successfully counter these challenges, tomorrow's work organization would require people who, while having enough skills, are not restricted within the confines of their limited skills only. The worker would have to play a much more creative and innovative role, operating more like a professional. It would not be possible to measure the output of their work in tangible terms. And, it is this very nature of work that will predispose them to resist organizational control. (Von Glinow 1988). As Forester (1989) puts it, the old "kick ass' routine would not apply any longer to these highly skilled and knowledgeable workforce. To manage these people, who would spend more time solving problems than performing routine tasks, there will be greater need to adopt more enlightened, participatory management techniques—such as quality circles. "These alternative management practices are designed to reduce or end the 'them' and 'us' conformation and to pave the way to a more appropriate method of conducting industrial relations in the "high-tech age" (Forester 1989).

The old "kick ass' routine would not apply to these highly skilled and knowledgeable workforce. To manage these people, there will be greater need to adopt more elightened, participatory management techniques–such as quality circles.

One of the major gaps found in the adoption of quality circles in many places is the artificial distinction between objectives and methods of work (Chakraborty, 1988). Though this was never intended in the basic theory of quality circle, the gap often surfaced during actual practice. Though this is not the only reason behind organizations not always being able to realize the full potentials of quality circles, it is this gap that contributes very significantly in the quality of involvement of the people. Obviously, in the factory of the future, one cannot afford such gaps. Thus, when quality circles are viewed in the context of tomorrow's technically advanced system, the focus should very clearly be on them as transition vehicles towards organizational change. With both managers and workers designing organisational change, and, the nature of change they would be seeking being similar rather than dissimilar in the factory of the future, quality circle should hold a much greater potential.

An important question that arises in conjunction with change in technology vis-a-vis quality circles is the nature of involvement that may be most appropriate in tomorrow's high-tech work organizations struggling to be always in the forefront. Lawler III (1988) classifies involvement in three broad categories. These are: suggestion involvement, task involvement and high involvement. The differences among these three types of involvement across the various aspects like job design, organization structure, parallel structures, performance information, knowledge, decision power, rewards, personnel policies have been discussed in detail by Lawler. Based on the different dimensions of tomorrow's factory as well as the new breed of workmen, it would seem that in our context, what we need to aim at is at least task involvement leading to high involvement. Mere suggestion involvement would neither meet the needs of the organization, nor would it cater to the aspirations of the newer workforce. A shift therefore would be in order from the so called control approach to what may be called the commitment approach. And, it is through quality circles that successful work teams, which are organized around natural work units, can be developed. Indeed, quality circles may not be the only way to do it. But, years of worldwide experience and existing practice would probably tilt the balance in favour of quality circles.

Experiences of having quality circles in work organisations clearly indicate that, given the right conditions, the circles can operate as self managing groups. The peer pressure helps every member in controlling their own task behaviour while multiple skills get developed in individuals through their participation as circle members.

According to Cummings and Blumberg (1987), traditional job design works fine in a situation characterised by low technical interdependence, low technical uncertainty, low environmental dynamics, low growth needs and low social needs. But when the task environment is dynamic, people have high social and growth needs and the technical interdependence and uncertainty are both high, the self managing work groups are most effective as they can help determine production goals and also perform various functions to achieve the set goals.

When the task environment is dynamic, people have high social and growth needs and the technical interdependence and uncertainty are both high, the self managing work groups are most effective.

Further, Cummings and Blumberg (1987) also bring out the fact that advanced manufacturing technologies are likely to result in higher levels of technical interdependence, technical uncertainty and environmental dynamics. While on this score alone these authors and others (Susman & Chase, 1986) suggest the need for self regulating work groups, the analysis presented earlier about the changing nature of the workfore would only further reinforce the necessity of having these kinds of work groups for which quality circles could be the body incarnate.

Concluding Remarks

Eventhough concepts like computer integrated manufacturing (CIM) began with the thought that human beings will be ultimately eliminated from this most modern and automated process, it is being recognized by many that human intervention is not only unavoidable but also indispensable (Ebel 1989). The need is therefore for qualified, motivated and experienced workers who are familiar with the system, can cope with uncertainty and assess situations, find the interpret situations quickly and can correct them as and when required. All these constitute a tall order requiring a certain amount of learning and renewal on the part of the workmen. According to Ebel as systems become more complex, they also tend to be less fail safe. These systems break down frequently and the cost of such breakdowns is high. Their perfection or repair requires human interventions and means that the workers responsible for the operation have to make choices and decisions that no technical system can make for them.

These systems break down frequently and the cost of such breakdowns is high.

As has been stated already, the need in tomorrow's automated factory is not only for workmen who can handle broader task responsibilities but also for people who are highly committed and involved in their job. May be, for the new breed, their own drive towards self development pulls them to better understanding and greater involvement. All the same, an organizational mechanism would be necessary that will help promote the spirit of involvement through teamwork so that both organizational and individual goals can be intertwined. Quality circle can very well be one such mechanism which can develop commitment through a spirit of togetherness and

cooperation duly channelized towards the set goals by the peer process. If the factory of the future is a reality, quality circles would probably be the all important vehicle towards its realization.

If the factory of the future is a reality, quality circles would probably be the all important vehicle towards its realization.

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I know why there are so many people who love chopping wood. In this activity one immediately sees the results.

— Albert Einstein

Feature

Existence & Awareness of Corporate Strategy for Quality & Productivity

Neeraj & Sushil

In the turbulent business environment of today many strategies and concepts regarding quality and productivity have evolved. An attempt was made to study the existence and awareness of strategies for quality and productivity. Inspite of so many jargons being talked from many platforms, a clear cut corporate strategy for quality and productivity does not seem to exist. Quality strategy does not seem to be understood nor fully internalised by grass root level functionaries of the organisation concludes the study.

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In the present Indian business environment, with the opening up of the economy and globalisation of the market, a lot of changes have been set into motion. In the wake of these major changes, Indian industries have started resorting to strategies/concepts such as TQM, TPM, TEI, WCO (World Class Organisation), and LO (Learning Organisation). Discussions on and practice of these concepts have been in vogue for the last three to four years. But the basic question remains, how much have we changed strategically? Or how much could we adjust ourselves in relation to the fast changing business environment? In this context, out of many factors, quality and productivity are of prime concern.

Need of Strategy for and Productivity

The concept of strategic management has been discussed by many authors — Certo and Peter (1991) Outline the following steps for strategic management:

- Environmental analysis
- Setting organisational direction
- Strategy formulation
- Implementation and control

Johnson and Scholes (1994) explains the same concept in the following steps:

- Strategic Analysis
- Strategic choice
- Strategic implementation

Sushil (1994b), based on the concept of systemic flexibility (through S-A-P) recommends the following way for strategy formulation.

Step I Defining the context: Firstly the position or the status of the organisation has to be made clear, this should be in relation to the total business environment. This helps in understanding the context of strategy formulation.

Step II Strategic Situation Analysis: The various environmental factors prevalent for the organisation have to be understood. The situation, may involve-internal, external, the operational or the political environment effecting the organisation.

Step III Strategic Actor Analysis: Various actors predominant in the organisation have to be made clear. The actor may be an individual or a group of individuals.

Step IV Strategic Process Evolution: Based on the above three steps, the various processes (course of action) for the organisation to develop its strategy can be evolved. Clear understanding of the first three steps makes the strategic process evolve sharper.

The process for strategic management should be seen as a holistic concept. Here the interplay of strategy with the situation and actors must be clarified and the implementation aspects should be meticulously planned.

Critically examining the above three approaches of strategic management, it can be concluded that systemic evolution of the strategy is of prime importance. A study was undertaken to find out: the existence of organisational strategy for quality and productivity; if it exists' its awareness by functionaries in the organisation.

Deming (1982) opines that TQM is not a fad or a new management jargon, it is a strongly felt need. The importance of continuous quality improvement is being realised in India. TQM is a quality focused, customer oriented management strategy and promises productivity gains more than what was considered as 'best.' The benefits of quality improvement include productivity increase, lower costs, better competitive position, and happier people on the job.

TQM is a quality focused, customer oriented management strategy and promises productivity gains more than what was considered as 'best'.

Crosby (1991) while clarifying the issue of policy says that the management has to make clear to the employees, suppliers, customers, and the world, exactly where it stands on quality. It is not enough to lay out stirring words like "excellence" or "TQM" or "Customer satisfaction" or "delighting the customer". They mean different things to different people and do not constitute direction. The policy on quality has to be a statement that cannot be misunderstood. It has to cover conformance to requirements, time and money.

Sink (1991) designates TQM as a big umbrella; everything we have done or will do somehow, magically, must fit under this umbrella. We see objectives in strategic plans simply stated as "implement TQM". No one knows that this means or how to do it, but they know it is politically astute to have this in their plan. Five to seven years ago the call was to "develop a productivity programm". Three years ago it was "implement Deming, Juran, Crosby etc" Now it is" implement TQM". Most fail to describe what they mean or to define TQM. Pressed to provide an operational definition (Deming, 1986) for TQM or quality, most have failed to even try.

Methodology of the Study

There has been an obvious gap in aligning the problem identified and techniques adopted to conduct the study. There is a dearth of literature on bridging this gap. Shshil (1994a) has given a scientific basis to bridge the gap using Flexible Systems Methodology (FSM). Adopting FSM, this study was done through personal interviews with seventeen senior executives of seven organisations through prior appointments. Open ended questionnaires

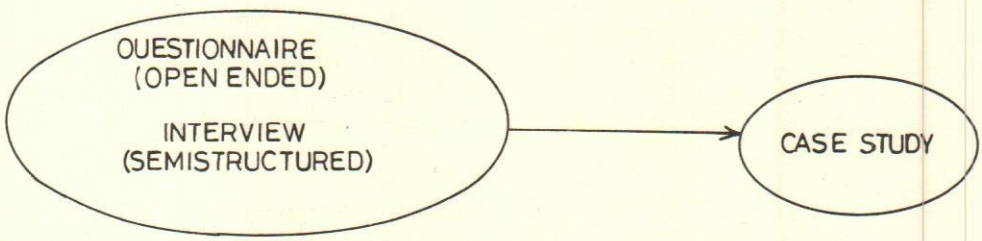

Fig. 1: Study Design

were filled through semistructured interviews. Fig. 1 depicts the study design. These organisations were from Delhi and nearby areas, and included those from the private sector, a government organisation and a private consultant in the area of TQM. Details are mentioned in tables 1 and 2

Table 1: Type of Organisation, location of the organisation and number of executives interviewed.

Type of Organisation/Management	Location	Number of Executives Interviewed
PRIVATE SECTOR ORGANISATION		
a. Traditional Management		
Usha (India) Ltd.	New Delhi	3
Usha Alloys & Steel Division	Jamshedpur	2
Shriram Foods and Fertilizers Ltd.	New Delhi	2
b. Professional Management		
Maruti Udyog Ltd.	Gurgaon	4
Modi Xerox Ltd.	New Delhi	2
GOVENMENT ORGANISATION		
National Productivity Council	New Delhi	3
PRIVATE CONSULTANT	New Delhi	1
Total		17

Table 2: Executives distribution over years of experience

Year of Experience	Interviewed Executives
1-5	5
6-10	1
11-15	4
16-20	0
21-20	2
26-30	1
> 31	4
Total No. of Executives	17

Observations

Three executives of an autonomous Government organisation (*National Productivity Council, New Delhi)* expressed different views regarding their strategy for quality. As per one executive the strategy was "privatising or making the organisation free from Government". Another executive opined that strategy was "human resource development and employee involvement in the management". The Third executive was of the view that "TQM is the strategy for quality and productivity."

A consistency in understanding and articulation of strategy for quality and productivity was observed in *Maruti Udyog Limited (MUL).* According to all the four executives interviewed, the strategy has been clearly articulated in the Quality Policy of the company displayed in many departments. Quality Policy of the organisation is "Consumer Satisfaction through quality of our products and services, achieved by consistent adherence to procedures and systems" The company has written down procedures for all activities throughout the organisation, which can undergo changes as and when required.

As per the two executives of *Modi Xerox Limited* "Employee Involvement and Documentation to improve the business is the strategy for quality and productivity".

i. For employee involvement — apart from many other TQM tools, Policy Deployment is the most important tool. Policy deployment at the initial level involves twenty percent of the people and in the later stages these employees carry the communication to the rest. The involvement of hundred percent is thus achieved which, helps in improving quality and productivity.

ii. Documentation to improve the business. Here the present status is made known and if direction is found wrong, changes are made accordingly.

The executives are emphatic that the basic strategy remains the TQM path (Employee involvement and Continuous improvement).

Consistency was observed while articulating organisation's (*Usha Martin Industries Limited)* strategy for quality and productivity. The executives end the discussion by repeating that "company wants to become a TQM company."

As per one executive of Usha (India) Limited TQM tools are used to achieve "Total Quality Leadership" which is the ultimate aim of the organisation. He opined that the concept of Total Quality Leadership is slightly different from Total Quality Management.

According to another executive continous improvement (tool of TQM) to have the competitive edge is the strategy to achieve quality and productivity.

Two executives were interviewed from *Shriram Foods and Fertilisers Limited*:

One executive stated that his "Company's strategy for quality and productivity is TQM". He added "TQM has been relevant in the free economy and competitive environment". He perceives TQM as a solution today."TQM in due course of time will raise problems, so after some years a new strategy will have to be adopted TQM is not the last thing but a solution today". The other

executive opined that "bringing an awareness for quality to grass root level functionaries and appraising them of their quality of work is the strategy for quality and productivity".

Very emphatically the consultant (*Director, Institute for Productivity Management)* states "Only TQM can be and has been rightly adopted as the organisation's strategy for quality and productivity". He adds "whatever failures have been seen in TQM are only because of the non monitoring attitude by the management. If effectiness of TQM is not monitored, it is a luxury, otherwise a sucessful strategy for quality and productivity."

Discussion

The analysis of the data collected for the stady reveals that the organisations do not have a clear cut strategy or policy for quality and productivity. Except for one or two organisations there was no uniformity in articulating the strategy for quality and productivity and it seems to be based on individual perceptions.

The interviews were done of mostly senior executives. If strategy is not clear at the top level or if the very existence of a strategy for quality and productivity is under question for them, one can imagine what would be the awareness at the grass root level. It is observed that awareness would be very less as the understanding about the characteristics of the corporate policy at implementation level percolates from top to bottom.

For all these executives TQM seems to be the panacea and they do not perceive any pitfalls in the concept of TQM. In most of the cases, where does TQM lead to or what is beyond TQM is not clear.

TQM has been defined as the end in Indian business environment. Whereas it is only a means to achieve certain ends. It is only a quality management paradigm in the total perspective of management. If TQM is perceived as an end, then naturally question of what next does not arise. This is a serious drawback.

The adoption of TQM/TQL itself in Indian business environment is not based on any analytical tool of policy making/strategy formulation but because of its success in Japan and elsewhere. The fact that TQM has not been that much effective in the American industries is forgotten.

When investigating the issue a revealing point was of Quality Policy that has to be framed for IS0 9000 certification. Except for Maruti Udyog Limited which defines that their strategy is clearly depicted in their Quality policy, other organisations do not have clear linkages between the company's strategy and Quality Policy. The case study cited of a large steel producing private sector company in the Eastern part of India further indicates that existence of Quality Policy may not be a manifestation of awareness of the company's strategy for quality and productivity.

Quality policy as defined by this company in 1991 when the concept of TQM was just initiated in the organisation was: "To achieve and maintain quality leadership for our products and services in the Indian market as well as the segments of global market to which we cater to".

Quality policy as defined and documented in Quality Systems manual for ISO certification in 1993 was: "It is our policy to deliver a reliable product, satisfying customer requirement and adhering to International Quality System Standards." Within two years the quality policy has undergone many changes, the final version being totally different from the initial one.

Quality policy seems to be formulated only for the sake of policy formulation. In formulating the policy only the topmost executives were involved. An executive director of one of the units and top most important funtionary of implementing the policy was heard quoting "I was not heard in the meeting where policy was being formulated" When audit was carried out for ISO certification in the organisation even a top management functionary could not explain the term 'Reliable,'. Reliability happens to be a complicated statistical term and needs a proper understanding. A non conformance report was booked for this lacuna.

The awareness of quality policy at grass root level was only at a verbal level, limited to verbatim reproduction in Hindi language. When inquired personally by the auditors as to how they were (workers as well as persons of managerial rank) contributing individually to quality policy, no satisfactory answer was obtained. Internalisation of the concept of Quality policy and its significance was found to be at a low level. (Non conformity report was booked for this aspect also by the auditors). Not understanding the quality policy by the functionaires of the organisation was amongst the major nonconformity booked on the organisation, others being in quality assurance and calibration department.

Interpretation

If this case is analysed in the light of Interactive Planning as proposed by Ackoff (1981) it becomes clear

that participative planning involving all or voluntary participation is one of the solutions for such problems.

In the particular case cited, the quality policy was developed by a few top executives. It appears to be made only for documentation and was not analysed in terms of its applicability in business operation i.e. how this quality policy is linked to corporate strategy for quality and productivity was not made to known to the functionaries throughtout the organisation. Since it involved only the top few, the majority did not understand it and the policy by and large remained on paper only.

Quality Policy has largely neither been understood nor internalised by grass root level functionaries of the organisations. In order to derive competetive advantage through the quality and productivity route, it is imperative that a flexible strategy for quality and productivity be evolved systematically.

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'The rule is, jam tomorrow and jam yesterday but never jam today.' 'It *must* come sometimes to "jam today",' Alice objected. 'No, it can't,' said the Queen. 'It's jam every other day: today isn't any *other* day, you know.

Lewis Carroll

Feature

Quality & Productivity: Study on a Public Sector Unit

Kampan Mukherjee & C.M. Krishna

In this paper the relationship between quality and productivity has been analysed for a labour intensive public sector unit. A few indices are earmarked for measuring the quality and productivity of operations and then attempt is made to establish their empirical relationships. The statistically significant coefficients provide valuable information which may subsequently establish a base for effective launching of Quality Management strategies.

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Quality Management has received tremendous attention due to the globalisation and open market policy of Indian economy. For survival and growth Indian business houses aspire not only for better quality of products, but also for better process quality. In the past 3 or 4 years ISO certification has become a sheer necessity for Indian manufacturers and most of the industrial organisations has started implementing quality improvement programmes with the objective of competing in the international market. However, there seems to be some resistance from the traditional management school in supporting this endeavour. The proponents of the old paradigm are of the view that quality improvement programmes may have some adverse effect on the productivity of the firm. Increasing inspection rate, one of the strategies to improve quality results slowing down of production lines; deployment of more inspectors ultimately increases the unit cost of the product. Besides this the larger number of defective items identified during inspection increases the labour hours, machine time, material, energy inputs and wastage (Mefford, 1991).

On the other hand, with the introduction of comprehensive quality improvement methods like Total Quality Management and Quality Circles, methods aimed at reducing inventories like. Just In Time prodction etc., it has been established that quality and productivity can be improved simultaneously and they both have direct proportionality. Many such success stories may be available from companies like Whister Company, Motorola and A.O. Smith Corporation, U.S. Mefford (1991). According to this modern management school, TQM implementation decreases rejection rates. The decrease in rejection rate reduces the rework costs and necessarily saves labour, material and capital costs which inturn reduces the unit cost of the product.

With the introduction of comprehensive quality improvement methods like Total Quality Management and Quality Circles, it has been established that quality and productivity can be improved simultaneously and they both have direct proportionality.

Although the latter school of thought has been very widely accepted by management specialists throughout the globe, its applicability in the particular industrial setup of India is still open to debate. The socio-economic and technological framework of Indian economy significantly differs from that of the western developed world. The socialistic pattern of Indian economy and the existence of the mixed economy have shown relatively less concern about the financial return. Productivity and quality consciousness has not still spread over to all units of Indian industry and business houses. Labour productivity measured as tonnes produced per employee in developed countries is more than 10 compared to that of India which is still in the range of 1 to 50 as most of the industries are labour intensive (NPC, 1988). The percentage acceptance index of quality is less than 95 in most of the industries in India which is lower compared to a value of more than 96 in developed countries indicating low rejection rate and low rework costs in the case of developed countries. This wide difference in industrial performance and economic setup demands an objective analysis of the relationships that exist between productivity and quality in Indian industries. This infact, will help in measuring the contribution of modern quality improvement programmes on the productivity improvement of the companies.

An attempt was made to study the productivity-quality relationship of Indian Public Sector Steel Industry with an analysis of Iron and Steel Foundary Works, one of the Public Sector Steel Units located in the eastern part of India. The study involves identification of various indices for measuring the productivity and quality of the product and subsequently establishment of the statistical relationship among them. This analysis is further extended to testing of certain hypotheses on these relationships.

Recent Trend

Productivity as measured by capacity utilisation shows a downward trend in five out of nine public sector steel plants (table 1). The four other steel plants however recorded positive growth. The figures reveal capacity utilisation for crude steel at DSP falling from 76% in 1990-'91 to 54% in 93-'94, while saleable steel utilisation rates declining from 73% in 90-'91 to 68% in 93-'94. At IISCO, Burnpur crude steel utilisation fell from 36 to 32% and saleable steel from 48 to 41%. Though the percentage is only 4, the capacity utilisation is all time low at 32 for IISCO. At ASP, Durgapur the productivity dropped from 73% in 90-'91 to 68% in 93-'94. Salem Steel Plant followed the same trend with a drop of 2% from 67 in 90-'91 to 65 in 93-'94. VIS showed capacity utilisation in 93-'94 as 12% which is lowest among all steel units. It was 89 for VIS in 90-91.

While the above steel plants reported decreases in capacity utilisation, Bhilai Steel Plant recorded 7% increment during the span of three years. Bokoro reported 8% growth which is highest among public sector steel units.

Table 1

Name of the unit	Productivity as percentage of total capacity utilisation	
	1990-'91	1993-'94
DSP	76	54
ASP	73	68
IISCO	36	32
VISL	89	12
Salem	67	65
Bokaro	85	93
Bhilai	94	101

DSP : Durgapur Steel Plant
ASP : Alloy Steel Plant
IISCO : Indian Iron and Steel Company
VISL : Visveswaraya Iron and Steel Limited
Salem, Bokoro and Bhilai are the places where steel plants are situated.
Source: 'Telegraph' daily dated 31st March 1995 published from Calcutta, India.

Case Study

The Iron & Steel Foundry Works, one of the plants of a public sector steel company is the oldest foundry in India, producing pig iron by modern methods. It was founded in 1870 and is the largest foundry in the eastern part of India. The present works consists of eight separate production sections, each laid out for producing a particular type of casting. In the last twenty years, the unit has shown very poor performance in terms of financial return. The plant has been reporting loss steadily for the last fifteen years despite the implementation of

various quality and productivity improvement programmes.

The major productivity and quality improvement programmes that have been implemented by the Iron and Steel Foundry Works since 1985 are :

- Method Study and Time Study techniques during 1985-'90 with the help of National Productivity Council.
- Factor substitution techniques (1985).
- Quality Circles programmes (1992).
- Total Quality Management programmes in some selected production shops (1993).

The key motivation for carrying out the study on this plant lies in the fact that the present management sincerely wants to know whether there at all exists any interdependence between productivity and quality. Any hypotheses in this light demands empirical and logical justification.

Productivity and quality are two important indicators of the performance of any company. Productivity shows the efficiency with which the activities are carried out mainly in the shop floor, whereas the betterment of quality of both the products and processes is reflected in the current financial return and in customer generation and thus sales enhancement in future. As the initial phase of this study, attempt was made to identify the appropriate indices for measuring the productivity and quality. As per the current productivity research it is proposed that there does not exist any single productivity index which will reflect all aspects of resource utilisation of a company. So both the partial factor and total factor productivity concepts are included in evaluating productivity of this steel foundry unit.

Productivity shows the efficiency with which the activities are carried out mainly in the shop floor, whereas the betterment of quality of both the products and processes is reflected in the current financial return and in customer generation and thus sales enhancement in future.

Productivity of this plant is measured by using three partial factor productivity indices such as labour, material, and capital as three major resource factors and also using the total factor productivity index which includes other input factors, such as overhead costs in addition to the above three direct inputs. Quality is evaluated by two quality measuring indices, such as Fraction Acceptance and Number of Customer Complaints keeping in view the fact that the effect of quality improvement is ultimately reflected in customer satisfaction. Annexure A includes the detailed relationships and formulae for these productivity and quality indices.

The following three hypotheses have been framed before carrying out the actual analysis. These hypotheses have been developed on the basis of the ideas and opinions of the executives of the Foundry Works:

1. Fraction Acceptance Index has a positive relationship with productivity indices (as decrease in rejection rate decreases the rework cost and thus results in decrease in unit cost of the product).
2. Number of Complaints Index of quality is inversely proportional to productivity indices (As improvement in this index increases the rework, results in loss of good will etc. and increases the unit cost of product).
3. It is possible to set the target values for input factor productivity and Fraction Acceptance of quality for achieving for zero complaints from customer.

In the next phase of the study the empirical relationships are established among the productivity and quality indices and subsequently the above hypotheses are tested statistically. Monthly data from April 1989 to December 1993 were collected for evaluating the quality and productivity of the Works. The sample size used for evaluating the relationships involving Fraction Acceptance Index is 53. However due to nonavailability of data, its relation with Total Factor Productivity Index has been evaluated by using a sample size of only 49. Similarly the sample size used for evaluating relationships involving Number of Complaints Index is 37 for Input Factor Productivity indices and 32 for Total Factor Productivity Index (Annexure B]. Two readings are omitted (corresponding to February 1993 and March 1993) as the production in both these months are very low due to repeated labour strikes called on by worker's unions.

Correlation and Regression analysis are first conducted by taking one index each from quality measurement group and productivity measurement group at a time. This results in the generation of eight combinations. To test the significance of the correlation and regression coefficients. Student's t-test tool is used (Fisher, 1993).

The results are tabulated in table 2 which shows the standard errors, correlation coefficients and results of Student's t-test. Table 3 displays the results of regression analysis.

to increase the labour and capital costs. It may also be noted that the total factor productivity index has consistent correlation of –0.25 (approximately) with both the quality indices.

Table 2

	Fraction Acceptance Index			Number of Complaints Index		
	S.E.	C.C.	T.S.	S.E.	C.C.	T.S.
L.P.I.	0.1135	–0.4257	<0.01	0.1477	–0.3376	<0.05
M.P.I.	0.1374	–0.0954	NS*	0.1320	–0.4560	<0.01
C.P.I.	0.1240	–0.3256	<0.02	0.1370	–0.4222	<0.01
T.P.I.	0.1342	–0.2653	<0.10	0.1630	–0.2527	<0.15

Table 3

	Fraction Acceptance Index					Number of Complaints Index				
	x-mean	y-mean	S.E.	R.C.	T.S.	x-mean	y-mean	S.E.	R.C.	T.S.
L.P.I.	15.9118 (N=53)	0.9312	0.0154	–0.0034	<0.01	9.3666 (N=37)	15.5125	11.5770	–0.0892	<0.05
M.P.I.	1.9860 (N=53)	0.9312	0.0053	–0.0119	NS	9.3666 (N=37)	1.9216	0.0110	–0.0067	<0.01
C.P.I.	4.3529 (N=53)	0.9312	0.0300	–0.0034	<0.02	9.3666 (N=37)	3.3785	0.0212	–0.0222	<0.01
T.P.I.	0.9295 (N=49)	0.8180	0.0004	–0.0555	<0.10	8.4000 (N=34)	0.7805	0.5944	–0.0015	<0.15

where

S.E. : Standard Error
C.C. : Correlation Coefficient
R.C. : Regression Coefficient
T.S. : Test of Significance
*NS : Not significant
L.P.I. : Labour
M.P.I. : Meterial Productivity Index
C.P.I. : Capital Productivity Index
T.P.I. : Total Factor Productivity Index

The correlation coefficients represent the degree and direction of relationship between the variables under study. The algebraic signs of correlation coefficients in all the cases are negative which indicates that quality is inversely proportional to productivity. This disproves hypothesis 1 and supports hypthesis 2. All the correlation coefficients obtained are significant as proved by t-test (table 2) upto 85% confidence level except for Material Productivity Index Vs Fraction Acceptance Index of quality. The magnitude of coefficients however reveals the fact that labour productivity has strongest correlation (–0.4251) with Fraction Acceptance Index of quality while material productivity has the weakest correlation (–0.0954). The low correlation of material productivity index with Fraction Acceptance Index is due to the fact that most of the rejected material can be reused before scrapping in this type of industries. Thus the increase in rejection rate does not necessarily increase the wastage of the material and material cost. However, the results indicate that increase in Fraction Acceptance Index tends

The regression equations give the effect of unit variation of one variable over the other. For formulating the regression equations, Fraction Acceptance Index of quality has been taken as dependent variable and productivity indices are taken as independent variables. The results are shown in table 3. In all the equations algebraic signs of regression coefficients for the values of variables agree with the signs of correlation coefficients.

It may be noted that the regression coefficient between Material Productivity Index and Fraction Acceptance Index is not significant. It seems that more number of readings may be required to derive significant relations. However the other coefficients are significant (table 3).

In case of regression equations involving Number of Complaints Index of quality and productivity indices, productivity indices are taken as dependent variables and quality index is taken as independent variable. This helps in further analysis for setting target values for productivity

indices and Fraction Acceptance Index of quality by substituting zero (in other words, aiming for zero customer complaints) in the equations for the Number of Complaints Index variable. The values of productivity indices obtained can thus be substituted in equations involving Fraction Acceptance Index to find out the minimum acceptance level that has to be maintained to achieve zero complaints from customers.

However this analysis has not been done in this case as hypothesis 1 has been proved wrong. All the coefficients in this case are significant as tested by Student's t-test. This justifies the feasibility of hypothesis 3 as the strategy for improvement of customer satisfaction.

Conclusion

The above analysis is a methodological endeavour for revealing the underlying relationships between productivity and quality which a manager of today requires for effective design of quality improvement strategy to grow in this competitive market. For getting a more signficant outcome, the sample size in the analysis needs to be larger and other related factors are also to be considered for better explaining the variation of data. However, as per the outcome of this study, in labour intensive Indian public sector units, quality is inversely proportional to productivity. In other words, quality improvement programmes have got negative effect on productivity improvement. In this particular case, though quality improvement programmes like Total Quality Management have been implemented, it will take sufficient time for obtaining the expected results. In fact the present analysis does not reveal any impact of TQM implementation. However this study proposes a methodological approach which may be suitably carried out for any production unit in order to bring out the underlying relationships between quality and productivity and the management may effectively utilise the outcome for redesigning the productivity and quality improvement programmes.

In labour intensive Indian public sector units, quality is inversely proportional to productivity.

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ANNEXURE A
FORMULAE AND RELATIONS FOR PRODUCTIVITY AND QUALITY MEASUREMENTS
(Developed on the basis of Ray & Sahu 1987)

Output (O) $= \sum_{i=1}^{8} \sum_{j=1}^{n} (Pij \times Sij)$

where Pi = Production in mt. of jth product at shop i, (There are 8 shops in the plant).

Si = Average annual sales price of jth product at shop i per mt.

n = Number of products at shop i (varies for each shop).

Labour Input (LI) $= \sum_{i=1}^{8} (Li)$

where $L = \sum_{j=1}^{n} (Ldj + Lwj + Sj + Mj)$

i denotes the shop and j denotes the stage here.

d : Direct workers w : Indirect workers

S : Supervisors M : Officers and Managers

e.g. $Ldj = \sum_{k} (Wmj \times Nm)$

where Wm denotes wage of mth worker and
N denotes number of such workers.

Material Input (M) $= \sum_{i=1}^{8} (Mi \times Pi)$

where M is the material input in mt.
P is the purchased price of material per ton.

Note: In process inventory is not included in the calculations.

Capital Input (C)

Annual capital cost method is applied to determine capital input factor in a given period :

$$C = \sum_{j=1}^{8} \{(Cj \times Pj) + Cwj\}$$

where Cj = Capital for shop j
Pi = Capacity utilization factor.

$$Cj = [\sum_{h} Cfh\ (1 - Nh/Lfh) + \sum_{hi} Cfhid\ ]$$

where Cfh =Capital investment for fixed asset of type h at shop j installed Nh periods before current period.

Lfh = Predicted asset life of fixed asset.

$Cfhi$* = Capital investment for fixed asset of type hi at shop j in current period.

$Cwj = Cwt \times fi$

where Cwt = Total working capital
fi = Factor proportion for shop j

*Assets which fall in the range ± 2 years to the current period are considered in the current period.

Other Indput (X) $= \sum_{i=1}^{8} Xi$

where Xi = cost of other inputs (overhead expenses) at shop i.

Fraction Rejection (PR) $= \left[\sum_{i=1}^{8} \{Ri/Pi\}\right] / 8$

where Ri = Rejected material in tons at shop i,
Pi = Total tonnage of material inspected at shop i.

PRODUCTIVITY INDICES :

Labour Productivity Index: (O/LI)

Material Productivity Index: (O/M)

Capital Productivity Index: (O/C)

Other Inputs Productivity Index: (O/X)

Total Factor Productivity Index: (O/(L + M + C + X)]

QUALITY INDICES :

Fraction Acceptance Index: (1 – PR)

Number of Complaints Index: $\sum_{i=1}^{8} Ni$

where N is number of complaints received at stop i.

ANNEXURE B

PRODUCTIVITY AND QUALITY INDICES

Month	L.P.I.	M.P.I.	F.A.I.	C.P.I.	O.P.I.	T.P.I.	N.C.I.
Apr '89	18.5948	2.0886	0.9313	7.2257	2.9213	0.9869	
May '89	21.0185	2.0765	0.9187	7.4590	2.8756	0.9891	
Jun '89	20.3821	2.0581	0.9157	7.8614	2.9808	1.0024	
Jul '89	18.8920	2.0577	0.9205	7.9924	2.7300	0.9706	
Aug '89	17.6065	2.1856	0.9206	8.1718	2.5321	0.9693	
Sep '89	18.2695	2.1243	0.9279	8.1145	2.4744	0.9498	
Nov '89	18.4100	2.0006	0.9330	7.5702	2.6075	0.9348	
Dec '89	16.4157	2.1215	0.9320	7.7274	2.5634	0.9507	
Jan '90	14.1345	2.1642	0.9125	8.1076	2.0925	0.8818	
Feb '90	11.9311	2.1770	0.9387	8.8455	2.0416	0.8726	
Mar '90	16.1796	2.1958	0.9208	8.5234	2.3089	0.9366	
Apr '90	14.3523	2.1692	0.9191	3.9411	2.5466	0.8496	
May '90	14.1775	2.1657	0.9141	3.8600	2.2447	0.8085	
Jun '90	13.5826	2.2526	0.9230	4.0076	2.2838	0.8299	
Jul '90	14.0644	2.2544	0.9250	3.8831	2.2625	0.8236	

Aug '90	12.8763	2.1405	0.9199	3.8599	2.1313	0.7855	
Sep '90	11.8429	2.0928	0.8931	3.6375	1.9792	0.7449	2
Oct '90	14.6002	1.9574	0.9109	3.8250	2.4148	0.7969	3
Nov '90	14.0271	1.8792	0.9217	4.0824	2.6776	0.8184	3
Dec '90	17.9557	1.8654	0.9177	4.3473	2.9319	0.8600	4
Jan '91	16.0932	1.9047	0.9102	4.1944	2.5937	0.8257	2
Feb '91	17.1347	1.8752	0.9157	4.2362	2.7741	0.8416	1
Mar '91	21.4169	1.8930	0.9192	4.4178	2.6928	0.8528	2
Apr '91	20.3311	2.0678	0.9150	3.7574	2.6323	0.8483	3
May '91	20.6191	1.9783	0.9191	3.7505	2.7063	0.8403	1
Jun '91	15.6844	2.0132	0.9072	3.4339	2.4481	0.7935	3
Jul '91	16.1652	2.2035	0.9251	3.4371	2.2424	0.7984	3
Aug '91	17.9198	1.9287	0.9114	3.7692	2.2952	0.7841	1
Sep '91	17.6507	1.9030	0.9100	3.7311	2.4024	0.7896	2
Oct '91	18.4110	1.8708	0.9252	3.6351	2.2711	0.7667	3
Nov '91	15.3870	2.0253	0.9526	3.5149	2.1135	0.7596	3
Dec '91	16.7095	1.8961	0.9397	2.9067	1.9693	0.6949	3
Jan '92	15.4834	1.6141	0.9317	3.5239	3.1129	0.7757	9
Feb '92	14.4202	1.8707	0.9295	3.4429	2.4277	0.7655	25
Mar '91	17.0029	1.8135	0.9253	3.6283	2.0092	0.7228	17
Apr '92	15.2249	1.5444	0.9277	3.3448	2.9822	0.7421	34
May '92	17.9521	1.8551	0.9145	3.4789	2.3268	0.7622	24
Jun '92	15.4346	1.9464	0.9383	3.2163	2.0087	0.7208	14
Jul '92	14.0591	1.8101	0.9381	2.8583	3.3260	0.7849	19
Aug '92	12.8969	1.9398	0.9514	2.9105	3.2958	0.8064	25
Sep '92	12.4040	2.1894	0.9727	2.7236	3.9352	0.8631	9
Oct '92	12.1860	2.0632	0.9782	2.5992	2.4623	0.7366	3
Nov '92	15.8744	2.2391	0.9455	3.1083	2.2189	0.7800	3
Dec '92	10.9918	1.9459	0.9779	3.1631	4.1259	0.8596	8
Jan '93	15.4137	1.8656	0.9660	3.0064	0.0218	0.7002	10
Feb '93	5.4941	1.7980	0.9483	1.8376	1.4673	0.5092	9
Mar '93	8.7541	1.8406	0.9488	2.1668	2.0011	0.6178	0
Apr '93	12.3148	1.7578	0.9347	2.6184	2.2151	0.6741	10
May '93	14.1526	1.9762	0.9335	2.8417	2.6282	0.7639	12
Jun '93	15.0740	1.9578	0.9689	3.0373	1.9406	0.7034	3
Jul '93	15.7766	1.8862	0.9464	3.2283	1.2739	0.5923	3
Aug '93	11.5582	1.9292	0.9817	2.6996			33
Sep '93	15.4019	1.8072	0.9433	3.1940			24
Oct '93	12.8704	1.8100	0.9315	2.7776			13
Nov '93	13.6427	1.8561	0.9527	2.9272			17

where
L.P.I. : Labour Productivity Index
M.P.I. : Material Productivity Index
C.P.I. : Capital Productivity Index
O.P.I. : Other Inputs Productivity Index
T.P.I. : Total Factor Productivity Index
F.A.I. : Fraction Acceptance Index
N.C.I. : Numbers of Complaints Index

□

Feature

Enterprise Process Redesign with Information Technology

S. Arunkumar & Vivek Khanna

Enterprise processes comprise strategic, tactical, operational, information, business, administrative and support processes. The processes specify the conduct of an enterprise including how resources are used, prescribe the way in which the resources of an enterprise are used towards meeting the organisational goals. The relevance of well structured processes as a major asset of an enterprise is increasingly accepted. Organisations typically specify, and seek technology to support enterprise processes. The paper describes an approach to (re)design Information Technology-leveraged enterprise processes for excellence.

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Competitive pressures, increasing scope of operations, and new market requirements such as increased product quality and decreased life-cycle, call for the effective use of Technology in general, and Information Technology (IT) in particular, as a critical enabler for providing cutting edge to enterprises. A common notion is that the use of IT improves coordination of the activities, necessary to deliver goods and/or service to a market, across an organisation (Rockhart & Short, 1989). Enterprises often try to integrate IT into every aspect of their procedures by means of decentralisation, which increases the cost of coordination for critical infrastructure components such as telecommunication. Many cases, fail not due to an inappropriate vision but from the inability of an enterprise to effectively design its enterprise processes and assimilate the use and management of technological infrastructure into the mainstream of the company (Henderson & Venkataraman, 1993; Henderson, 1990). Assimilation facilitates the organisations to move from compartmentalisation, which is the design and management of the complex processes via separate functions and discrete stages, through integration, which is the coupling and streamlining of stages and cross linking of functions, to fusion (Arunkumar & Khanna, 1994a). Rastogi (1994) reviews and brings out the importance and rationale of Business Process Reengineering. It is essential to define and describe an enterprise process,

Many cases fail not due to an inappropriate vision but from the inability of an enterprise to effectively design its enterprise processes and assimilate the use and management of technological infrastructure into the mainstream.

information process, the fusion thereof before a detailed approach for enterprise process redesign is evolved.

Enterprise Process

Process is a collection of activity centres and generates outputs of value to the internal or external customer. An Activity Centre is one which transforms a set of inputs to a set of outputs using resources, including time. For example, the activity of storing takes one unit of commodity with the availability of one unit of storage space for the same makes available one unit in the next time period. A process also specifies people, their roles, commitments and accountabilities. This is not a mere augmentation of the familiar procedural aspects of process definition but adds another dimension. Consider the two extremes of organisations, one which has completely defined procedures but no defined accountabilities for its employees (bureaucracy) and the other which has well defined accountabilities but no defined procedures (startup company). The optimum for any given organisational entity would fall somewhere within the spectrum shown in Figure 1. The addition of the accountability

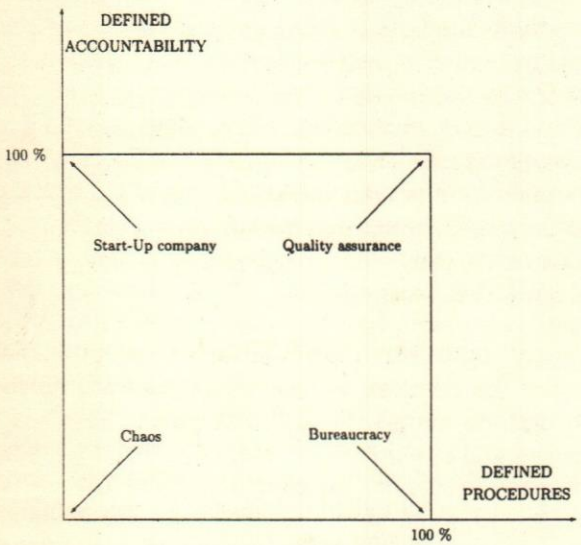

Fig. 1 Organisational Extremes

protocol and the dimension of accountability to the procedural orientation of classic process definition methodologies is of significant value (Arunkumar & Khanna, 1994b). It provides a new degree of freedom in defining how organisations work. The top right hand corner represents 100 per cent accountabilities and defined procedures, synchronous for quality standards.

Enterprise process is the organising of Man, Machine, Material, Money, Management (5 M's), time (t), Technology (T) and Knowledge (K) into work activities designed to produce specified outputs. The enterprise processes may be real-time, on-line, batch and/or on demand (active transaction based). In an enterprise the information is the life-line.

A set of processes — strategic, tactical, operational, business, information, administrative and support form an enterprise system. Processes have two important characteristics:

- They have customers; i.e. the processes have defined enterprise outcomes and their recipients.
- They cross traditional-organisational boundaries; i.e., they normally occur across or between the organisation's sub-units.

For example, ordering goods from a supplier typically involves multiple organisations and traditional functional sub-units. The end user, purchasing, receiving, accounts payable, quality check and the supplier organisation itself, are all participants. The end user could be viewed as the process customer. The process outcome could be either the creation of the order, or, perhaps more usefully, the actual receipt of the goods by the user.

Information Process

Decision makers suffer from too much information not properly transformed and presented rather than information overload, of which there are frequent complaints (Arunkumar & Khanna, 1994b). The issues are of increasing product quality and decreasing time to market, place processing and response-time requirements. Inappropriate information transformation may keep activity-centres busy with various irrelevant processes. Further, when executives in industry talk about information processes, they disregard how people in the industry actually go about acquiring, sharing and making use of information. They glorify IT, ignore psychology and hence are caught off-guard by *irrational* human behavior (Boynton et al. 1993). Too many managers still believe that once IT is in place, appropriate information will follow. Contrast the human centered approach to information and knowledge management with the standard technology view:

- Information evolves in many directions, taking on multiple meanings; rather than forcing employees to simplify information so that it will fit into a system, a human centered approach to information calls for preserving the rich complexity in the information diets.
- People do not share necessary information easily. The assumption that different departments will like to use IT to share information is an oft committed false premise, i.e., *if you build it, people will use it.*

In fact there is a need for fusion of information with enterprise processes so as to facilitate sharing.

With the growth of business, the volume of work related to information processing at each work centre has increased many fold. Due to this overload the resultant corporate objectives are not fulfilled, nay unsatisfactory, in spite of the use of data, information and knowledge-bases. Effective approaches and solutions for information handling and management are important, hence the enterprise process redesign.

IT has made a dramatic shift by vastly reducing the constraints imposed by time and space in acquiring, interpreting and acting on the information to run an enterprise successfully and making possibly the use of information as a leverage. The smartness of an organisation can be visualized by the simple relationship between the environmental complexity index and corporate IQ, the ability of an enterprise, to generate knowledge out of the available data (Figure 2) (Haeckel & Nolan, 1993). As the complexity index grows, so will corporate IQ to retain the competitiveness of organisation in the prevailing scenario. IQ can be increased by connecting (ability to access knowledge and information), sharing (ability to integrate and share information) and structuring (ability to extract meaning from data). Indian entrepreneurs, executives, and managers need to tailor their companies to be lean, flexible, competitive, innovative, customer focussed, and dedicated enough to deliver optimum quality. Hence, there is a need for redesigning the companies, specifically to operate in today's and tomorrow's world and not function as institutions carried over from an earlier, but no longer relevant age.

IT has made a dramatic shift by vastly reducing the constraints imposed by time and space in acquiring, interpreting and acting on the information to run an enterprise successfully.

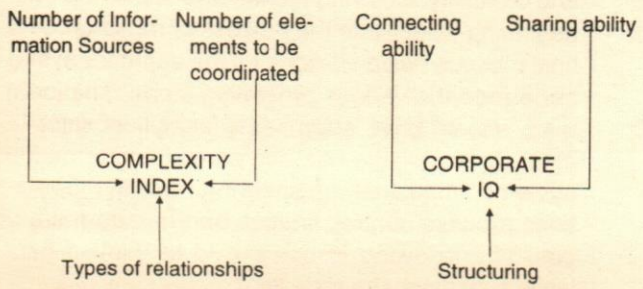

Fig. 2: Complexity and Smartness Index

Indian entrepreneurs, need to tailor their companies to be lean, flexible, competitive, innovative, customer focussed, and dedicated enough to deliver optimum quality. Hence, there is a need for redesigning.

Fusion

The protocol between two different departments at the operation or business level is not quite different from the protocols between a supplier and a customer. The basic need is to look for a *strategic fit* and a *functional integration,* as the former addresses both external and internal domains and the latter provides a link between the organisational structure and the process. Strategic fit is the vertical framework emphasizing the need to make choices that position the enterprise in an external market place and decide how to optimally structure internal arrangements to execute this market-positioning strategy. The functional integration extends the strategic fit notion across the functional domains. The strategic alignment highlights the coherence between the organisational requirements and expectations. It provides strategic attributes to distinguish a firm from its competitors. It is concerned with the choice pertaining to the logic of administrative structure, the design of critical business processes as well as acquisition and development of human resource skills.

Fusion occurs, when the processes, both physical and informational, are so intertwined that the enterprise's IT is integral to the enterprise processes, and the elements of service and communication. The extent of fusion of technology in an enterprise can be equally judged by the analysis of information processing and communication network, comprising *sensors, processors* and *media.*

Enterprise Process Redesign

A company may go in for a review of its functioning in order to make dramatic gains in the market. Also, a new company may work to structure itself properly. In either case, how does one proceed? We propose the following ten major steps (Figure 3); extending the approach of Davenport and Short (1990):

- **Strategic Vision**: Typically enterprise process redesign intends to simply rationalise the task of eliminating obvious bottlenecks and inefficiencies. It does not involve conceptualising strategic vision

or context. We strongly suggest that rationalisation is not an end in itself and is thus insufficient as a process redesign. Instead of task rationalisation, redesign of the entire process should be undertaken with a specific strategic vision and intent. Conceptualising a strategic vision specifies strategic intent, associated strategic objectives and related tactical goals, which include — cost, timeliness, quality of output, quality of work life and empowerment.

Instead of task rationalisation, redesign of the entire process should be undertaken with a specific strategic vision and intent.

- **Identify the Process to be Redesigned:** Most organisations could benefit from IT — enabled redesign of critical enterprise process. Even when total re-design is the objective, select a few key processes for initial efforts. The means by which processes to be identified and prioritised are vital. This is often difficult because managers do not think about their operations in terms of processes. The approach associated with should be such in which an organisation's use of data dictates the process to be redesigned. There are two major approaches to identify and prioritise the processes on key issues:
  - The *Exhaustive* approach attempts to identify all processes within an enterprise and then prioritise them in the order of redesign urgency.
  - The *High impact* approach attempts to identify only the most important processes or those in most conflict with the enterprise vision and process objectives.

Whichever approach is used, companies will find it useful to classify each re-designed process in terms of beginning and end points, interfaces and organisational sub-units involved. Analysis in these terms will broaden the perceived scope of the process.

- **Study and Analyse the Existing Process:** The two primary reasons for doing this are for understanding the problem, so that they are not repeated, and analysing accurately will help in providing a bottomline for future improvements.

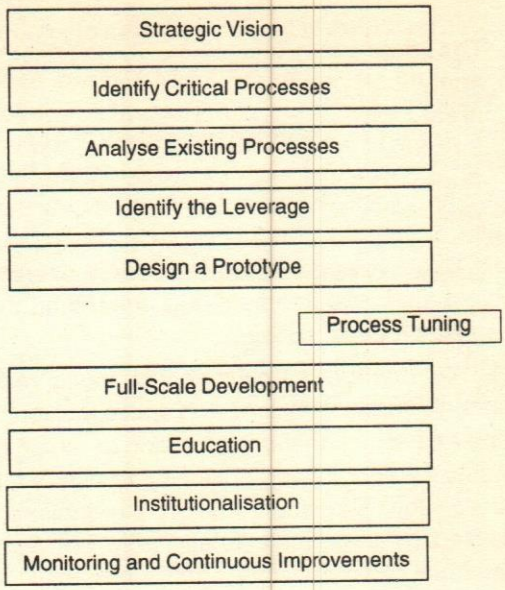

Fig. 3: Ten Steps in Enterprise Process Redesign

The designer should be informed of the need, present process problems and errors. Measurement, while analysing, should be specific to the objectives of the redesign.

- **Identify the Leverage:** Even the most sophisticated management approaches did not consider IT-capabilities as leverage, until after a process had been redesigned. Conventionally, IT usage has always been to first determine the business requirements of an activity and then develop the system. The awareness of IT-wisdom and capabilities will help, first to determine the process and then to develop the system. Firms can accomplish this by brainstorming sessions with IT-experts, with process redesign objectives and existing process measures in hand, as IT can create new process design options, rather than simply support them, including across space and time.
- **Creating a Redesigned Prototype Process:** Designing a process is largely a matter of diligence and creativity. Evolving technologies, are however beginning to facilitate the process of redesign. The final process design is done by the same team that performed the various preceding steps. The ideal team should have appropriate analytical skills in multi-dimensional areas, for example, information systems, industrial engineering, quality, operations process control, finance and human resources. The following issues are to be looked into, while specifying the redesign:

The ideal team should have appropriate analytical skills in multi-dimensional areas, for example, information systems, industrial engineering, quality, operations process control, finance and human resources.

- *Process Entities*: Whether the process is taking place between two or more organisations, i.e., *interorganisational* process or it exists within the enterprise, but across several functional or divisional boundaries, i.e., *interfunctional,* or involves tasks within and across small work-groups, typically within a functional department, i.e. *interpersonal.*
- *Process Objects*: The two primary object types are physical and informational. In physical object processes, real and tangible things are either created or manipulated, while informational object processes create or manipulate information from the available data. Usually the need is for all the processes to involve a fusion of physical and informational objects.
- *Process Activities*: There can be two types of activities — operational and managerial. Operational activities involve the day-to-day carrying out of the enterprise's basic business purpose. Managerial processes help to plan, control and provide resources for operational activities. The generic ability of IT for reshaping management processes include improving analytical accuracy, enabling broader management participation, generating feedback on action taken and streamlining the resources, a specific process consumes.

- **Process Tuning:** Actual design is not the end of process redesign, rather, it should be viewed as a prototype, with recursive iteration expected and managed. The factors to consider in process redesign and prototype creation include using IT as a design tool, understanding generic design criteria and creating an organisational fit.
- **Full-Scale Development:** First stabilise the redesigned process and when it becomes predictable, after the process of tuning, start implementing it in stages. The companies must recognise that they will have to build robust IT platforms, rather than buy them from software package vendors, because most applications are designed by them with particular functions in mind.

Training tells the person *how* to do the work, but education also teaches the *why*.

- **Education:** The end-users, who are supposed to work with the redesigned processes are to be educated, rather than just trained to perform the work fast. Training tells the person *how* to do the work, but education also teaches the *why* (Hammer & Champy, 1993). Hence, education provides motivation to the end-users by helping them learn the new ways of working.
- **Institutionalisation:** Assess and improve the given process till the end-users become familiar with it. If some discrepancies are observed, analyse them, and go to Step 6. Once discrepancies are solved, the redesigned process is assimilated into the *chemistry* of the enterprise.
- **Monitoring & Continuous Improvements:** IT-leveraged enterprise process redesign must be dynamic and robust enough to support new technologies evolved over a period of time. Simultaneously, the group responsible for the process redesign should constantly investigate whether new IT capabilities make it possible to carry out a process in new and effective ways. This concept of process improvement assures quality in the process.

This novel process (re)design can lead to IT being an indistinguishable part of the chemistry of the enterprises in a true sense, which will ensure competitive edge in the emerging free-market era of changing trends with respect to competition, customer and change itself.

Conclusion

Information Technology is neither the savior nor archdemon of the information age. At its worst, it distracts and misleads us. But as its best, new systems can support the kind of information use that results in real business change.

IT should be viewed as more than an automating or mechanising force for enterprise process. It can fundamentally reshape the way business is done. Thinking deductively about IT should be in terms of how it supports new or redesigned processes, rather than merely

enterprise functions. Enterprise processes and process improvements should be considered in the context of IT and its cost-benefit. This approach will help the enterprise to develop more flexible, team-oriented, coordinated and communication based work capabilities.

It should be viewed as more than an automating or mechanising force for enterprise process. It can fundamentally reshape the way business is done.

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We have found that the concept of time compression is a powerful force, especially in traditional white-collar functions. Talk to an engineer or an accountant about productivity and they may consider this as a compromise to quality. Then ask them how much time it takes to do things and suddenly the lights go on. Focusing on reducing process time is an effective — and enjoyable — approach to improving quality and productivity.

James H. Keyes
President and CEO, Johnson Controls

Feature

Formation & Implementation of Team Technology — A System Approach

P. Aravindan & N. L. Hiregoudar

Old management paradigms are no longer valid in the global arena of today. The new management thinking revolves around organizational re-engineering, international engineering, core competencies, time based competence, and other such terms. The essence behind all such new systems is team working. However, the changeover from conventional to team working is extremely complicated and has to be implemented with extreme care and rigor. This paper describes a system approach for team formation and implementation of Team Technology.

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In the current competitive global environment, the paradigms are markedly different. The new management thinking revolves around organization re-engineering, international engineering, core competencies, time based competition, and other such terms. Behind all such movements is the need to deviate from the conventional individualism and specialized concept of management to multifarious and team working concept. The state-of-the-art management thinking is oriented towards responding to the challenges of the dynamic environment and provide full customer satisfaction — encompassing both internal and external customers.

Of late, a large number of industrial enterprises have ventured into launching re-engineering programs. 'Team working' has attained a certain logical appeal and, at least in the present climate, an arresting glamour. There is a real danger that some enterprising manager(s) will jump unprepared on the team working bandwagon to the ultimate sorrow of the concept. The changeover from conventional to team working is extremely complicated and has to be implemented with care and rigor. Most difficulties arise from having to take tough decisions regarding employees, their designations, their relative authority and parity within their organization, redeployment, relocation, etc. In view of this, a totally new way of managing the organizations will alone be able to cope with the dynamic environment of the present times.

The changeover from conventional to team working is extremely complicated and has to be implemented with care and rigor.

Team Technology

Team Technology (T-T) is a radical step of completely restructuring the organizations around teams of persons rather than hierarchies. TEAM (Team Engineering and Management) technology as an innovative modern approach to effectively, re-engineer factories, through human and computer integrated network systems (HACINS) as shown in Figures 1 and 2. The human network comprises teams with creativity, integrity, and intelligence to learn from one another while working with multiple interacting teams whereas the computer systems include networks of information systems and expert systems to enhance the performance of the teams (Aravindan et al, 1994a, 1994b; Araivindan & Hiregoudar 1994c; Aravindan & Hiregoudar, 1995; Hiregoudar et al, 1994).

A System Approach

The three major steps of systematic team formation and implementation are as follows:

- Identification of organization for team formation
- Team Formation
  - Awareness phase
  - System analysis phase
  - Team formation and pilot implementation phase
- Final Implementation
  - Installation
  - Training
  - Maintenance

The various stages of team design and implementation are explained in Figure 3.

Identification of Organization

The first stage in team technology is the identification of industry for implementation, because teams are to be formed to suit the particular organization. It is possible to implement Team Technology in any manufacturing and service organization. However, since the concept of Team Technology is now only in the research stage and most of the Indian industries do not understand the power of team working, it becomes imperative to search for the right organization to start the pioneering work. Innovative and forward thinking top management, educated and enlightened middle management and intelligent work force are the key attributes of the organization where restructuring work can be easily started.

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Team Formation

Team formation and development has the following three major phases:

Awareness phase

System analysis phase and

Team forming phase

Awareness Phase

The top management of the organization should be properly briefed about the need for restructuring around teams and the benefits they may expect on successful implementation. One or two hour lecture-cum-interaction meetings with the various heads of departments will be the first step. Separate meetings with middle management and key workers will follow as subsequent steps. Since the success of any change mainly depends on the commitment of top management, this phase gains utmost importance. After duly making the top management aware of the need and scope of work, formal permission has to be obtained for subsequent work.

System Analysis

The present functioning of organizational system has to be extensively studied to understand the functioning of various departments and the inter relationship between various activities. Organization chart, plant, layout, information flow in various departments, document flow, material flow in the manufacturing area, and activities of the various departments will help to understand the present system. Interaction with various key personnel through informal talks and formal interviews, physical observation of the functioning of various departments can also supplement the system analysis. Most of the team forming ideas emerge in this phase on analyzing the various data gathered during this phase.

Prior to the initialisation of the detailed and subtle aspects of system design, it is desirable to take into confidence the management. A final round of discus-

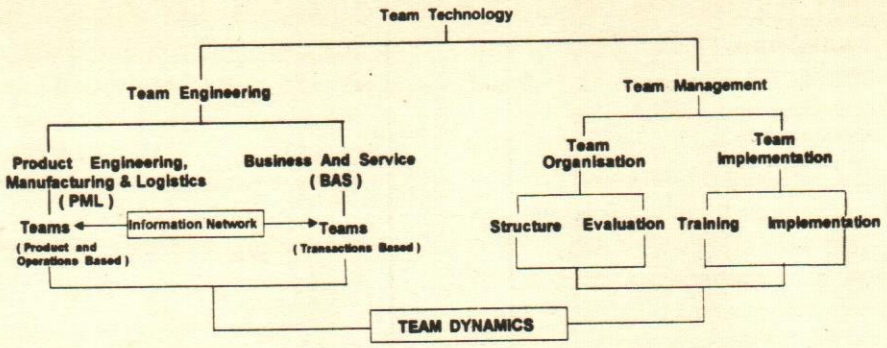


Fig. 1. Framework of Team Technology

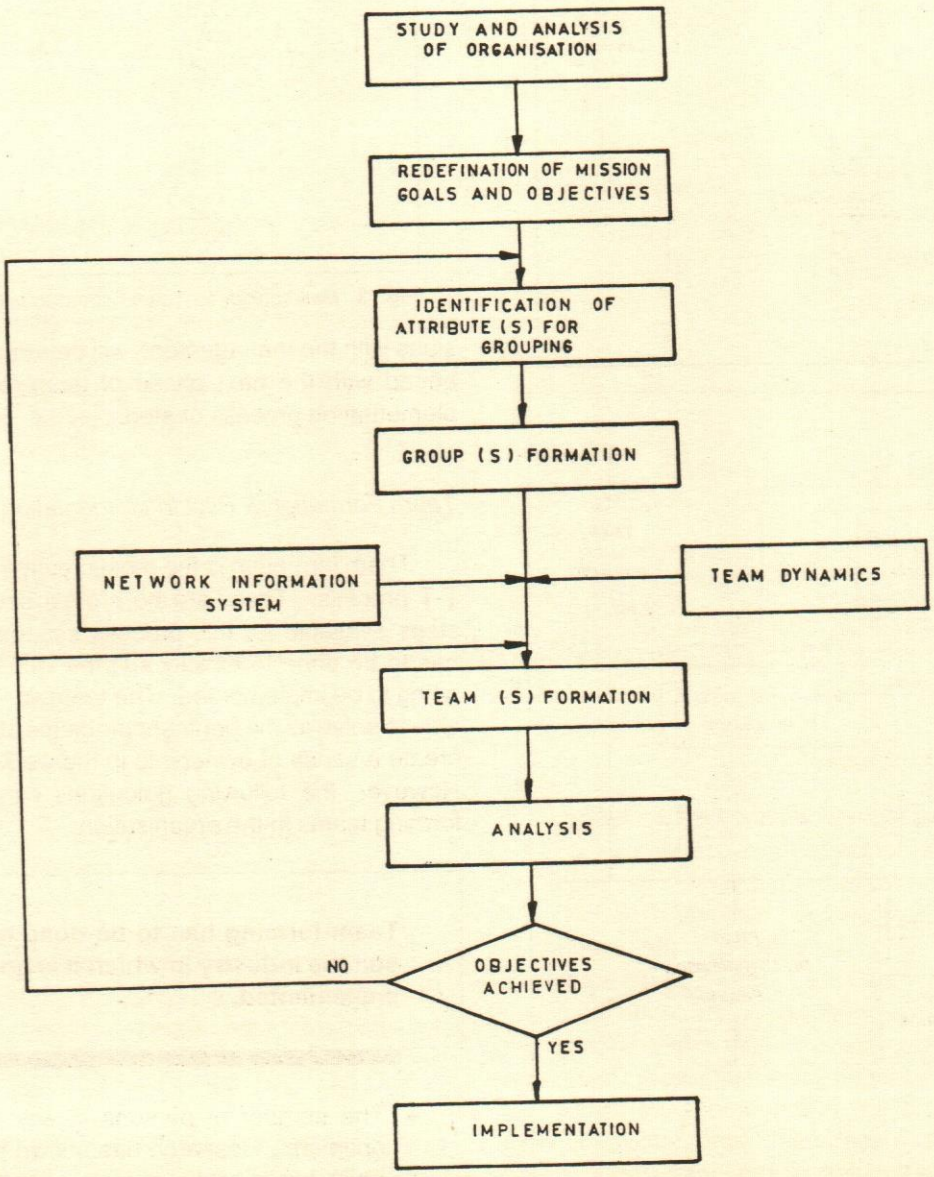
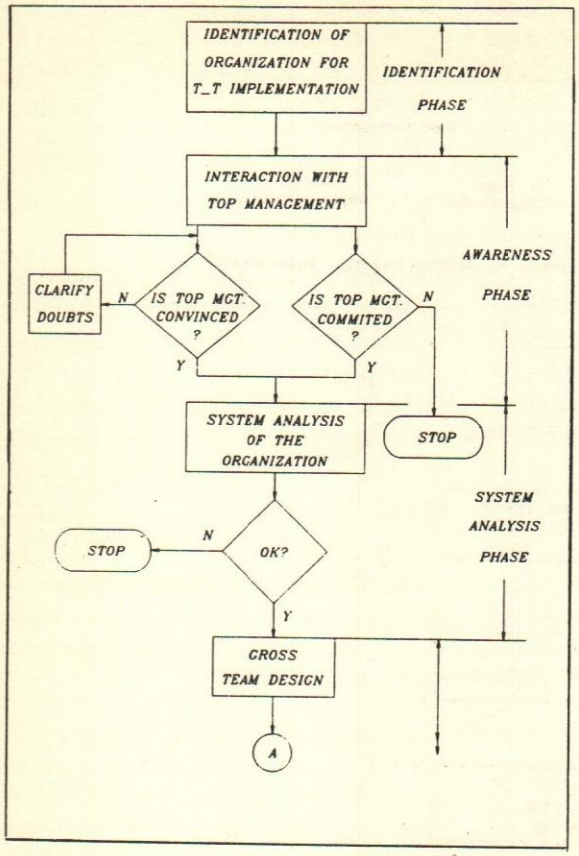
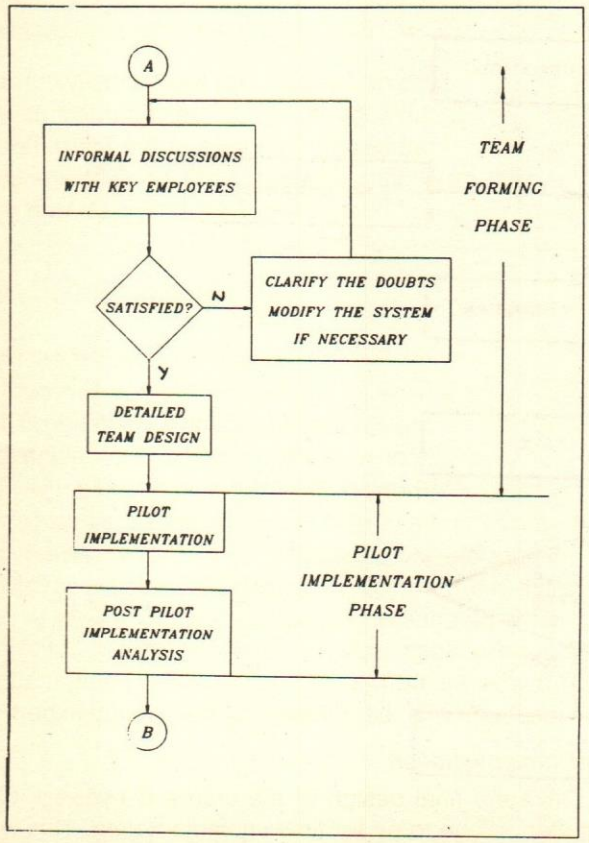


Fig. 2





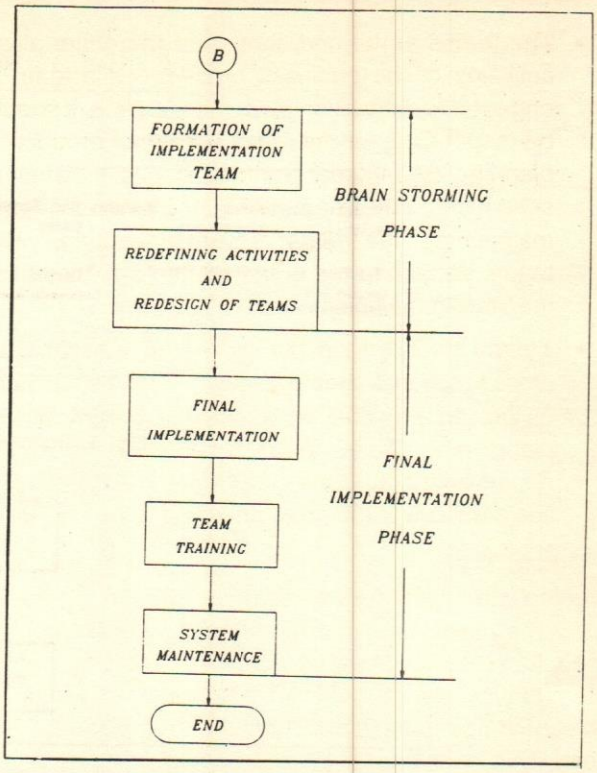


Fig. 3. Methodology for Team Formation and Implementation

sions with the management, will determine whether to go ahead with the next phase of team formation and implementation process or stop.

Team Formation & Pilot Implementation

Team formation is the most creative part of the entire T-T process. There are no proven seven steps or ten steps available for this process because, team forming has to be done to exactly suit the industry in which it is going to be implemented. The team so formed should be able to solve all the pertinent problems of the industry and create a sense of ownership in the working level people. However, the following guidelines can be followed in forming teams in the organization:

Team forming has to be done to exactly suit the industry in which it is going to be implemented.

- The number of persons in any team should be optimum. Research has shown that at the maximum, two to twelve persons can work harmoniously in a team (Fazarkerly, 1976).

- The teams so formed should do the entire allied activities of the business process. If a team is engaged in production planning activities, it should be responsible for the entire activity of production planning like material planning, capacity planning, scheduling, rate fixing, monitoring production and maintaining due dates of part production. The teams should do the entire related activities from the start to the finish.
- Teams thus formed can either be functional or cross functional. Some teams need to be functional, looking after one functional area like production planning. Cross functional teams will cross department boundaries looking after the entire allied activities of the process.

During all stages of team formation, the people who are going to actually work in the future system should be involved. Since it is not possible to get the involvement of all people, some key persons can be identified during the system analysis stage itself. The suggestions and comments of those people will finetune the plans of the teams. This involvement will also enable the acceptance of future team organization without much resistance by the people concerned.

Pilot Implementation

After forming teams based on the above guidelines, the top management should be taken into confidence. Once the top management is convinced, the next step will be to install part of the proposed teams as a pilot implementation.

Pilot implementation gains weight due to the following reasons:

- Workers in the organization will understand the seriousness of the top management for change.
- The intrinsic lacunae of the team formation which otherwise would not have have been foreseen in the preliminary design stage will be made known, which can be corrected during the final implementation.
- Pilot implementation will also help in understanding the intensity of resistance for the new system from the work force.

Post Pilot Implementation Analysis

The period which immediately follows the pilot implementation is a gruelling and challenging time for the top management, because change in any system always evokes resistance from the people concerned and team technology is no exception to this. Medium to heavy resistance to change can be expected from the work force for the new system. This resistance may go to such an extent that it may stall the entire team technology work if not properly tackled at this stage. The commitment, understanding and involvement of top management play a vital role during this stage.

This resistance from the people can effectively be overcome by convening a meeting of key persons in the organization. A team of people can be formed primarily to solve the immediate problems faced during the trial implementation. Since the same team will carry out the final implementation, it is named the implementation team. The implementation team will have the followig persons:

Team leader: He will be a senior person in hierarchy representing the top management. He should have strong commitment to team culture and should command considerable respect from all the persons in the organization. He should have enough powers to implement changes suggested by the team members.

Team members: Key persons from among the employees who are actually involved in the teams can be selected as members. Intelligence, forward thinking, commanding respect from colleagues are some of the attributes of good team members. These members should also represent almost all related functional areas of team formation.

Outside expert: The external person who actually carries out the team technology work can be regarded as an outside expert. Harnessing the views of the team members and directing the team meetings in the right direction and clarifying the doubts of the team members and the leader are the duties of this expert.

Brain Storming Meetings

The implementation team so formed should meet half a day daily for a week or ten days, initially to sort out all the problems arising out of the pilot implementation. This team will further concentrate on process redesign by systematic brainstorming. The complexion and activity of the teams can be changed to suit the redefined process. It is not possible and practicable for an outsider to design the entire team complexion without the active involvement of the persons who are actually going to work in the future system. The final complexion and various activities of the teams will be desiged during the implementation team meetings with the guidance of the outside expert.

Final Implementation

Once the final design of the teams is evolved, the next step will be to go for final implementation. This will

not evoke any resistance from the work force because they have been involved right from the design stage itself and are fully aware of the benefits of the system.

Final implementation will not evoke any resistance from the work force because they have been involved right from the design stage and are fully aware of the benefits of the system.

Team Training

Some team members need to be given proper training to work in this future system because of changes in the scope of the activities. The training needs of persons should be identified by the implementation team and should be provided by the top management through internal or external experts.

System Maintenance

The installed teams should be periodically monitored for any problems in functioning. The same implementation team may meet once a month to monitor the performance of the teams. Suggestions for improvements and criticisms can be invited from employees of the organization to continuously improve the functioning of the new system.

Case Study

This case study reveals our endeavor to implement T-T in an organization. Initially implementation was tried in a private enterprise recently qualified to ISO 9001 certification. After preliminary discussions, further attempts at implementation were abandoned due to lack of commitment of the top management. Subsequently a government organization manufacturing multi-products was identified as suitable to undertake implementation of T-T, after a careful analysis and frequent interactions with the top management. This is a railway production unit which has effectively benefited, increased its profitability and improved job satisfaction.

Three product groups based on design and manufacturing similarities were identified due to the policy decision of the Railway Board and uncertainty of product demand the following constraints were imposed by the management:

- Change of process layout is not permissible.
- Complete restructuring is not possible.

The immediate reaction from the supervisors and workmen during trial implementation in "Production Planning and Control" department was a strong resistance and opposition to the new system. Nevertheless, the new system was continued with the active support of top management. Though most of the employees acknowledged the merits of the new system, they experienced some operational difficulties. After two weeks, a careful analysis of the initial reaction of the employees was carried out. The following were found to be the main reasons for the resistance:

- As the work of all persons were redefined, they had to learn new things to carry out their day to day activities in the new system.
- Senior employees were very reluctant to change their work habits.
- Since the layout of the machines and other production facilities were process oriented, excessive movements of inspectors were necessitated. This is because, in the new system they had to inspect all the components of the same products group, but the components were manufactured in different production areas.
- All the people concerned were not fully consulted before implementation and therefore felt the implementation was sudden.
- Similar grouping of persons was not implemented in shop floor among production supervisors. This resulted in lack of communication among planning and production people since one was working in the new system and the other in the old system.

Advantages of Team Formation

- Understanding of various production processes involved in products group has been enhanced since the persons are now involved in all allied activities of the same products group. These persons now actively involve themselves in further improvement of the process in their day-to-day routine work.
- The dynamic decision making capacity of the concerned persons has improved as planning and progress monitoring have now been made simple.

The dynamic decision making capacity of the concerned persons has improved as planning and progress monitoring have now been made simple.

- The work in process inventory in various stages has been drastically reduced. This is mainly attributed to improved monitoring.
- Maintenance of records is done by one group of persons. Earlier more persons had access to smaller portion of information about the product. Now a small team of persons is responsible for the entire information on the product.

Acknowledgement

The authors wish to thank Mr. Joy Varkey, Works Manager, and the employees of Production Planning and Control and Machine Shop of S & T Railway workshop, Coimbatore, for their cooperation. The authors acknowledge the work of Mr. V. Rajamanikam and Mr. V. Vijaykumar, postgraduate students in Mechanical department, in the analysis and implementation of Team Technology at S & T workshop.

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Revolutions begin long before they are officially declared. For several years, senior executives in a broad range of industries have been rethinking how to measure the performance of their businesses....At the heart of this revolution lies a radical decision: to shift from treating financial figures as the foundation for performance measurement to treating them as one among a broader set of measures.

Professor Robert Eccles,
Harvard Business School

Feature

Liberalization, Human Face & the Labour Justice System

Debi S. Saini

Alongwith the worldwide trends towards restructuring and liberalization, the industry is increasing by indulging in competitive approaches to ensure a low wage strategy. Efforts are being made to avoid liberalization at new work sites so as to discourage union influence. The author seeks to analyse the human values dimensions of the liberalization policy in India. The present structure of the labour justice system, the likely impact of liberalization on it and a broad agenda for bringing above reforms are discussed.

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Recent Trends

Since the last fifteen years or so world economic scenario has been undergoing structural changes. India is pursuing the New Economic Policy of liberalization since July 1991. "Flexibility," "competitiveness," "deregulation", "globalization" have become new catchwords. A growing internationalisation of the economy is being witnessed. "Infringing upon national sovereignty and power of organised labour", among others, is tending to fundamentally affect the form and outlook of labour relations and labour law (Blanpain, 1985: 191). The developed world too is facing rapid technological advances, market globalization and shorter product life-cycles. They are facing competitive challenges not just from developing countries with low labour costs but also from the industrially advanced countries which have set new records in levels of productivity, product quality, innovation and flexibility as a consequence of new consumer preferences. Selfreliance is becoming old fashioned and anti-modern.

Industry is increasingly indulging in competitive approaches so as to ensure a low-wage strategy. Efforts are being made to avoid unionization at new work sites so as to discourage union influence of existing plants. The value of union formation is being frowned upon by capital as "negative," and antithetical to efficiency and competitiveness; thus, they are in a state of deep crisis. Human resource management strategies are pursued by larger organisations to dilute union power and to individualise

A flourishing class of labour consultants is emerging to counter union-organising campaigns.

the collective labour law. In the U.S.A. too, both legal and illegal moves are being intensified to fight organizing drives (Weiler, 1990). A flourishing class of labour consultants is emerging to counter union-organising campaigns. It is estimated that 70 per cent of the U.S. employers used outside consultants to counter union organizing campaigns and 40 per cent of the workplaces are not able to secure a collective bargaining agreement with their employers after winning certification (Commission on Future of Worker-Management Relations, 1994).

In its attempt to reduce costs, there is increasing tendency on the part of managements to employ contingent, non-permanent employees in the form of part-time, temporary and contract workers. In the new dispensation egalitarianism is doomed and so are concepts like dignity of worker, human values, 'countervailing power of people'. All these concepts are viewed from the eye of the market. Society is tending to move from status to contract and in the sphere of labour-management relations is giving primacy to managerial prerogatives and rationality. Taylorist work practices are showing tendencies of rejuvenation and internalisation. Industrial restructuring is threatening large-scale unemployment due to expected closure of sick industrial units.

Industrial restructuring is threatening large-scale unemployment due to expected closure of sick industrial units.

The present paper seeks to analyse the human values dimension of the liberalization policy in India. In this context are discussed the present structure of the labour justice system, the likely impact of liberalization on it and a broad agenda for bringing about reforms in it.

Crisis of the top-down Model

A bureaucratic framework usually involves a top-down model. After independence, the Indian state, under its tutelage, devised a massive programme of modernisation, reflecting Nehru's vision of a modern India. He was deeply impressed by the modern West and sought to devise India's development vision through such a top-down model, which could be evident in all areas of public policy. The state was made the centre of national life. This dispensation conferred a massive role to central planning and the public sector. This ensured a key role to India's elite administrative service. Nehru's vision of India's modernisation was guided by his belief that "in a degenerate society with substandard 'human material', a few enlightened men wielding political power offered the only hope of change" (Parekh, 1994: 43).

An over-expanding governmental involvement in social and economic life of people carries with it the dangers associated with bureaucratic maladministration. Bureaucratic administration is known to suffer from "the overdevotion of officials to precedent, remoteness from the rest of the community, inaccessibility, arrogance in dealing with the general public, ineffective organization, waste of manpower, procrastination, and excessive sense of self-importance, indifference to the feelings of convenience of citizens, and obsession with the binding authority of departmental decision, inflexibility, abuse of power, and a reluctance to admit error. (Encyclopaedia Britannica, 1987: 342). Administrative law has been evolved — an unwritten law in India — to check bureaucratic misuse of power and executive lawlessness through judicial review of administrative action. But it does not include control of policy. Also, it is difficult to expect miracles from courts in this regards as tremendous grey area of residuary powers exists where misuse of authority is difficult to arrest through judicial review.

Ineffective organization, waste of manpower, procrastination, and excessive sense of self-importance, indifference to the feelings of convenience of citizens, and obsession with the binding authority of departmental decision, inflexibility, abuse of power, and a reluctance to admit error.

The Constitution of India assigned a massive instrumentalist role to the Indian State by obliging it to follow the goals of the Indian Republic as state in the Preamble and the Directive Principles of State policy. This meant strengthening the bureaucratic network of the state. It is well known that Nehru's top-down model of development helped laying strong foundations of a vigorous liberal democracy, shaped vital legal and political institutions and strengthened the roots of Indian federalism. But this model of development gave tremendous powers to the bureaucracy which virtually became the "sole guardian of its [state's] collective interest. A number of laws were designed and fitted in the legal framework of the Constitution. Among others, these laws

envisaged regulatory organisations. Tremendous responsibilities were assigned and powers conferred to bureaucracy. Its thinking was dominated by a colonial mentality which could not motivate and take along masses in the development task. Parekh (1994: 45) argues, since the bureaucracy could not execute the gigantic task it became "inefficient" and eventually "corrupt"[1]. This happened in the area of labour bureaucracy as well. Some of the recent researches in this area reveal that instead of promoting industrial justice, the labour administrators colluded with employers and union leaders to work as suboteurs of labour laws (Saini, 1995; Baxi, 1994). They did power dispensation through structures created by the labour law system, in effect to control the labour power. This alliance involved, apart from employers and labour bureaucrats, even those who are adjuncts to the industrial justice system like certain outsider union leaders, management consultants and labour lawyers. The alliance has been found conspicuous at the conciliation, labour administration, exercise of reference power, strike prohibition, award implementation, and general law and order maintenance levels (Saini, 1995).

The new instrumentalities of change carved out to transform a traumatically changeful, hierarchical, feudal society such as India did not work in the way they were intended to. Assessment — empirical and intuitive — of these politico-legal institutions revealed powerful gaps between promise and reality. The bureaucratic model so worked that, as Dhavan (1989: xxxii) has argued, "over the years, the Indian State has been directly or indirectly privatized to the use of some sectors of the political economy to the exclusion — or partial exclusion — of the other sections".

Indian Sate has been directly or indirectly privatized to the use of some sectors of the political economy.

As is known various institutions of the state are riddled with corruption, susceptible to manipulation and have thus led to considerable distance between state and society. The present legal structuring projects that by holding on to liberal institutions and huge bureaucracies we can change the future of Indian masses. Dhavan (1989) has argued that the bureaucracy as a part of the emergent class has contributed to corrupting the institutions to a point that they could not secure any substantive rationality to the Indian political economy. The working of our socio-political system has led to the emergence of a number of privatized interest groups in various parts of the political economy. In economic jargons they are described as rent-seekers or quasi-rent seekers.

Despite monumental legislative output merely an impression has gained ground that society cares for the poor and the deprived; in effect, however, legislations are mostly seen legitimating the *status quo*. Many legislations have facilitated the powerful to repress the poor and powerless. It is often disernible that "the same set of forces which ask for passage of certain social laws collude to subotage the realisation of the goals of such laws... providing [in effect] only symbolic protection" (Saini, 1995: xix). These very forces which "support" the movement (of modernization) and which are released by it defeat it from its apparent destination" (Galanter: 1981). This is happening in the sphere of labour justice institutions as also in other areas of planned economic and social change. The Constitution of India promises the legal system to act as instrument of production of politics (Burawoy, 1985) through an active utilization of law as an instrument of change; but its working reveals that it is becoming an instrument of the dominant class and interest groups to repress the disempowered (Baxi, 1995). Our model of development has kept the masses at bay to watch their doom in bureaucratic processes and latent rent-seeking collusions between power wielders.

Liberalization, Workplace and Human Face

As is discernible from the concern of the organisers of various seminars on the subject, liberalization and globalization are being looked at as means to faster development, restructuring of the economy and by using the potential of the infrastructural set up in a proactive way. But the organisers do express their concern for liberalization with a human face. Looking at the way industrial restructuring and liberalization are working at the global level in both the advanced and the developing world, the simultaneous commitment to liberalization and the concern for human face appears to be paradoxical and perhaps a wishful thinking. The proponents of the new economic policies seem to simply wish away the fact that there was a labour aspect involved in the whole process of liberalization. It is perhaps due to the fact that

1. Parekh cites data in support of this submission. Between 1956 and 1964 more than 80,000 complaints were registered with the Administrative Vigilance Division in the Ministry of Home Affairs. Out of this more than 63,000 were found worth investigating. Major penalties were imposed on over 6,000 government servants and minor penalties on under 57,000.

the most severe impact of the new thinking will be on the merginalized and deprived sections of the working class, who do not enjoy even a modicum of power in the existing politico- legal dispensation, and thus can be ignored.

It is important that we elaborate on the workers qua human beings and the effects of the new policies on them. It appears in the enthusiam to restructure, we are oblivious to the reality that the worker is somehow fading away. In the kind of changes which are being heralded by the ensuing dispensation, it is certain that they will decisively register the subjugation of labour by the iron rule of capital. It is important that this subjugation is resisted or at least minimised through effective union power. However, the role of unions world over including in the third world is coming under renewed scrutiny. But despite all their limitations, unions are fundamental organisations of the working class which workers "cannot do without" if they have to resist exploitation by the capital (Waterman, 1977: 58). It has been argued that it will not be right to ignore the emerging "employment patterns, changes in the labour process, class formations, trade union forms and practices, system of labour control, union-state relations" due to changes in the international division of labour (Southall, 1988: 6). We need to be concerned at the continuance and re-emergence of Taylorist work principles which are applied by the capital in the emerging economic scenario.[2] It is equally important that we understand the way in which the production shapes working class struggles and resistance to unilateral imposion of managerial rationality on issues concerning the work place.

Despite all their limitations, unions are fundamental organisations of the working class which workers "cannot do without" if they have to resist exploitation by the capital.

It is noticeable that in the post-Reagonomics U.S.A., "union membership has dropped to below 16 percent of the total labour force and 12 percent of the private-sector labour force in 1994"; which was 35 per cent in 1954 (Kochan and Weinstein, 1994: 484). There are tremendous pressures on union practices and membership in the Indian case also, which will eventually lead to grave diminution of labour power. Our industrial jurisprudence has projected union formation as an inalienable right of the industrial workers, even as only less then 10 per cent of the country's work force of 306.8 million is organised (CMIE, 1992).

In a well-argued human development critique of the new economic policy, Mehta (1994) has convincingly challendged the claims of its protagonists that a human face can be salvaged by carefully working the new economic policy. He shows that in the atmosphere of 'exit' and 'downsizing' which will result from the policy of privatization, workplace and society as a whole may have to suffer moral and mental health problems which would suck into the self-esteem and self-efficacy of workers. This, he argues, would eventually hit their skills, capability and human development. Based on Walse (1993), Mehta summarizes the socio-psychological effects of the Thatcherite economic policy as follows:

(i) The unemployment rate in 1993 was about 11 per cent with nearly three million people out of work.

(ii) A depressing loss of idealism has invaded the society.

(iii) The permanently jobless youth have taken to crimes and vandalism.

(iv) The Thatcher Government corroded the society with grab-the-money ethic.

(v) General moral decay.

(vi) Gains of productivity in the British industry have been achieved largely by sacrificing jobs rather than by boosting output through innovative work. Public opinion surveys have revealed that nearly 50 per cent of the working Britons would like to emigrate as Britain would become a worse country to live in (Walse, 1993).

Undesirable effects of unbridled individualism and consumerism in the Indian case could be caused, for example, from the rat race between private red-line buses plying on Delhi roads defying even a semblance of sensible driving, amid killing on an average two persons every day and injurig many others. The "grab-the-money ethic" (Mehta, 1994) will surely lead to general moral decay, social unrest and acceleration in crime rates. This would debilitate the working of the workplace and will be antithetical to human development. In U.S.A. due to the dismal effects of the working of the Reagonomics, the Clinton Administration is putting labour market and workplace policies back on the national agenda. Shortly after Bill Clinton took office in 1993 he established the Commission on the Future on Worker-Management Rela-

2. Taylor's (1911) scientific management envisaged work design on the basis of one-man-one-job whereby complex tasks were fragmented into simpler jobs.

tions under the chairmanship of former Labour Secretary John T. Dunlop (Kochan and Weinstein, 1994: 484). It has been asked to consider means to (i) promoting employee participation; (ii) improve performance of collective bargaining law; (iii) facilitate resolution of workplace problems that now are subject to government regulations and court litigation. The final report of the Dunlop Commission is expected shortly. In its interim reprot the commission notes large-scale resort to unfair labour practices, legal and illegal efforts of employers to curtail trade union activity or avoid collective bargaining. The commission has also noted rise in litigation over employment disputes and that the government enforcement procedures are inefficient, leading to delays. These developments are tending to put industrial relations issues back on the academic agenda in the USA and the developed countries after their clouding for more than a decade.

These developments are tending to put industrial relations issues back on the academic agenda in the USA and the developed countries after their clouding for more than a decade.

We thus notice that what is most important for us is a choice relating to value systems. It is not a simple choice between current economic policy and its alternatives. It is the peoples collective which should evolve the value structure. No Constitution is immutable and can change as per the exigencies of time. But we must resist imposition of value structure by the funding agencies the Bretton woods twins (the World Bank and the IMF). In a democracy, people must decide to optimise the welfare of the society as a collectivity and not individual benefits resulting from unbridled individualism. It is time that we unbundle the structural adjustment package and rework it to accommodate the impoverished, their requirements for subsidies, and the values of dignity, freedom, autonomy, and freedom from dependency and subjugation.

Labour Justice System

The goals of the Indian labour justice system are discernible from the Preamble and Chapters III and IV of the Constitution. The Preamble sums up the constitutional vision and values; so important is considered the Preamble that the contents of the Constitution are treated as a "long massive footnote to the Preamble" (Baxi, 1995: 5). It envisages the pursuit of liberty, equality, justice, fraternity and dignity. Chapter III among others contains fundamental freedoms such as rights to equality (Art. 14); assembly (Art. 19 (i) (b)) ; association (Art. 19 (i) (c)); occupation, trade and business (Art. 19(i) (g)); protection of life and personal iiberty (Art. 23). Chapter IV of the Constitution contains, among others, Directive Princiles which relate to an adequate means of livelihood (Art. 39(a)); equal pay for equal work for men and women (Art. 39 (d)); protection of health and strength of workers and children (Art. 39(e)); equal opportunity by the legal sytem (Art. 39A); Just and humane conditions of work and maternity relief (Art. 42); living wage (Art. 43); and workers participation in management (Art. 43A).

A reading of the Constitution shows that it provides certain minimalist and ameliorative duties of the Indian state towards its working people. Baxi (1995: 10) sees in the Directive Principles an incrementalist model of law as furthering the production of politics [referring to the term used by Burawoy] concerning 'unorganised labour and weaker sections. To operationalize the constitutional vision a number of labour laws were passed by the Parliament or existing labour laws were continued. The principal labour laws in India can be classified into four broad headings. First, the law relating to minimum conditions of employment can be said to consist of: the Factories Act, 1948; the Motor Transport Workers Act, 1961; the Plantation Labour Act, 1951; the Working Journalists Act, 1955; the Contract Labour (Regulation and Abolition) Act, 1970; the Bonded Labour System (Abolition) Act, 1976; the Inter-State Migrant Workmen Act, 1974. Second, the law relating to wages and other monetary benefits consists of: the Payment of Wages Act, 1965; and the Equal Remuneration Act, 1976. Third, the law of social security is contained in: the Workmen's Compensation Act, 1923; the Employees' State Insurance Act, 1948; the Employees' Provident Fund Act, 1952; the Maternity Benefit Act, 1961; the Payment of Gratuity Act, 1972; and the Public Liability Insurance Act, 1991. Fourth, the industrial relations law is contained in the Industrial Disputes Act, 1947; the Trade Unions Act, 1926; and the Industrial Employment (Standing Orders) Act, 1946.

On an analysis of these four sets of labour laws in India, we note that the first three types contain a system of protective labour legislation. The labour bureaucracy was expected to supplement the instrumental role of these protective laws. The fourth, i.e. the industrial relations laws, mainly provide certain minimum conditionalities for a voluntary system of just sharing of gains of industry and failing which provides a framework of processing the disputes not settled by voluntary arrange-

ments-these include provision of union registration, precisely specifying the terms of contract of employment, and making a provision of formus for settling the dispute.

The state emphasized labour laws as means to secure social justice to the working class. The academics as well as the judiciary repeatedly reminded the executive that the constitutional scheme is a just conception of development (Baxi, 1994; Desai, 1994). The labour bureaucracy has been conferred reactive as well as proactive powers and duties to operationalize the objective of these labour laws. Though not very many empirical accounts of the actual working of these laws are available, intuitive analyses abound. It has been argued that the working of these laws is far from satisfactory (Among others, Baxi, 1995; Saini, 1994 and 1995; Patel and Desai, 1995; Advani and Saini, 1995; Breman, 1990). For understanding of the working of the labour justice system, one can analyse its working in: (a) transnational corporations; (b) public sector industries; (c) large and medium-sized private sector industries; (d) medium- and small-scale private industries with semi-organised work force; and (e) the unorganized private sector.

Geographically, the TNCs in India are largly limited to Calcutta and Bombay Industrial belts. In the private sector they are largely involved in chemicals, pharmaceuticals, light and medium engineering, food and various modern consumer products (Damle, 1992: 160). It is wellknowm that in the TNC sector there exists union rights to a fair extent which include recognition of unions, periodic wage settlements, voluntary dispute settlements, grievance procedures and general observance of labour laws. Alongwith large private sector industries especially in the Bombay region, the TNCs are envied as "high wage islands"; though this picture is not even over the whole region. Negotiations have become the common method of dispute processing, and unions have often signed productivity deals, even as the incidence of strikes and lockouts among them is no less than that among other private sector industries. It can be said of this sector that the labour law framework has helped the working class in this sector to a great extent; the desire of voluntarism on the part of both the labour and management has not allowed bureaucracy to play any substantially negative role.

The working of the labour law system-especially through the role of the judiciary-in the public sector did make a meaningful impact in imposing fair and just procedural norms in industrial governance. But in the private sector industries even large organizations could still use the bureaucratised labour justice system to their advantage by entering into surreptitious deals with union leaders camouflaged under facades of legal forms. The role of the labour administration systems in the small-scale—and often in the medium-scale sector as well—has been noted to be indifferent, fraudulent, or even tyrannical (Saini, 1991). In the area of implementing the minimum conditions of employment in the unorganised sector, one can guess what kind of anarchy prevails (Baxi, 1995 and 1982; Patel and Desai, 1995). Typical bureaucratic syndrome, as identified in the foregoing paragraphs, can be observed at its pinnacle.

An Agenda for Reform in the Labour Justice System

We do need to effect reform, among others, in the bureaucratised set up of the labour justice system including enforcing the minimum standards of employment. Moreover, the reforms suggested are not intended to serve the micro objectives of the MNCs to further their pursuit of profit maximization. De-bureaucratization, however, should aim at reforming arrangements and institutions so as to be conducive to the realization of thier objectives. We could briefly consider the suggested reforms for the unorganized and organised labour as follows:

1. Reforming the system must aim at making law (conceived as legislation, administration and adjudication) as instrumentality of production of politics for the impoverished sections and unorganised labour. The first step in this direction, of course, is to so carve out our national agenda as not just to tolerate but to encourage organisation of the unorganised, to realise their civil and political rights. It requires not a repressive state but a state reflecting commitment to the values and convictions accepted by the Constitution.
2. Mere exhortation, including "a programme of social action or a crystal-clear instrument of instructions" (Baxi 1995: 11) to administrators are not seen as producing results. But we need a model of law which truly "strives" and "endeavours" to realise the desirable and feasible goals. The programme of action must be proactive. This essentially requires involvement of representatives of concerned people in the implementation programme. This will help fight bureaucratic inertia and corruption. People's participation in all aspects of life including economic and political realms are necessary for building a just society (DAGA, 1992: 3).
3. A programme of action such as enforcing minimum standards of employment requires "constant

monitoring of its implementation" and a continued "review of legislative and administrative performance" (Baxi, 1995).

4. We need an integrated approach to legal protection for the unorganised. At present the labour laws are piecemeal, numerous and complex. Baxi suggests a codification for amelioration of the unorganized labour.

5. In the organised sector, the point of utmost importance is restoring autonomy of labour administrators and adjudicators and de-linking them from the state apparatus. Also, there is need to make these bodies as consisting of multiple people including those possessing professional competencies. The history of Indian industrial relations shows that it is most difficult to come by.

6. As is noted above, in relation to the liberalized framework in the U.S.A., a large number of outside consultants have emerged in the industrial relations scene to guide the employers towards subverting the labor law framework. This would lead to further juridification[3] of the system and make the position of individual worker and labour collectives further vulnerable in India as well. If liberalization must succee, this must be the most serious areas of concern for all sympathisers of the labour class. The state must take effective measures to avoid this situation.

7. The Bonded Labour System (Abolition) Act, 1976 can be described as a fine piece of a social legislation. It involves the community in its administration. There may be a number of environmental variables which dilute its efficacy in the abolition of the bonded labour. But this type of community involvement even in the enforcement of other labor laws can have a general salutary effect.

8. A greater use of public interest litigation and a greater role of Legal Aid Committees should also be attempted as a short term measure of empowering labour in the matter of implementing minimum conditions of employment (Advani and Saini, 1995).

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3. For a Comprehensive discussion on juridification, see Saini (1995)

Capitalist Globalization: Wanted Manpower Planning

Bhasker Majumder

This paper takes globalization as a process of enveloping a subordinate group of large non-industrialized countries by a dominant group of a few industrialized countries by application of finance-military-technology power. The author attempts to unearth the conditions of capitalist globalization and the reasons why the governments in LDCs of late 20th century have come to accept this globalization. If a late-starter LDC is to move forward in the global ordering of events, it has to prepare its people to compete by consensus concludes the author.

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Any activity involving more than one individual is a social activity. These activities become globalized when a society is seen across national boundaries. "Economic activity, for example has become institutionalized as a rather global economy, mainly of the capitalist mode, with trade and commodity chains crossing national boundaries and long distances" (Schott, 1994, p. 23-24).

Capitalist globalization of production is an event of the recent past (Frobel, 1980, Gordon, 1988). The post-second World War Globe has been compartmentalized into a dominant group of a few industrialized countries and a subordinate group of a large non-industrialized or industrializing countries. Globalization is a process of enveloping the latter by the former by application of finance-military-technology power. A discussion on alternative interpretations of this concept has been done elsewhere (Pieterse, 1994).

Conditions of Capitalist Globalization

Globalization of production is based on location of multiplants of a single firm in countries found suitable.

The non-exhaustive conditions for such location are:

- Cheap labour in LDCs
- A large technical work force or a pool of scientific and technical manpower
- A middle class, e.g., in an LDC like India, offering a market size higher than that offered by the whole of the internal market in any DC for commodities of higher order and probably technology of western origin (location of such commodities in consumption mapping is above the social-national average in an LDC)
- A political structure weighted in favour of the national elite to accept commodities-technologies of western origin.

- Particular/special relation between governments.
- Provision of infra-structure by governments in LDCs for smooth operation of such multi-plant firms.
- A scope for dumping of chemical (hazardous) products/plants in LDCs by DCs
- A possibility of production (extraction) of intermediate products (mining and minerals)
- Trade related benefits offered by LDCs, e.g., tax benefits and other fiscal advantages assured by host governments, duty free items free trade zones etc.
- Easy access of firms in DCs to product and factor markets in LDCs, given local and global power-structure. The 'Cheap labour' argument stands on, among others.
- Non-existence of labour legislation
- Weak labour legislation
- Weak Trade Unions or Trade Unions working at cross purposes
- Non-labour or anti-labour attitude of Government where the plant is to be located
- Political stability, even in a situation of wage-freeze etc
- Oppressive/coercive government, e.g., Military Government.
- Unlimited supply of labourers, generally unskilled
- Absence of State protection for labourers, e.g., Umemployment Insurance/Allowance etc.,
- Absence of Minimum Wage ACt and/or non-functioning or irrelevant Act
- Ignorance of the masses, particularly of potential labourers in LDCs.

If these conditions can be accepted as major factors explaining the existence of 'cheap labour' in LDCs, then the root of the latter lies in their socio-political structure. For example, the existence of tradition-custom-belief-based attitude of the majority of people and their non-interference in the political process of decision-making may be taken as the explanatory factor. In military governments, for example coercion is explicit but people are compelled to consent on *modus operandi* in the absence of any alternative choice, if at all they have any idea about their potential power to reveal such a choice; fear works for their suppression of choice. In case of perhaps a better (possibility of higher social welfare via. peoples' participation) political system, e.g., of parliamentary democracy, people are 'guided' to exercise their maximum political power, viz, casting votes after every five years generally, here, for instance, wage-freeze may be rationalized in the name of 'nationalism', or in a frame of elite-declared-effort, often a camouflage, to attain higher alternative socio-economic goals (Duverger, 1977). Political stability in parliamentary democracy may conceal coercion or the hegemony of the minority section of the people in political power.

Political stability in parliamentary democracy may conceal coercion or the hegemony of the minority section of the people in political power.

To be precise, particular/special relation between governments in LDCs and DCs may be explained by the operation of the former as an overt or covert, political spy (espionage) and/or as an economic/political agent in a continent/sub-continent, to serve the interest of the latter. One purpose of such an operation is to ensure continuous patronage of the latter for protection and 'dependent prosperity'. Globalization gives the DCs the scope of direct use and control of the resources of LDCs, particularly the geological potential. The vulnerability of the governments in LDCs does not necessarily imply the same of the people in these countries for perpetuation of the position of subordination to DCs, but then the majority of the people in LDCs may be ignorant about the long-term consequences of modern/western technology/illusory development and potential ecological disasters.

The governments in LDCs have come to accept globalization, by choice or by compulsion, because of, among others, the following factors:

- Failure of the inward-looking import-substituting regime and/or failure of the 'protected regime' dependent on 'quota' of quantitative restrictions (Majumder, 1990, 1991)
- Failure of public enterprises to attain commanding heights for various reasons (Bagchi, 1986, Dandekar, 1994)
- Failure of centralized planning (Dandekar, 1994)
- Willingness to avail superior technology.
- Willingness to rely on market-led or outward-oriented industrialization (Majumder, 1992)
- Willingness to have foreign investment and collaboration

- Willingness to be aid-independent and export-dependent to have inflow of foreign exchange
- Willingness to ensure competitive environment in the national economy.
- Willingness to generate wide product range and forward product planning based on R&D.

The willingness to achieve the above is essentially derived from a compulsive situation the LDCs of late 20th century have been facing, viz, to realize the current problems and initiate steps accordingly for survival.

It is often argued that "the military power of the West was used ... to force some countries to engage in trade against their will by imposing so-called open-door policies. ... The economic consequence was that in the underdeveloped countries the pattern of production and trade, ... and the development of human resources through education and training were all largely determined external to the societies concerned" (Griffin, 1981, p. 221). If it is in fact a consequence of an exercise of hegemony by some DCs in an unequal production-exchange relationship, it surely cannot be offered as an argument for autarky for the LDCs. Also post-1973 period has brought about an end of the Third World as a homogeneous group of adversely affected countries. Globalization, it seems, is an aspect to-day not for the rich nations only (Streeten, 1982).

Manpower Productivity & Globalization

The New International Economic Order (Streeten, 1982) has brought about a compelling necessity for LDCs to concentrate on problems related to the productivity-absorption-mobility of manpower, the compulsion reflected often in the exit of labourers, often exit of the product/ firm itself. In other words, the indifference towards raising labour productivity, expressed or not, by the governments in such countries breaks down in the context of techno-globalization.

The New International Economic Order has brought about a necessity for LDCs to concentrate on the productivity-absorption-mobility of manpower, reflected often in the exit of labourers, often exit of the product/firm itself.

We accept that the economic power of a nation state is directly proportional with manpower (Denison, 1967, Nayudamma, 1980). The quality of a labourer is reflected in higher labour productivity. This productivity is dependent on education, training and research on the individuals, provision of physical capital, viz., machinery and equipment to support the individuals, policy decision by government regarding technology, incorporating both the above. In a dynamic frame, productivity in each period and hence the productivity-differential is conditioned by the initial level of technology and its changing state (Oshima, 1994).

The economic growth of a nation 'as a process' can be read as of generation of input-productivity. Productivity is an index of output-input ratio recorded as a final event. However, the factors and forces, often non-cardinal, may be concealed in the recording of this final event. Also each nation has to start on the path of progress from where it is, i.e., each is subject to its own initial conditions, and thus each is differentiated from the others, invalidating any generalization of prescription for the generation of wealth of a nation (Nayudamma, 1980). Keeping in mind the factors and forces, cardinal and non-cardinal, initial and altered over time, for countries perhaps with the same economic objective function, it can be asserted that the formation and development of skill expressed in high and rising productivity of a labourer at any time is a derivation from the injection of education at different levels and forms through academic institutions (technical and non-technical, industry-related or not) and learning by doing (Myrdal, 1982).

Whatever be the political, sociological, philosophical or engineering variations in the concept of activity aimed at commodity production, it remains a fact, experienced by countries industrialized by now, that productivity has to focus on "restructuring of work tasks, work performance, work environment, work systems, work cultures, and work organization, including restructuring of management." (Mills, 1984, p. 362). This restructuring has to encompass all the employees or all the members of the corporate community sharing the corporate goals for the success of the programme of restructuring. If the success story of Japan till date is kept in mind, productivity has to rest on the 'quality of worklife' (QWL), where the total quality control programme means organizing a company

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"so that members of the corporate community are in constant communication irrespective of their position" (Arai, 1984, p. 395).

Labour productivity in the context of globalization of production is derived from, among others, the competence and creativity of man depending on his acquiring education and training. The quality of the product/service is a reflection of this productivity. It is derived from the strength of the manpower as a team, responsive to market and technology (Zairi, 1994). In an era of high-technology globalization, manpower particularly in an LDC today is prone to self-destruction because of the rapid disappearence of the requirement for traditional skills (Hunter, 1970; Oshima, 1984). In addition to this technological question "if people have to be laid off at one time or another to adjust to a demand change in the market place, most likely they will not participate in the (quality control) programme" (Arai, 1984, p. 396). Herein comes the conflict between development of 'corporate community culture' and the 'threat of being thrown out'. The new technology in the shape of "computers and information systems... are reducing the need for clerks, secretaries, typists and supervisors" (Oshima, 1994, p. 247). The new technology determined exit of manpower has to be rehabilitated to socially useful old technology based lower wage jobs, which is however constrained by problems in the labour market (Majumder, 1995, forthcoming). In addition, the post-oil shock world economy created a 'crisis of unionism' throughout the western world. "Employers intensified their opposition to unions in response to the mounting cost pressures that come from high inflation and slow economic growth... . The severe blow dealt to labor movements by the recessionary 1970s is further evident by a period of international labor passivity extending from that time" (Western, 1994, p. 1319-1320). Any structural adjustment in the context of globalization has to resolve these crises and thus cannot rest on the cost-benefit calculations of a particular firm in isolation but has to view all the firms in the group and all the industries in the economy in production-labour absorption-mobility nexus. Thus comes the necessity of manpower planning in the context of globalization.

Rationale of Manpower Planning

Knowledge is society-neutral but its application in production is not. In fact, technology reflects the specific socio-economic dimensions of a particular society corresponding to a particular stage of growth (Hettne, 1981). Since globalization encompasses those LDCs willing to be open-door or moving beyond the national orbit, participation by them in this process of techno-globalization requires adequate and appropriate home preparation viz., manpower planning at home.

Globalization encompasses those LDCs willing to be open-door participation by them in techno-globalization requires adequate manpower planning at home.

Occasionally we talk about initial conditions posing problems in the sense of imposing constraints on the process of development of late-starters. Apparently these initial conditions manifest themselves in the lack of power to generate and absorb technologies for the revolutionization of a society. The real roots, for countries like India in S. Asia lie in illiteracy, ignorance and rampant miseducation of the mass, often anti-life outlook, alienation of the educated elite from the mass and the vulnerability of this section alienated from the mainstream in the shape of acute dependence on and collusion with foreign rulers and powers (Myrdal, 1982).

Effectively it would mean that manpower planning in these countries has to take care of ensuring education and training for the workforce on the job, initiating programmes in the sphere of production for ensuring the flow of required machinery and equipment, initiating educational planning for people out of jobs to make them employable, job guarantee for the employable. Since production is a reflection of social cooperation, reflected in the plant between labourers of varying skills, in the consensus between people inside the plant and people outside, the State has to initiate the above minimum dimensions of manpower planning. The social structure is always vulnerable, threatened by non-cooperation by people whose stake is least in non-cooperation. Education is a first check to this threat.

Since scientific and technological revolution in the globe has embraced production spheres for almost all existing commodities and commodities in pregnancy (in research laboratories), and the countries in the back-seat are to be a part, by consent or by victimization, of this process of techno-globalization, manpower planning has become a compulsion today for these countries. In the context of integration of old and new technologies for globalization to succeed in LDCs for capitalist industrialization, this compulsion is evident (Wad, 1983). The implicit assumption is that old accumulated tech-

nologies in LDCs developed by indigenous people via learning-by-doing are not to be discarded. In practice, elite-selected new technologies supported by profit-hunters on the home ground in these countries often support repetitive import of technologies and hence dictation by western industrialized countries implying dependency (Pack & Todaro, 1969; Chakravorty, 1988). Also, development of scientific outlook of people and acceptance of technology by people to ensure competitive growth cannot be ensured by application of force since it involves acceptance of new values (Goldsmith, 1984). It is to be via development 'consensus' of the agents of change, its development is to be guided by educational planning or social control via education. It involves time. Let us accept time as a vital input in the production of commodities by social cooperation.

There are two mutually supporting ways to welcome global competitive environment: creating conditions in the national economy today to face global competition tomorrow, incorporating global competition today by direct foreign investment or otherwise aimed at ensuring competitive environment in the national economy tomorrow. Techno-globalization incorporating both the above rules out minimizing, and at the extreme eliminating, government intervention (Gordon, 1988). Also, "both the United States and Japan retained indigenous control over the technologies which they imported from aboad. This has been a conspicuous feature in the Japanese case ever since its 'opening' to the West in the 19th Century" (Rosenberg, 1982, p. 327). The point is precise. If a late-starter in the back-seat is to move forward in the global ordering of events it has to prepare its people to compete by consensus. And market-determined strategy of manpower development is to be supported by, and often to be preceded by, government intervention, so that preparations for participation of home agents of change are ensured in the global environment of competition.

Market-determined strategy of manpower development is to be supported and often preceded by, government intervention, so that preparations for participation of home agents of change are ensured in the global environment of competition.

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'The man with a method good for purposes of his dominant interests is a pathological case in respect to his wider judgement on the coordination of this method with a more complex experience... We have here a colossal example of anti-empirical dogmatism arising from a successful methodology.'

'...interplay of thought and practice is the supreme authority'.

Alfred North Whitehead

Feature

Technological Modernisation of Small Sector in India

Vikram Chadha

Small industrial sector in India is seriously afflicted with low productivity, which has been mainly due to their technological backwardness, besides other factors, such as poor financial availability and lack of professional management. This paper highlights the Government's policy and programmes towards uplifting the technological levels of small industrial sector.

The major conclusions are that, in the face of liberalisation and economic reforms in the country, the small manufacturing sector has to modernise the production techniques to withstand competition; it has to diversify into more technology intensive areas of production. There has to be meticulous monitoring of the activities concerning the transfer of benefits of technical support programmes to small industry.

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The small industry sector in India has been making significant progress since independence and has contributed to the fulfilment of the socio-economic objectives of growth with-equity. This is evidenced by the fact that the number of registered small industrial units increased from 16 thousand in 1950, to 20.80 lakhs in 1992. The number of workers employed in small industries went up from 16.53 lakhs in 1972 to 36.66 lakhs in 1988, and gross investment from Rs 1334 crores, to Rs. 4671 crores. Output in the small industry sector expanded from Rs 2603 crores in 1972, to Rs 178700 crores in 1992; net value added registered an increase from Rs 841 crores to Rs 3230 crores, and export earnings from small industry sector jumped from Rs 150 crores in 1972, to Rs 9100 crores in 1992, i.e. from 9.6 percent of total Indian exports to 28 percent (Sandesara, 1993 and Government of India, 1992-93).

Small industries have been accorded a strategic place in India's planned economic development.

Problems

Despite a phenomenal contribution of the small industry sector to the economy, it remains afflicted with serious problems, as a result of which, about 31 percent of the registered small units had to close down in 1988 (Sandesara, 1993). These problems range from the shortage of finance and credit; shortage of raw materials; underutilisation of capacity; problems of marketing, to the inadequacy of infrastructural facilities like power and transport. Nevertheless, the most critical constraint on the growth and modernisation of the small industries, is the use of obsolete technology by this sector. This fact has

been highlighted by expert groups, technical committees and planning teams like, International Planning Team of 1954; Karve Committee on Village and Small Industries, 1995; International Perspective Planning Team, 1963 and Reserve Bank of India Studies during 1980s, instituted to study the plight of the small industries in India and recommend policies to ameliorate their conditions. The use of outmoded technologies in the small industries in India, does not allow them to exploit optimum potential of labour, capital, skills and equipment, resulting in low labour and capital productivity and underutilised capacities.

The most critical constraint on the growth and modernisation of the small industries, is the use of obsolete technology by this sector.

Although Sandesara (1993) estimated that during 1972 to 1988, the ratio of net value added to fixed assets increased from 1.06 to 1.10, and net value added per person employed increased from Rs. 5.09 thousand, to Rs 8.81 thousand, in small industries in India, yet in his earlier study, Sandesara (1966) had found a low capital and labour productivity during 1953-58, pertaining to 29 industries. Mehta (1969) and Shetty (1982) produced similar evidences. Goldar (1988) also points out an extremely low labour productivity and low total factor productivity (though high capital productivity). Similarly Sandesara (1993) observes that due to technological obsolesence, overall capacity utilisation in the small industry sector is merely 48 percent. Chadha and Sandhu (1990) also observed considerably low level of productivity in the small scale industry sector in India. The cited evidence suggests that the small industrial sector is extremely inefficient technically as reflected in low productivities. The fundamental reason of the technical inefficiency of the sector lies in the use of outdated capital equipment and a low level of knowledge of productive techniques (Little et al., 1987).

Government Programmes for Technological Upgradation

Since the beginning of the Planning era, the Indian Government has been making efforts to modernise the techniques of production in the small industrial sector. A Ford Foundation Team, which visited the Country during 1953-54, strongly recommended the establishment of regional institutes of technology for small industries. The Government accepted this proposal, and by 1954, four Regional Small Industrial Service Institutes, with a number of branches, were set up to provide technical assistance to small scale industries. Besides this, by the end of 1954, the Small Industries Development Organisation (SIDO) also came into existance, to promote programmes of assistance to small units, including technical advice and supply of modern machinery on hire purchase.

At the beginning of the Second Five Year Plan, the Karve Committee drew up plans for the development of village and small industries. It was accordingly stated in the Industrial Policy Resolution of 1956, that the State will concentrate on measures designed to improve the competitive strength of small scale producers, for which techniques of production should be constantly improved and modernised. The assistance programme for strengthening the technological base of small scale industries included assistance in procurement of machinery on hire purchase to speed up their modernisation and technological development. An appropriate Technology Cell was also set up in the Ministry of Industrial Development. As a consequence of these efforts, this sector started producing articles requiring high degree of technical skill and import substitutes, like radio components; tape recorders; optical, microscopic, telescopic and camera lenses etc.

The assistance programme for strengthening the technological base of small scale industries included assistance in procurement of machinery on hire purchase.

During Third and Fourth Five Year Plans, the production in small scale industries was to be further diversified by encouraging small manufacturers to deploy modern technologies. During 1968-69, modern machines worth Rs. 4.5 crores were supplied to these industries on hire purchase. The Fourth Plan launched a phased programme of modernisation of machinery and equipment in the small scale sector, initially for a group of selected industries including machine tools, foundary and re-rolling. Further, the Fourth Plan envisaged formulation of schemes for imparting training and financial assistance to technically qualified persons to enable them to set up small industries on modern lines.

Continuing the programme of technological modernisation of small industry sector, the Fifth and Sixth Plans

mentioned efforts to improve the skills and production techniques of small manufacturers by providing them a package of technical consultancy services. It was during this period that the Industrial Policy Statement of 1977 introduced the concept of District Industries Centres (DICs), mainly to provide and arrange a package of assistance and facilities including credit, raw materials, technical training etc. At present 422 DICs are operating in the country covering 431 districts.

The Seventh Five Year Plan laid down that the objective to modernise small scale industries will be achieved through the strategy of improving productivity, enhancing quality, reducing costs, restructuring product mix through upgradation of technology and strengthening and enlarging the skill profile of the workers.

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In the current liberalised scenario for industrial development, the private sector is expected to cooperate with the state in providing technical facilities for the technological upgradation of small units. The 1991 Industrial Policy expects industry associations to establish quality counselling and common testing facilities for small scale industries. According to the Eighth Plan greater emphasis would be on the establishment of tool rooms and provision of training facilities in order to upgrade technology in small scale industrial sector (Government of India, 1992).

Programme of Technical Modernisation

Under its programme of modernisation of small industry units, the Government of India aims to upgrade the obsolete technology in small industry, by identifying the inputs needed for small rural industries and small industry in backward urban areas. The main objectives of this modernisation programme are, to improve production technology; to improve product design and development; to promote utilisation of appropriate technology for achieving operational results; application of improved management techniques; helping selection of proper raw materials and subjecting the small industry product to testing and quality control.

The Government of India aims to upgrade the obsolete technology in small industry, by identifying the inputs needed.

Some 20 industries, on all India basis, and 38 industries with their concentration in specific states, have been selected for modernisation under this Programme, These industries include, machine tools, automobile componants; castings; domestic electrical appliances; hosiery and knitwear; bicycle and bicycle parts; hand tools; leather and leather products; scientific instruments etc. By 1988, 740 units had been registered under the modernisation programme. For modernisation of small industry, a Small Industry Development Fund was created in 1986, with an initial capital of Rs 2500 crores.

Ancilliarisation Programme

Through the ancilliarisation and sub-contracting programme of Government of India, small industries have been helped to overcome such problems as procurement of raw materials and consultancy. With the assurance of minimum off take at predetermined prices, the small units can concentrate entirely on improving the quality of their products. As a result, against 500 ancilliary units in 1977, there were 1176 small ancilliary units in 1983 (Kumar, 1990).

Industrial Estate Programme

The programme of setting up industrial estates was also directed to promote small scale industries by providing comprehensive facilities, assistance and guidance to small industrialists, at every stage of operation and management. By 1981, total number of sanctioned industrial estates was 799.

Institutional Infrastructure

For the growth and technological progress of small industry, an essential pre-requisite is the establishment and consolidation of institutional research in the country. Since, in a developing country like India, small entrepreneures wield meagre resources, they can hardly commit an adequate proportion of their proceeds for in-house technical research and development for technical advancement. Therefore, the small sized industry should

make the best use of the technologies developed in R&D institutions. Thus institutional support for technological upgradation of small industry is very crucial (Toren and Galai, 1978 and Chadha, 1990). In India, since independence, a widely diversified organisational structure, both at the Central and State levels, is functioning to promote technological modernisation of the small industries.

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Central Level Organisations

Small Industries Development Organisation (SIDO)

At the Central level, SIDO, under the Central Ministry of Industry, acts as a policy formulating, coordinating and monitoring agency for the development of small industries. Its activities relate to modern small industrial units, excluding those which fall within the perview of specialised Boards or agencies, viz. All India Handloom and Handicrafts Boards; Coir Board; Central Silk and Khadi and Village Industries Commission.

SIDO functions through a network of 27 Small Industries Service Institutes (SISI); 38 Extension Centres; 31 Branch Service Institutes; 4 Regional Testing Centres; 3 Process-cum-Product Development Centres; 2 Training Centres; 20 Field Testing Stations; 74 Workshops and 2 Central Tool Rooms. Besides these, it has five allied institutions, viz. National Small Industries Corporation (NSIC); Central Institute of Tool design (CITD); Tool Room and Training Centre; Institute for Design of Electrical Measuring Instruments (IDEMI) and Small Industry Extension and Training Institute (SIETI).

Besides providing various services for the growth and development of small industries in the country, SIDO provides technical and managerial counselling to the existing and prospective small entrepreneures; organises training programmes in technical and management subjects; conducts Entrepreneurship Development Programmes to motivate new entrepreneures and technocrates etc.; prepares study reports through consultants and by the technical staff of the SISI, for the modernisation programme for small units; provides common facilities services and vocational training in the workshops attached to the service institutes and through mobile demonstration vans; conducts economic and technical surveys and prepares techno-economic reports for selected areas and industries; organises seminars, workshops and industry clinics for the benefit of entrepreneures, to bring all those involved together to discuss the latest trends in technology; provides back up support to the Directorate of Industry at the State level and the District Industries Centres at the district level, in preparing project profiles etc.

Small Industries Service Institutes (SISI)

The SISI has a wide spectrum of technological and management tasks to perform. Technical assistance by SISI had been provided to 86.88 thousand units in 1986 and to 83.05 thousand in 1987.

Process-cum-Product Development Centres (PPDCs)

The PPDCs are designed to perform tasks such as, development of new technology and upgrading the technological level of existing small units; development of new products; improvement in the quality of products to meet national and export standards; conducting market research and providing training to craftsmen and supervisors.

Regional Testing Centres (RTCs)

The RTCs, located at New Delhi, Bombay, Madras and Calcutta, together with Field Testing Stations, perform modernising tasks, such as promoting awareness of quality control among small entrepreneures; helping ancilliary units for supplying precision parts and components to parent units; providing testing facility to small units to enable them to conform to Indian Standards Specifications, providing pre-shipment inspection required by Export Promotion Council; assisting State Governments to operate Quality Marking Scheme; providing consultancy for setting up 'on line' quality control facilities in small units; designing and developing tests for this purpose and conducting programmes in testing and inspection.

Besides these, SIDO has a number of specialised institutes closely connected with it, to render technical modernisation services to small industrial units, such as, Central Institute of Tool Design (CITD) at Hyderabad; Central Tool Rooms at Calcutta and Ludhiana; Institute for the Design of Electrical Measuring Instruments (IDEMI) at Bombay; Institute for Hand Tools at Jallandhar; Integrated Training Centre at Nilokheri and the National Institute for Entrepreneurship and Small Business Development (NIESBUD) at New Delhi (Kumar, 1990).

National Small Industry Corporation (NSIC)

The NSIC was set up in 1955 to provide specific technical assistance to small industries by supplying indigenous and imported machinery on hire-purchase basis; distributing scarce raw materials, components and parts and providing training to skilled workers and entrepreneures in various trades, in the network of prototype development and training centres.

The most important programme of NSIC to assist small industry is to provide domestic and imported machinery on hire-purchase basis, to be repaid in easy instalments spread over a period of 7 years. Thus, NSIC obtains import licences, opens letters of credit and delivers the machines to customers. It also scrutinises the suitability of the machines to customer requirements. Special rates of earnest money and interest are provided to technically qualified personnel for modernisation.

Table 1 shows the growth of hire-purchase of machinery supplied by NSIC. The table shows that the value of machinery supplied NSIC increased from Rs. 9.16 crores in 1972-73, to Rs. 17.58 crores in 1988-89, showing an average annual growth of 9.48 percent.

Table 1. Value of Machinery Supplied by NSIC on Hire-Purchase Basis to Small Scale Units in India

Year	Applications Accepted	Value of Delivered	Machinery (Rs. Crores)
1972-73	880	9.16	
1973-74	874	5.96	(–34.87)
1974-75	432	9.91	(+66.18)
1975-76	73	9.06	(–8.55)
1976-77	275	2.94	(–67.52)
1977-78	238	2.49	(–15.41)
1978-79	627	1.50	(–40.15)
1979-80	1300	4.56	(+204.17)
1980-81	1190	8.31	(+82.14)
1981-82	1365	11.52	(+36.54)
1982-83	1124	17.54	(+52.31)
1983-84	1195	21.57	(+22.93)
1984-85	1000	17.75	(–17.70)
1985-86	1120	20.79	(+17.11)
1986-87	1651	16.57	(–20.29)
1987-88	1906	21.83	(+31.76)
1988-89	1725	17.58	(–19.47)
Annual Average Growth Rate		9.48	

Note: Figures in brackets are percentage change over previous year.
Source: Government of India, *Annual Reports, SIDO*, New Delhi: Development Commissioner (Small Scale Industries), Ministry of Industry, Various Issues.

National Research Development Corporation (NRDC)

The NRDC leases processes and know-how developed in government laboratories, to small entrepreneures to upgrade their production technologies, based on indigenous effort.

Polytechnology Transfer Cenre (PTC)

The PTC bridges the gap between the technologist and the user of technology by establishing an intimate two-way rapport. It offers diagonostic service to industry through identification of the scientific, technological and engineering needs of small entrepreneures by furnishing information on machines and processes developed by Council of Scientific and Industrial Research (CSIR).

Centre of Plastic Engineering Technology (CIPET)

The CIPET provides valuable service to small units engaged in making plastic products by designing and manufacturing the necessary dies for them.

National Science and Technology Entrepreneurship Development Board

In 1982, the National Science and Technology Entrepreneurship Development Board was set up with main objective to promote self employment by making available to entrepreneures, assistance of various types, such as information on technical know-how and providing training/retraining facilities (Government of India, 1982).

Industrial Development Bank of India (IDBI)

The IDBI was set up in 1964. Besides providing institutional finance for small industry by refinancing NSIC to augment its industrial machinery hire-purchase service, it also provides training and consultancy assistance, through Technical Consultancy Organisations (TCOs). By 1987-88, it had set up 17 TCOs in different states and had conducted 2337 projects/feasibility reports; 170 rehabilitation/diagonostic studies; 18 assignments relating to turnkey jobs and 90 modernisation studies. IDBI also has provision to provide assistance to industrial concerns engaged in R&D work pertaining to any product/process and to provide technical knowledge. It concentrates on projects involving sophisticated technology and projects promoted by technicians and those exploring new areas of technology which might not find ready support from other institutions (Industrial Development Bank of India, 1987-88).

A prominent scheme of IDBI is the Venture Capital Fund (VCF), envisaged for encouraging commercial application of indigenously developed technology or adapt-

ing imported technology. The purpose of financial assistance would include setting up of pilot plants based on indigenously developed laboratory processes or upscaling/adapting/modifying processes for commercialisation.

A prominent scheme of IDBI is the Venture Capital fund for encouraging commercial application of indigenously developed technology or adapting imported technology.

Industrial Finance Corporation of India (IFCI)

The IFCI provides financial assistance for the development of technology through in-house R&D efforts, undertaken by private small firms and entrepreneures. The scheme is restricted to in-house R&D units involving investment not exceeding Rs. 50 lakhs (National Institute of Science, Technology and Development Studies, 1985 and 1988).

Industrial Credit and Investment Corporation of India Ltd. (ICICI)

The ICICI was established in 1955. Under its Venture Capital Scheme, lauched in 1987, ICICI provides long term financial assistance for projects involving development and/or commercialisation of high risk new technologies. In the same year, ICICI also launched a Programme for Acceleration of Commercial Energy Research (PACER) designed to support selected research and technology development proposals in the energy sector and to create an institutional environment for relevant technology innovation (Bertrabet, 1987). With a view to widening the base of technology development oriented activities, during 1987-88, ICICI promoted a new company called Technology Development and Information Company of India Ltd. (TDICI). The TDICI is meant to provide technological information and finance for development activities which also include commercial R&D schemes. An extensive knowledge network is proposed to be established as a part of TDICT (Industrial development Bank of India, 1987-88).

State Level Organisation

State Directorate of Industries

Directorate of Industries in all States and Union Territories looks after the development of industries in general and small scale industries in particular. The State Directorates organise various training schemes, provide common facility services and facilities for the development of infrastructure and allocate scarce indigenous and imported raw materials etc.

State Small Industries Development Corporation (SIDC)

The SIDCs have been set up in all States and Union Terrotories which are charged with, among other tasks, the responsibility of supplying scarce indigenous and imported raw materials to small manufacturers.

District Level Organisations

District Industries Centres (DICs)

At district level, DICs were set up from 1978, as the nodal agency for the development of small and village industries and to provide all support services needed for such development. The DIC organises Entrepreneurial Development Programmes (EDPs), to motivate entrepreneures and to promote industries. It guides and helps entrepreneures right from project formulation to project implementation. It monitors the smooth flow of raw materials to industries. In fact, DICs were expected to render all support services, including technical services to small units, under a single roof. Some states like, Karnataka (Single Window Agency); Tamilnadu (Gilla Udyog Mitra); Gujrat (Single Window Industrial Follow up Team) and Andhra Pradesh (A.P. Assistance Centre for Entrepreneures (APACE), have already started providing single window service to small entrepreneures. Table 2 depicts the total and average number of small units to have benefitted from DICs, by way of technical assistance.

Table 2. Industrial Units Receiving Technical Assistance Under DIC Programmes

Year	Number of units Receiving Technical Assistance (Fig. in '000)		Project Profiles Prepared (Fig. in '000)
1978-79	72.22	(317)	—
1979-80	177.79	(646)	—
1980-81	169.72	(524)	—
1981-84*	98.42	(251)	143.20
1984-85	50.62	(128)	218.44 (552)
1985-86	47.87	(121)	238.85 (564)

Note: 1. Figures in brackets are average per DIC.
2. * Yearly average during Sixth Five Year Plan (1980-81 to 1984-85)
Source: Government of India, *Annual Reports, SIDO*, New Delhi: Development Commissioner (Small Scale Industries), Ministry of Industries, Various Issues.

Industrial Development Centres and Quality Marking Centres (IDCs and QMCs)

At the district level, two significant institutions exist to provide technical support to small industrial units. These

are, Industrial Development Centres (IDCs) and Quality Marking Centres (QMCs). These Centres have been set up with the main objective of imroving the quality of goods being produced in the small scale sector, by providing essentially needed processing and testing facilities, like heat treatment, elactroplating, manufacture of jigs, dies and fixtures etc; testing facilities for hardness and strength of metals, chemical analysis, testing electrical components and appliances; imparting technical consultancy; helping in selection of new machinery; channelising new technology from R&D labs to industry; holding seminars for promoting quality consciousness among small entrepreneures; helping standardisation of small industry products to improve their quality etc. (Chadha & Sandhu, 1987).

Other Specialised Agencies and Programmes

For the traditional cottage industries, the respective Commodity Boards and socialised institutions, such as Khadi and Village Industries Commission provide technical assistance, including those relating to the development of designs and improved techniques of production.

There are also special programmes in khadi and village industries conducted by the Khadi and Village Industries Commission for technicians, supervisers, managers and artisans. Similarly, training is also imparted to artisans in the handicraft sector in sericulture and coir. The Council for Development of Rural Technology (CART), renamed as CAPART (Council for People's Action and Development of Rural Technology), acts as a nodal point for the coordination of all efforts for the dissemination of technology relevant for rural areas.

R&D in Indian Small Industry

Besides institutional support for technological upgradation of small industrial sector, a good measure of in-house R&D activity is also taking place within some small units. Such in-house R&D, not only helps in generating appropriate technologies, but also helps in their true assimilation in the small manufacturing.

In-house R&D, not only helps in generating appropriate technologies, but also helps in their true assimilation in the small manufacturing.

Table 3 presents the number of DSIR (Department of Scientific and Industrial Research) recognised in-house R&D units in the small scale industrial sector, and R&D expenditure incurred therein. The table shows that in case of electronic and electrical equipment industry, the number of R&D units in small industrial units, increased from 43 to 66 over 1982-83 to 1990-91, while in case of Industrial Machinery manufacturing industry, they more than doubled from 7 to 16; in Chemical industry, their number increased from 30 to 46; in Drugs and Pharmaceuticals their number increased from 13 to 25. However, most spectacular performance in small industry R&D has been in Food Processing Industry, where the number of R&D units went up from 3 to 13, and R&D expenditure increased from about Rs 36 lakhs to about Rs 11.50 crores, at an annual rate of over 40.31 percent. Whereas the total number of inhouse R&D units in small industrial sector increased from 148 to 253 during 1982 to 1991, the R&D expenditure in these units increased from Rs 7.88 crores to Rs 36.22 crores over the same period, at an annual average rate of over 23.16 percent.

Table 4 highlights the statewise R&D expenditure. Maharashtra accounts for the largest number of in-house R&D units in small industries, which increased from 50 to 90 during 1982-91, with R&D expenditure going up from Rs. 3.85 crores to Rs 16.75 crores, giving annual growth rate of about 22.51 percent. In Tamil Nadu, R&D expenditure in small industry went up from Rs 1.12 crores to 3.11 crores, at the rate of about 18 percent. Karnataka showed a tremendous boost in small industry R&D activity, with their R&D units increasing from 12 to 34, and their R&D expenditure rising from Rs 58.75 lakhs to around Rs 3.71 crores, growing at 23 percent per annum. But the most spectacular increase in R&D activity in small industry has been in Andhra Pradesh, where the number of R&D units grew from 8 to 21 and R&D expenditure spurted from Rs 36.48 lakhs to around Rs 3.91 crores over this period, at an annual rate of 41.5 percent. However, the highest growth of R&D expenditure in small industry was recorded in Rajasthan, where it increased at over 76.7 percent per annum.

Thus we find that R&D activity in small industrial sector is stronger in states like Tamil Nadu, Maharashtra and Karnataka, where a lot of public sector industry in the large sector has come up, giving a stimulus to the technological upgradation in small industry which grew in an ancilliary relationship with large public industrial units.

R&D activity in small industrial sector is stronger in states where a lot of public sector industry in the large sector has come up, giving a stimulus to the technological upgradation in small industry.

Table 3. R&D Expenditure by Industry Groups for Small Scale Industries in India (Rs. Lakhs)

Industry Group	No. of R&D Units	Total R&D Expenditure 1982-83	1983-84	1984-85	No. of R&D Units	1985-86	1986-87	1987-88	No. of R&D units	1988-89	1989-90	1990-91	Annual Growth Rate of R&D Expenditure
Metallurgical Industries	4	39.32	16.39	7.05	4	10.82	13.19	9.71	9	102.55	130.45	158.68	32.87
Fuels	1	0.11	0.13	0.18	0	0.00	0.00	0.00	0	0.00	0.0	0.00	27.92
Boilers and Steam Generating Plants	0	0.00	0.00	0.00	0	0.00	0.00	0.00	1	0.00	5.63	6.00	6.57
Prime Movers	1	4.31	3.04	2.35	1	2.35	2.58	2.83	2	2.31	2.98	5.19	1.40
Electronic & Electrical Equipment	43	178.06	168.68	214.71	50	227.77	278.08	245.96	66.	587.71	691.88	836.34	23.19
Telecommunication	11	44.23	59.63	48.84	15	59.83	62.93	80.44	26.	166.09	158.68	202.55	17.18
Transportation	2	5.62	1.43	1.85	2	3.92	3.11	2.63	3	8.83	12.16	12.61	22.92
Industrial Machinery	7	32.44	53.09	44.28	11	62.44	47.10	47.10	16	158.29	158.86	209.77	24.24
Machine Tools	1	6.13	5.86	4.27	1	4.26	8.61	2.72	5	22.40	25.98	26.30	24.52
Agricultural Machinery	0	0.00	0.00	0.00	1	0.08	0.19	0.07	1	2.66	1.18	2.92	116.92
Misc. Mechanical Engg. Industries	3	32.90	30.64	31.18	2	26.02	'26.89	28.79	2	57.78	47.40	53.26	7.92
Commercial Office, Household Equipment	2	14.26	21.98	41.08	2	24.65	43.45	62.02	2	22.36	8.37	9.41	– 7.77
Medical & Surgical Equipment	0	0.00	0.00	0.00	0	0.00	0.00	0.00	1	7.68	10.71	12.00	25.00
Industrial Instruments	14	95.60	73.52	83.80	17	79.98	87.49	95.12	15	62.26	59.06	102.10	– 1.29
Scientific Instruments	6	32.39	41.43	40.30	8	45.73	47.47	56.63	9	85.06	63.55	60.75	9.61
Chemicals (Other than Fertilizers)	30	69.16	70.66	79.62	41	130.14	210.81	356.71	46	329.62	237.66	395.17	27.25
Drugs & Pharmaceuticals	13	59.92	58.67	77.18	15	49.17	77.08	124.01	25	167.33	322.72	309.53	26.61
Textiles (Dyed, Printed Processed)	0	0.00	0.00	0.00	0	0.00	0.00	0.00	1	1.37	3.07	3.50	59.84
Food Processing Industries	3	85.92	101.85	116.65	6	154.47	181.33	237.24	13	686.83	750.72	1145.91	40.33
Soaps, Cosmetics, Toilet Preparations	2	75.92	63.02	49.86	2	45.75	75.87	67.31	0	0.00	0.00	0.00	– .37
Rubber Goods	1	0.48	0.82	0.65	0	0.00	0.00	0.00	1	7.29	8.02	8.83	97.91
Leather, Leather Goods & Pickers	1	1.14	1.63	1.79	0	0.00	0.00	0.00	0	0.00	0.00	0.00	25.31
Glue & Gelatin	0	0.00	0.00	0.00	0	0.00	0.00	0.00	1	0.88	8.75	10.31	242.29
Ceramics	0	0.00	0.00	0.00	1	1.32	1.54	0.99	0	0.00	0.00	0.00	– 13.40
Miscellaneous Industries	3	10.41	4.48	13.96	3	8.42	12.88	24.69	8	40.16	62.38	50.37	33.64
Total	148	783.32	776.95	859.55	182	934.12	1180.60	1444.97	253	2519.46	2770.21	3621.50	23.16

Source: Government of India, *Research and Development in Industry*, New Delhi: Department of Science and Technology (Ministry of Science & Technology), Various Issues.

Table 4. R&D Expenditure in Small Scale Industrial Units in Different States & Union Territories in India (Rs. Lakhs)

Name of State/Union Territory	R&D Expenditure												
	No. of R&D Units	1982-83	1983-84	1984-85	No. of R&D Units	1985-86	1986-87	1987-88	No. of R&D Units	1988-89	1989-90	1990-91	Annual Growth Rate of R&D Expenditure
Andhra Pradesh	8	36.48	38.63	32.91	12	39.47	43.95	44.14	21	399.45	309.16	391.42	41.52
Bihar	0.	0.00	0.00	0.00	0	0.00	0.00	0.00	1	88.00	101.00	115.50	14.56
Chandigarh	10	38.86	32.84	37.43	10	70.95	129.24	356.71	7	49.49	45.27	56.32	8.00
Delhi	10	48.25	62.08	94.40	10	69.36	94.69	118.75	13	148.75	145.24	177.87	16.60
Dadra & Nagar Haveli	0	0.00	0.00	0.00	1	2.50	3.50	5.50	0	0.00	0.00	0.00	48.32
Daman & Diu	0	0.00	0.00	0.00	0	.00	0.00	0.00	1	0.26	0.29	0.32	10.94
Goa	0	0.00	0.00	0.00	1	2.36	8.62	10.24	1	3.37	8.43	10.00	18.84
Gujarat	11	43.33	49.66	61.89	17	72.05	70.79	94.76	17	128.47	134.20	168.91	18.45
Haryana	3	2.74	7.82	7.95	3	7.55	5.66	6.22	7	51.19	64.42	72.75	46.65
Karnataka	12	58.73	48.13	67.10	17.	76.34	61.45	69.26	34	142.65	162.77	370.95	23.04
Kerala	1	1.57	0.48	2.40	1	2.40	10.61	3.16	2	8.35	12.61	26.85	49.01
Madhya Pradesh	4	5.88	3.42	5.25	4	5.41	5.60	4.23	5	23.07	20.00	26.67	26.41
Maharashtra	50	384.75	394.61	409.11	61	441.27	597.10	633.88	90	1162.75	1413.01	1674.97	22.47
Orissa	0	0.00	0.00	0.00	0	0.00	0.00	0.00	1	3.31	1.93	3.72	6.01
Pondicherry	1	5.88	6.47	7.12	0	0.00	0.00	0.00	2	5.89	9.71	12.50	14.70
Punjab	1	0.41	0.32	1.10	0	0.00	0.00	0.00	0	0.00	0.00	0.00	63.80
Rajasthan	1	0.33	0.24	0.14	2	6.98	4.08	3.16	3	'11.66	8.47	15.58	76.71
Tamil Nadu	19	111.68	68.37	69.46	27	78.71	93.83	124.01	23	181.56	212.80	311.31	17.91
Uttar Pradesh	9	23.25	20.62	21.26	9	23.99	25.15	33.62	12	40.44	37.75	51.55	11.67
West Bengal	8	26.18	43.26	42.03	7	34.78	26.33	31.51	13	70.80	83.15	134.31	17.05
Total	148	788.32	776.95	859.55	182	934.12	1180.60	1447.97	253	2519.46	2770.21	3621.50	23.17

Source: Government of India, *Research and Development in Industry*, New Delhi: Department or Science and Technology (Ministry of Science & Technology), Various Issues.

Problems in Technological Modernisation

The Indian small manufacturer is not averse to technological improvement in his production techniques, instead he tries to seize every opportunity to upgrade his production methods, even by adapting sophisticated and costly domestic or imported technologies (Chadha & Dhawan, 1993), despite his technical, physical and financial constraints. A number of impediments stand in the way of technological modernisation of the existing level of production techniques. The most crucial hurdle is the availability of finance.

An overview of the financial policies indicates that the government has launched specific schemes for providing financial assistance for technological modernisation of the small scale industries. Nevertheless, the lending policies of the financial institutions are based on security oriented approach. Before sanctioning the loan to an entrepreneur, the concerned financial authority assesses the financial status of the entrepreneure and technical feasibility of the project. This, many a times, obstructs the flow of financial assistance to deserving entrepreneurs (Nigam, 1984). In a case study of 112 small entrepreneures, Solanki and Qureshi (1988) observed that a very small proportion of sale proprietorship small firms which had applied for financial assistance, could get it. Even the National Small Industries Corporation has been criticised for causing inordinate delays in providing hire-purphase finance to small producers, resulting in their hesitation to procure new machines under this scheme (Dawar, 1986).

Although the government has set up a comprehensive infrastructure of R&D institutions and other technical support mechanisms for technological upliftment of small industries, the system is wrought with problems, which shackle the small manufacturer's initiative to improve his production techniques. Chadha (1990) and Solanki and Qureshi (1988) observed that the indigenous technologies, developed in R&D laboratories in India, are mostly in half backed condition and developed only upto bench scale. Such technologies need to be further upscaled through design and development modifications on the shop floor, which involves huge expenses and time, beyond the capacity of small manufacturers. Besides this, most of the R&D labs are churning out irrelevant technologies, and those small units which tried to adopt these technologies, failed to produce products according to customer requirements which resulted in their commercial failure (Vepa, 1982).

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Moreover, there is an utter lack of initiative on the part of these technical institutes, in so far as they neither motivated, nor demonstrated the techno-economic performance of new technologies to the small manufacturers. There has been an extreme absence of professionalism among technical institutes, like IDCs and QMCs. The technical centres were either indifferent in providing technical services like, heat treatment; product analysis and designing tools for small manufacturers, or charged heavy fees from them for these services (Chadda and Sandhu, 1987). These technical institutions work like government departments and are characterised by bureaucratic delays and red tapism. There is least emphasis on communicating new technological developments to manufacturers and even if new technologies were supplied, there were hardly any monitoring or followup, which resulted in uneconomic and stunted performance of institutional technology in the manufacturing unit.

The small industry is afflicted with the problem of absence of standardisation of products. Standards are pegged to unduely high level of performance, which are often unrealistic and unattainable in small manufacturing. As a result small entrepreneures are often forced to operate at low technology levels and there is lack of quality control in their production processes (Government of India, 1969).

Due to the specific constraints of the small industry and the general apathy of the technical institutional set up, industrial technologies in small industrial sector have remained anachronistic and unproductive.

Thus due to institutional failure to upgrade technology, some small manufacturers are lured to adopt costly foreign technology, which besides being expensive is not amenable for effective operation due to technical, financial and physical constraints. The R&D institutes and

technical organisations do not even help the small entreprensures in adapting and assimilating such technology. So, due to the specific constraints of the small industry and the general apathy of the technical institutional set up, industrial technologies in small industrial sector have remained anachronistic and unproductive.

Many government programmes, initiated specifically to upgrade small manufacturer's technical levels, have flopped. There are many studies, which report the failure of Government's industrial estates programme in providing modern technology, technical inputs and expertise to small scale industries, either on account of irrelevant choice of location of the industrial estates (Abram, 1984), or due to the lack of professional management of these estates (Chattopadhaya, 1984), or simply due to the inadequacy of technical support institutions (Neilson, 1978). Similarly, the government's programme of ancilliarisation of the small scale industries has failed; helped neither in transferring new technology, nor it in quality improvement of the small industry products by the parent unit (Vepa, 1988; Subrahmaniam & Kashyap, 1988).

Prospects for Technological Modernisation

The New Economic Policy (NEP) and the spate of structural reforms, especially in the industrial and trade sectors, being introduced since mid 80s and subsequently intensified since 1990, harp on stimulating technical change in all sectors, particularly in industry. These reforms and NEP have unleashed the forces of competitiveness and modernisation due to liberalisation and globalisation of the economy. In the wake of these structural changes, the dictum, 'survival of the fittest' is going to prevail. All such industries, which were hitherto protected against the onslaught of large domestic and multinational companies, shall have to gear themselves up by imbibing modern technological and commercial culture. Otherwise, the inefficient, protected and sluggish will be squeezed out of competition and the market (Indian Express, 1994).

The fundamental features of NEP and structural reforms, viz. removal of import controls; convertibility of rupee on trade account; foreign equity participation beyond 51 percent; interest rates reduction; withdrawal of MRTPA (Monopolies and Restrictive Trade Practices Act) and FERA (Foreign Exchange Regulation Act) regulations; removal of licensing requirements and opening the reserved sectors to foreign companies, are going to throw up new challenges to small industries in India. The implications of these reforms are somewhat promising for the small industries, but generally ominous shadows have been cast on indigenisation of technology in India.

There is no doubt that the small industry, to survive the competition from large Indian and foreign companies, will be forced to introduce technological modernisation of their existing production processes. But what would be the cost of such modernisation and possibilities? The small industry will have to address itself to such implications as, whether it will be possible for it to remain 'small' with the introduction of hi-tech, automative or computerised technology; will it be possible to generate enough finances and use the modern technology within their constraints of financial, physical and technical resources; will the small manufacturers be able to put the latest technology to optimum use, given their low technical and market optima; will it be possible for the modernising small industry to produce traditional consumer products like textiles, food products, soap and detergents, leather goods etc., which earlier fell within their domain, but now are being produced with capital intensive hi-tech by multinationals, and so which are the areas of production left open for small industry to diversify into. Then the question of lack of professional management and market competition remains nightmarish issues for small industry. Such issues are sure to sully the prospects of modernisation of the small industry in India.

Another stumbling block in the way of technological upgradation of small industry would be the conditionalities imposed on India, being a signatory to GATT Agreement (now World Trade Organisation, WTO), which are totally inimical for industrial R&D in developing countries like India (Chandra, 1993), because it limits subsidies on R&D to 50 percent for basic industrial research and 25 per cent on applied research. It puts special hurdles for developing countries, without subsidies for R&D, particularly for entering into technology intensive areas of production, most small industrial units may not undertake technological research.

The shape of the emerging economic scenario would be such that those small industries which fail to upgrade their production technologies, will be at the mercy of Indian giants or multinational corporations. Such small units will have to either close down due to their failure to compete, or will have to take the role of ancilliary or sub-contractorship to large Indian or foreign companies. Even in that case, the small industry shall have to update its technology. There is another view (Vyasulu, 1993) that India companies would merge and collaborate with MNCs and would let the latter undertake risky and expensive R&D for technological competitiveness. So, technological

modernisation would be the name of the game in the future of Indian industry to come, at all scale levels, with the coming of free market competitive capitalism. That is another question whether such technological modernisation of small industry is compatible with the objectives of our development strategy.

Technological modernisation would be the name of the game in the future of Indian industry to come, at all scale levels, with the coming of free market competitive capitalism.

The Way Out

Traditionally, the small industry has played a significant role in the socio-economic development of the Indian economy. It has a well entrenched base in the economic system of the country. It does have a vast potential for growth and suits the requirements and resource endowments of our economy. Now in the changed scenario of economic reforms, this vital sector of the Indian industry ought not to be left to fend for itself. In the fitness of things the small industry should have been first on a strong footing technologically, before letting in the competitive forces from industrial giants. But now a cautious policy approach has to be mooted, to make it survive the wave the revolutionary economic change in the economy (Indian Express, 1994).

> The small units must be helped to modernise by rationalising the schemes of incentives and support systems. R&D institutions, besides furnishing latest technologies to small industries, must help small industries in adapting imported foreign technology to suit their financial and technical requirements. These institutions should help the small industry to introduce technical modernisation based on indigenously available resources and inputs, to make them cost competitive. A system of rewards and punishment should be instituted upon work appraisals of R&D staff of these institutes. The concern of the Indian Government towards upgradation of technological standards of the small industrial sector in India is already evidenced in the recent formation of a Technology Transfer Consortium, which teams up the Asia-Pacific Centre for Technology Transfer (APCTT), Council of Scientific and Industrial Research (CSIR) and the National Small Industries Corporation (NSIC), to help small scale industrial units in selecting and evaluating technologies to upgrade productivity levels, design standards and efficiency to make this sector competitive. The Consortium will hold a series of workshops in premier Indian cities, to expose small scale industrial units to national and international developments in technology and help them acquire relevant technologies (Indian Express, 1994).

Small units must be helped to modernise by rationalising the schemes of incentives and support systems.

The District Industry Centre (DIC) programme should be revived with a gusto, so as to provide an integrated package of industrial and technical services to promising small units. The small units must be granted liberal fiscal and monetary incentives such as, taxation and investment allowances etc. to induce them to carry out in-house R&D, particularly in technology intensive industry. By encouraging small industrial units in technology intensive areas like, telecommunications equipment; scientific and medical equipment; automobiles; electronics; computers and semi-conductor industry etc. and other light engineering manufacture, there will be an inbuilt pressure on small units to modernise their technological parameters. Besides this, the programme of ancilliarisation and sub-contractorship of small industry, based on structured contractual relationship with a large parent industrial unit, monitored closely by a government agency, will further stimulate technological modernisation of the small industry in India.

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Feature

Factors Determining Pesticides Use: A Study of Borewell Irrigated Area

A. Narayanamoorthy

Consumption of pesticides is mostly determined by variety of the crop, since pest resistent capacity varies with crop's variety. However, most of the available studies have not specified the variety and not incorporating relevant socio-economic factors while studying pesticides consumption in India. Taking into account these important points, the present study focuses the factors which determine pesticides consumption and its relationship with yield. The study has been conducted in a highly bore-well irrigated area of Tamil Nadu, among 200 sample farmers -- 100 bore-well and 100 non-bore-well farmers. The study has shown that the farmers of bore-well irrigated area use large quantity of pesticides without adopting proper method. There is a positive significant relationship between quantum of consumption of pesticides and the consumption of fertilisers. Likewise, farmers who have used more NPK fertilisers mix also use more pesticides for their crop. Land size and farmer's community are not significantly related with consumption of pesticides uniformally for both groups. However, farmer's education helps to use pesticides properly. The study also found that yield of crop was positively associated with consumption of pesticides.

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Pesticide has become a necessary input in Indian agriculture after the introduction of bio-chemical technology. Intensive cultivation is usually associated with high incidence of pesticides (Desai 1970). As an input the role of pesticide is different from that of fertilisers — Fertiliser directly helps to increase the crop yield but it is not so in the case of pesticides. That is, the former is yield augmenting input, while the latter is yield protecting or saving input. Macro-level data show that the use of persticides has increased from 2.4 thousand tonnes in 1950-51 to 79.4 thousand tonnes in 1991-92 in India (CMIE, 1993a).[1] However, per hectare consumption of pesticides is much less in India compared to developed countries. For instance, per hectare consumption is around 400 gm/ha. in India which is one fourth of the same in the US, one fifth of that in Europe and one twentieth of the consumption in Japan (Alagh 1988, Business Line, 1994). Due to less and improper use of pesticides there has been huge economic loss in agriculture. It is estimated that about 25 to 30 per cent of the crop yield is being destroyed by pests every year (OECD, 1977, Agarwal, 1983)[2]. In monetary terms, it comes to about Rs. 6000-7000 crores per annum (Rangarajan 1994, Kumar 1994).

Literature

Though pesticide is an important input, detailed studies, incorporating socio-economic characteristics of the farmers, are not available as in the case of fertiliser. This is because of the fact that detailed time series data are not available and hence reliable estimate of pestcides consumption for agricultural crops are lacking (GOI, 1985). As in the case of other technological inputs,

1. Pesiticides consumption has consistently increased (in thousand tonnes) from 2.4 in 1950-51, 8.6 in 1960-61, 24.3 in 1970-71, 45 in 1980-81 and 79.4 in 1991.92.
2. See Agarwal (1983) for cropwise loss of yield due to pest damage.

pesticides use is higher among the large farmers than small (farmers) Saika & Bora 1975, Parthasarathy & Pothana 1983). It is obvious that pesticides are costly inputs hence the large farmers consume relatively more than small and socially backward classes (Reddy 1985).

More importantly, majority of farmers use either too much or too little of pesticides without understanding its effectiveness (Ghodake et al., 1973). Many socio-economic factors including systems of agriculture also determine the use of pesticides (Lipton 1989., NCAER 1967). In many cases lack of information on the part of farmers leads to an excessive use of pesticides (Feder 1982). Price of pesticides, availability of dusting and spraying equipment also determine the use of pesticides (PEO 1970-75, Dasgupta 1980). Importantly, use of pesticide is also related to the knowledge and perception of farmers (Alagh 1988., Pandey 1989), since its complex technology needs more workmanship[3]. However, studies are not available under what conditions farmers attempt to use more pesticides and on what basis they select pesticides.

The use of pesticides, especially liquid pesticides has rapidly increased recently. But very few studies are available on this. Details available in these studies are also not enough to understand the magnitudes of pesticides consumption. Pest ravages cannot be similar in all varieties and all crops. Some of the varieties have more pest resistence power while others do not. For instance, pest damage is much less in *ponni* paddy variety, while it is more in *CR-1009* and *IR-50* paddy. Hence one should specify the variety of the crop before conducting studies on pesticides. It is also argued that there is a relationship between the quantum of chemical fertiliser application, especially nitrogen, and use of pesticides. Some farmers also relate pesticides use with the yield of the crop without considering the quantum of use of crucial yield increasing inputs like fertilisers. The present study focuses on these issues between borewell and non-borewell farmers. A popular paddy variety namely *CR-1009*, in Pudukkottai district of Tamil Nadu, has been chosen for this study.

Study Area and Sample Design

This study has been conducted in four revenues village namely Vallathirakottai, Kalangudi, Maniyambalam and Vandakottai of Pudukkotai district, Tamil Nadu. These villages have a high concentration of borewells (Narayanamoorthy, 1990, 1993, 1994a). Three crops are being cultivated in a year, since there is no scarcity of water. The crop pattern of these villages are distinctly different from the state, district and taluk averages (table 1). Paddy occupies an important place in all state, district, taluk and study areas; however there is an important difference in terms of area under sugarcane crop. Sugarcane accounts for about 25 per cent of the net sown area (NSA) in the study area, whereas the same is only 0.76, 1.05 and 3.08 per cent in the taluk, district and state respectively. The other difference is that groundnut, which accounts for a fifth of the cropped area in the district, occupies a much less proportion of area in the study villages. Millets account for about 24 per cent of the cropped area in the state and 10 per cent in the district, but the area under the same is very meagre in the study villages. It indicates that borewell irrigation creates way for more remunerative crops like sugarcane etc.

Table 1: Study area crop pattern (in percentage) for 1990-91

Crop	Tamilnadu (State)	Pudukkottai (district)	Alangudi (Taluk)	Study area
Paddy	34	46	79	63
Total millets	24	10	2	meagre
Sugarcane	4	1	1	27
Pulses	16	9	1	1
Groundnut	19	21	3	2
Others	3	13	14	7
% of NSA to total area	43	45	47	53
Total area (hectares)	129.93*	466329	71743	926

Note: *Indicates lakh hectares, NSA — net sown area.
Source: Govt. of Tamil Nadu, Tamil Nadu — An Economic Appraisal. Joint Director of Agriculture Office, Pudukkottai. Study area Village Administrative officers records.

Total cultivator households of this study area is 532-178 borewell farmers (BWFs) and 354 non-borewell

3. See : NCAER (1967) for more details relating to the importance of farmers knowledge and awareness on consumption of pesticides.

farmers (NBWFs). Number of cultivator households, their landholdings and list of names of borwell owners have been collected from the respective village administrative office (VAO). We have grouped the farmers broadly into three categories as small (< 2 acres), medium (2-5 acres) and large (> 5 acres) based on land holding size of farmers before collecting household data. Details have been collected from 200 sample farmers — 100 from BWFs and 100 from NBWFs based on proportionate random to population size. After collecting the data, the farmers who have cultivated CR-1009 paddy variety in the *samba* season (August-December) only were taken for analysis.[4] This is done to avoid hetrogeneity of varities and to maintain uniform variety as indicated earlier.

Macro Picture

It would be better to understand the macro-level position of pesticides consumption before going into the micro-level study. For this purpose, we have collected data related to pesticides and its associated variables like paddy area (PA) cotton area (CA), Gross Irrigated area (GIA), Gross Cropped Area (GCA), Groundwater area (GWA) and consumption of NPK for 17 Indian major states for the year 1987-88. Data show that Tamil Nadu stands first in the per hectare consumption of pesticides among the different states. Tamil Nadu consumes about 1700 gm/ha, but the same is only 600 to 70 gm/ha even in highly irrigated states like Punjab and Haryana. Tamil Nadu consumes about 340 percentage higher than the national average and 160 percentage higher than Punjab, which is at the heart of green revolution.

Table 2: Correlation value : Pesticides with its associated factors

Variable	"r" with Pesticides
Paddy Area (PA)	.27
Cotton Area (CA)	.14
Paddy plus Cotton Area	.36
GIA	.47
GCA	.40
GWA	.35
Consumption of fertiliser (NPK)	.72*

Note: *Significant at one per cent level.
Source: Computed from CMIE (1992), FAI (1988-89) and Chandhok and the Policy Group, India Database, The Economy, Vol. II.

4. This is a detailed study conducted in two different seasons namely *samba* and *thaladi* during 1990-91. This study has not only considered the pesticides but also other inputs like seeds, fertilisers, weedicides, groundwater (water market) and machineries. However, pesticides only are reported in this paper. For more details see: Narayanamoorthy (1993).

There is an argument that consumption of pesticides is higher in cotton crop followed by paddy and other commercial crops (Agarwal 1983., Balasubramanian 1994, Kumar 1994)[5]. To test this, we have computed correlation for pesticides with its related variables including cotton and paddy area for 17 major states. These results did not support the hypothesis that there is any significant relation between cotton area and consumption of pesticides (table 2). That is, the correlation value between CA and pesticides consumption, PA and pesticides, and both PA plus CA with pesticides are very weak and not significant. In contrast pesticides consumption is highly and significantly (r = .72) correlated to the quantum of NPK consumption. It implies that states which consume more NPK also consume more pesticides. The correlation value of pesticides with GIA, GCA and GWA is somewhat (however not significant) better than PA and CA.

Pesticides consumption is highly and significantly correlated to the quantum of NPK consumption.

Micro-Level Study

Consumption of pesticides has been increasing in these areas, particularly after the introduction of borewell irrigation. Unlike in the majority of Indian canal tracts, there is no strict season based cultivation and mono-culture in these study areas.[6] Some farmers cultivate paddy while others in the very adjacent field cultivate sugarcane which helps the pest to stay in the area itself. Majority of the farmers say that after the introduction of borewell irrigation — which has also increased cropping intensity and more water consuming commercial crops — intensity of pest damage has started to increase. Because of these reasons they had to use pesticides atleast two times for their crop. Consumption of pesticides is much more in *samba* season than in other seasons because of dull and monsoon climate (Farmer 1979). As indicated earlier, the study considered only the farmers who have cultivated CR-1009 paddy variety, in both BWFs and NBWFs, for analysis. 61 of BWFs and 63 of NBWFs have cultivated CR-1009 paddy variety in the *samba* season (August-December).

5. Cropwise estimation of consumption of pesticides is discussed in detail by Alagh (1988).

6. Private irrigation (own borewells and wells) allows the farmers to take up crop and season as they wish.

Land Size and Pesticides Use

Land size is one of the important factors which determines the adoption of modrern technological components in agriculture.[7] Generally the resource position of the farmer is positively related to his land holding size. It is clear from table 3 that land size is significantly higher for BWFs than NBWFs. Altogether, the quantity of consumption of pesticides is significantly (at one per cent level) higher for BWFs than for the NBWFs. Likewise yield of the crop is also significantly higher for BWFs. It is obvious that BWFs have assured irrigation facility with enough resources and hence they could use technological inputs and produce more yield. In both BWFs and NBWFs, quantity of use of pesticides increases with land size. However, the group of NBWFs owning about 5 acres use relatively lesser than the medium size of NBWFs. It is mainly because of the fact that large farmers in both groups mostly used dimecron (a kind of pesticides) which requires less quantity per acre compared to other pesticides.

For both BWFs and NBWFs there has been much difference in the extent of use of pesticides, between small and medium farmers. But the difference is very small between medium and large farmers. This is clearly because of difference in their resource position. Almost all small farmers, in both groups, do not have any income other than from agriculture. Secondly, those owning above 2 acres use pesticides as a preventive measure even when they find mild pest damage. More importantly, majority of the large and medium farmers usually mix *dithane M 45*, which is a fungicide, with pesticides as recommended by the extension officers, which increases the quantum of pesticides consumption.

7. See Feder et al., (1982) for more details on the relationship between land size and use of technological components in agriculture.

The medium and large farmers buy pesticides in bulk amount in half and one litre bottles in the nearby town of Pudukkottai (15 km. from the survey area) at lower price, whereas the small farmers buy all their pesticides in the retail shop in the village where price is relatively higher. Sometimes they do not even get the pesticides which they actually need.

It is not wise to compare the pesticides consumption with the yield of the crop without knowing the intensity of pest damage and use of other yield increasing inputs. Moreover, pesticide does not directly influence the crop to increase the yield like fertilisers do. Yield of the crop is also not determined by any single input but by the use of a composition of inputs determined by the managerial capability of the farmer (Narayanamoorthy 1992, 1994). However, if the pesticide is used at the right time it would help increase the yield by preventing pest damage. The relationship between yield of the crop and quantity of pesticides consumption across land size is not significant, except between small and large farmers in BWFs.

Table 3: Pesticides use and size of landholdings

(average/acre)

Land size (in acre)	BOREWELL				NON-BOREWELL			
	No.	Land size	PCS in ml.	Yield in kgs.	No.	Land size	PCS in ml.	Yield in kgs.
< 2.0 (small)	11	1.38 (0.28)	618.18 (187.41)	2198.18 (342.55)	49	1.19 (0.52)	554.76 (229.40)	1905.94 (395.60)
2.0-5.0 (medium)	33	3.44 (0.88)	860.61 (285.97)	2203.64 (367.28)	12	2.15 (0.77)	837.50 (276.90)	1915.00 (408.01)
> 5.0 (large)	17	12.01 (8.03)	935.29 (341.61)	2304.71 (597.19)	2	4.00 (1.00)	825.00 (175.00)	1980.00 (180.00)
ALL	61	5.45 (5.96)	837.70 (307.78)	2230.82 (442.31)	63	1.46 (0.84)	617.19 (264.80)	1910.02 (393.24)

Note: Figures in parentheses are standard deviations. PCS — Pesticides in milli litre.
Source: Field level survey data.

Yield of the crop is not determined by any single input but by the use of a composition of inputs determined by the managerial capability of the farmer.

Pesticides and Nitrogen

There is a relationship between the quantum of nitrogen use and pesticides consumption. It is quite natural that when nitrogen use increases, the crop growth will also be higher and pest damage will be more. To understand this relationship, we have divided the nitrogen fertiliser users into two groups: those who use above 40

kg/acre and those who use upto 40 kg/acre. This is done based on the recommended rate of nitrogen fertiliser.[8] Recommended rate of fertiliser application is more for the longer duration variety of paddy than the short duration variety. It is clear from table 4 that the number of farmers who used nitrogen fertiliser above the recommended level, is much large in BWFs (46 per cent of total) than in NBWFs (16 per cent of total). There is a clear positive relationship betweeen nitrogen use and quantum of pesticides use in the case of both BWFs and NBWFs. Computed correlation values between pesticide use and nitrogen are positive and significant for both BWFs and NBWFs (table 9). It implies that nitrogen use increases pesticides consumption. Majority of the farmers also understand that pest damage increases with overuse of nitrogen (N) fertiliser. However, they could not avoid overuse of N, since they are "nitrogen biased".[9] Some of the farmers who own sprayers or have easy accessibility of sprayers use pesticides immediately after application of fertilisers so as to avoid pest attack even before pest symptom. However, this is not possible for all farmers, since majority of them do not own sprayers in the NBWFs group and also suffer from resource constraint.

Rate of yield is positively related to pesticide use. However, this may not be purely because of pesticides effect. It is reported by many studies that yield is mostly determined by the quantum of fertilisers and other complementary inputs. In our study, moreover, the farmers who use more pesticides also use more NPK mix fertilisers. Hence, this yield variation could be because of more NPK use.

Pesticides and NPK

As in the case of nitrogen use, we have divided NPK users into two groups: farmers who use upto 80 kg/acre and who use above 80 kg/acre. There is a clear relationship between use of NPK and pesticides (tables 5 and 8). In the case of BWFs as well as NBWFs, use of pesticides is significantly (at one per cent level) higher for users of more NPK than for users of less NPK. However, one cannot forget that pesticide use is primarily determined by the intensity of pest ravages. Once pest attack is identified, then its consumption is mostly determined by the resource position of the farmer. Rich farmers can immediately buy pesticides and take necessary action to prevent pest damages, whereas it is not possible for poor farmers.

Social Factors

Role of social factors in the use of modern technological components cannot be ignored, since socially backward or poor farmers cannot easily get new technological information/components from agriculture officers/depots. To know the impact of the social characteristics of farmers on pesticides use, two variables namely farmers' caste and education have been considered.[10] We have divided caste of the sample farmers broadly into two as

Table 4: Pesticides use based on Nitrogen fertiliser

(average/acre)

Nitrogen use	BOREWELL				NON-BOREWELL			
	No.	Land	PCS	Yield	No.	Land	PCS	Yield
< 40 kgs	33	4.07 (3.65)	728.79 (251.07)	2134.55 (375.44)	53	1.54 (1.17)	572.32 (241.85)	1842.47 (300.49)
> 40 kgs	28	7.87 (9.27)	966.07 (318.76)	2344.29 (486.10)	10	2.72 (1.14)	855.00 (228.53)	2370.00 (529.40)
Mean difference*		sig. 5%	sig. 1%	sig. 1%		sig. 1%	sig. 1%	sig. 1%
ALL	61	5.45 (5.96)	837.70 (307.78)	2230.82 (442.31)	63	1.46 (0.84)	617.19 (264.80)	1910.02 (393.24)

Note: Figures in parentheses are standard deviation.
PCS — Pesticides in milli liter.
* — Mean difference is calculated by using t-test.
Source: Field level survey data.

8. Recommended rate of fertiliser for both long and short duration of paddy varieties have been collected from Joint Director of Agriculture Office, Pudukkottai.

9. Owing to less knowledge about other components of fertilisers, many farmers still feel that nitrogen fertiliser has more power to increase the yield of crop.

10. Studies so far mostly considered the education of the respondents/head of the household for analysis. Agriculture is a combined activity. Decision related to inputs use is mostly finalised by the collective decision of the family members who are involved in agriculture. Hence the average education of the farmers (AEF) who are involved in agriculture would be the reliable method. This follows this AFE approach. For more details see: Narayanamoorthy A. (1994).

backward castes (BC) and scheduled castes (SC). It is clear from table 6 that there is no statistically significant difference in the use of pesticides, between BC and SC farmers. This is true among BWFs as well as NBWFs. However, SCs of BWFs group have used about 50 ml. per acre higher than their BC counterparts. This is because almost all SC borewell farmers are rich hence they use pesticides as equally as other non-SC BWFs. SCs among BWFs are also taking agriculture activities seriously — using own family labour, strict and personal

Table 5: Pesticides use based on NPK consumption

(average/acre)

NPK use	BOREWELL				NON-BOREWELL			
	No.	Land size	PCS in ml.	Yield in kgs	No.	Land size	PCS in ml.	Yield in kgs
< 80 kgs	23	3.53 (2.35)	728.26 (260.36)	2055.65 (294.59)	49	1.50 (1.40)	538.43 (219.11)	1801.86 (270.49)
> 80 kgs	38	7.19 (8.49)	903.95 (315.27)	2336.84 (481.37)	14	2.39 (1.17)	892.86 (223.49)	2288.57 (505.50)
Mean difference*		sig. 5%	sig. 5%	sig. 1%		sig. 5%	sig. 5%	sig. 5%
ALL	61	5.45 (5.96)	837.70 (307.78)	2230.82 (442.31)	63	1.46 (0.84)	617.19 (264.80)	1910.02 (393.24)

Note: PCS — Pesticides in milli litre.
Figures in parentheses are standard deviation.
* — Mean difference is calculated using t-test.
Source: field level data.

Table 6: Pesticides use based on farmer's community:

(average/acre)

Community	BOREWELL				NON-BOREWELL			
	No.	Land Size	PCS in ml	Yield in kgs.	No.	Land size	PCS in ml.	Yield inkgs.
SC	9	4.32 (2.37)	883.33 (387.30)	2460.00 (384.71)	21	1.21 (0.73)	590.24 (282.51)	1888.90 (304.65)
BC	52	6.07 (7.58)	829.81 (291.10)	2191.15 (439.57)	42	1.94 (1.31)	630.67 (254.52)	1920.57 (430.36)
Mean defference*		NS	NS	sig. 5%		NS	NS	NS
ALL	61	5.45 (5.96)	837.70 (307.78)	2230.82 (442.31)	63	1.46 (0.84)	617.19 (264.80)	1910.02 (393.24)

Note: PCS–presticides in milli liter. NS–not significant. Figures in parentheses are standard deviation. *–Mean difference is calculated using t –test.
Source: Field level data.

Table 7: Presticides use and farmers' education

(average/acre)

Education Level	BOREWELL				NON-BOREWELL			
	No.	Land Size	PCS in ml	Yield in kgs.	No.	Land size	PCS in ml.	Yield in kgs
Primary	21	5.06 (6.32)	895.24 (376.36)	2265.71 (376.71)	40	1.30 (0.79)	565.83 (264.06)	1854.78 (405.56)
Above Primary	40	6.21 (7.42)	807.50 (259.70)	2212.50 (472.10)	23	2.39 (1.46)	706.52 (241.51)	2006.09 (350.67)
Mean difference*		NS	NS	NS		NS	NS	NS
ALL	61	5.45 (5.96)	837.70 (307.78)	2230.82 (442.31)	63	1.46 (0.84)	617.19 (264.80)	1910.02 (393.24)

Note: NS–not significant, PCS–pesticides in milli liter. Figures in parentheses are standard deviation. *–Mean difference is calculated using t–test.
Source: Field level survey data.

management practices etc. — than the BCs. But in the case of NBWFs, BCs have used relatively more pesticides (around 40 ml). However, this is not significantly higher than the extent of pesticides used by SC farmers.

Role of social factors in the use of modern technological components cannot be ignored, since socially backward or poor farmers cannot easily get new technological information/components.

Recently much attention has been given to the impact of farmers education on the use of modern technological components and productivity of the crop. Many studies have confirmed that farmers' education has direct bearing on the yield of crop.[11] However, one cannot completely endorse the view that farmers' education alone has the power to increase the productivity of crop, since it is crucially determined by the use of yield increasing inputs like fertilisers etc. Application of these technological components are mainly related to the resource position of the farmer and expected gain of the cultivated crop (Narayanamoorthy, 1994). Hence one must divide the farmers group based on their resource position and relate that with education. We can consider, in our study, the BWFs as more resource owning farmers and NBWFs as less resource owning farmers. It is clear from table 7 that education does not make any significant difference in the use of pesticides as well as in the yield for BWFs. The fact is that both educated and not-so-educated farmers have enough resources to run the cultivation. But it is somewhat different in the case of NBWFs group. Farmers educated above the primary level have used more pesticides (significantly) and produced more yield per acre. This may also not be because of education, since these farmers own more land and hence could use more pesticides and fertilisers.

However, mere use of pesticides would not be useful for crop. The right pesticides must be used in the recommended quantity, at the right time. Undoubtedly, education is an important factor for the proper use of pesticides. We could also understand from the field survey that educated farmers are adopting all possible methods while applying pesticides. They could also spell out the names of pesticides which they have used during the last season and before. However, they could not adopt all possible methods most of the time due to climatic vagaries and other problems, like non availability of sprayer, recommended pesticides etc. It shows that availability of machineries like sprayer also (which directly relates with the resource position of the cultivators) determines crucially the pesticides consumption.

The right pesticides must be used in the recommended quantity, at the right time. Undoubtedly, education is an important factor for the proper use of pesticides.

Other important factors are the time of application, selection of pesticides, who is spraying the pesticides and their technical knowledge regarding pesiticides etc. Surprisingly, most of the small and medium farmers, especially non-owners of sprayers, use pesticides in the day time after 9 o'clock in the morning. This is not good both economically and environmentally. According to agriculture extension officials, pesticides should be used either early in the morning or very late in the evening, for best results. Regarding selection of pesticides many small and low caste farmers think that pesticides means Ecalax—a trade mark. They use Ecalax blindly whatever the pest they find. More educated, rich and high caste farmers (who have easy access to FDO) discuss the pest problem with farm demonstration officer (FDO). However, majority of them are not satisfied with the FDO's recommendation. They select pesticides either with their own past experience or based on the advice of experienced farmers. Very small and tiny land owners get advice from the 'sprayer-man' (who owns and hires out sprayers). Sometimes 'sprayer-man' himself comes with pesticides and charges for both pesticides and application from very small farmers. Majority of the sprayer owning farmers apply pesticides with family labour and rarely use wage labour.

Pesticides should be used either early in the morning or very late in the evening, for best control of pests.

11. See Birhaeuser et al., (1991), Duraisamy (1992).

Table 8: Correlation Values for Pesticides with its Related Variables

Variable	BWFs (N=61)	NBWFs (N = 63)
Community $	–.06	.07
Education	–.06	.31*
Total land	.08	.41*
Nitrogen	.40*	.50*
Phosphate	.26	.50*
Potash	.30*	.50*
Total PNK	.41*	.66*
Yield	.24	.39*

Note: *– significant at 1 per cent level.
$–for computing correlation and regression we have given value one and zero for BC and SC farmers respectively.
Source: Computed from field data.

Regression Results

To understand the influence of each variable on pesticides use, we have computed two types of multiple regression: considering N, P, K as separate variables and together as single variable NPK. The results are reported in table 9. It shows that among the different variables, the influence of chemical fertilisers is more

Table 9: Regression co-efficients for pesticides determing factors

Variables	BWFs	NBWFs	BWFs	NBWFs
	(NPK separately)		(NPK together)	
Nitrogen	8.93 (2.00)[a]	3.92 (0.94)		
Potash	4.88 (1.45)[c]	7.52 (2.42)[a]		
Phosphate	1.42 (0.33)	11.28 (3.15)[a]		
NPK	—	—	5.24 (3.17)[a]	7.11 (5.80)[a]
Total acre	–0.39 (–0.06)	45.06 (1.72)[b]	0.21 (0.03)	44.42 (1.79)[b]
Education	–1.95 (–0.16)	4.98 (0.50)	–3.15 (–0.26)	5.81 (0.61)
Community	–40.30 (–0.36)	–63.55 (–1.09)	–47.42 (–0.43)	–75.78 (–1.34)[c]
Constant	378.23	97.05	435.73	78.35
R^2	.19	.48	.17	.48
F	2.17	8.73	2.88	13.75
N	61	63	61	63

Note: Figures in parentheses are 't' values.
a, b, c indicates significant at 1%, 5% & 10% respectively.
Source: Computed from field data.

significant for both BWFs and NBWFs. However, the magnitude of the results are not similar for BWFs and NBWFs. For instance, nitrogen significantly and postively influences the use of pesticides for BWFs but it is not so in the case of NBWFs. Likewise, potash and phosphate also positively and significantly influence the pesticides use for NBWFs, but it is not so for BWFs. Total land holding postively increases with the pesticides use of NBWFs, whereas the same is not significant for BWFs. This is because of the fact that almost all BWFs have enough resources hence land size does not influence the use. But in the case of NBWFs, when land size increases the consumption also increases. These results further indicate that factors which determine the consumption of pesticides are not similar for all farmers. Altogether, R^2 is very low in BWFs than NBWFs. This indicates that the variables included in the regression model do not explain pesticide use by BWFs.

Conclusion

This study shows that the famrers of borewell irrigated area apply large quantity of pesticides without following the proper method of application. BWFs use relatively more quantity of pesticides than NBWFs. Land size of the farmer does not give similar conclusion for both BWFs and NBWFs. Consumption of pesticides is significantly related with land size of NBWFs, but it is not true for BWFs. There is a clear positive association between quantum of use of nitrogen and the consumption of pesticides in both BWFs and BNWFs groups. Likewise, total NPK consumption is positively associated with pesticides consumption in both groups. Yield of the crop is also positively related with consumption of pesticides however, farmers who use more pesticides also use more NPK fertiliser. Educated farmers know the methods of application of pesticides relatively better than less educated ones who unfortunately form the majority. They need more exposure in this regard. The present extension network system is not helpful and need to be restructured. Proper use of pesticides will not only reduce the cost of cultivation but also help to arrest the deterioration of the future environment.

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Transformation is required in government, industry, education. Management is in a stable state. Transformation is required to move out of the present state. The transformation required will be a change of state, metamorphosis, not mere patchwork on the present system of management. We must of course solve problems and stamp out fires as they occur, but these activities do not change the system.

— W. Edwards Deming
"Foundation for Management of Quality
in the Western World"
October 10, 1989

Feature

Minor Irrigation Projects & Agricultural Development

R.S. Sidhu & J.S. Sidhu

The conservation and optimum use of water resources have become extremely important for further agricultural growth in our country. Minor irrigation projects offer a viable alternative in this direction by harnessing the water of rivulets and streams flowing throughout the year in the hilly state of Himachal Pradesh. This paper analyses the impact of these projects on the cropping pattern, income and employment levels in the State.

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Water is the pivotal link of seed-irrigation-fertilizer technology which ushered Green Revolution in India and its demand is shooting up due to irrigation based technological changes taking place in our country. We have now reached a stage where conservation of precipitation and elimination of water wastages have become absolutely necessary for further agricultural growth and stability. The problem of productivity fluctuation among farms is pronounced under uncertain water supply situations. Under these situations the influence of supplemental irrigation is significant (Palanisami & Flinn, 1988). The expansion and improvement of irrigation facilities as well as conservation and optimum use of water occupy a prominent place in India's programmes for agricultural development. The marked shift of emphasis in favour of minor irrigation projects was witnessed during the Third Five Plan when their share in the total irrigation outlays was doubled (Vaidyanathan, 1987).

The agriculture sector of Himachal Pradesh is not so well developed and the overall agricultural productivity is low. Among various factors responsible for the low level of development, lack of assured irrigation facilities and hilly terrain are the most important ones. In Himachal Pradesh only about 17 per cent of the net sown area is under assured irrigation. The irrigation facilities in the state could not be developed sufficiently because large proportion of terrain is rocky and the topography is uneven, which make the digging of canals and deep tubewells extremely difficult and expensive. The state has been caught in a paradoxical situation. On the one hand, scarcity of irrigation water for agriculture crops exists where a large quantity of water from perennial river flows and rain goes untapped and is thus wasted away. Rather it causes heavy soil erosion and carries away top depleting its fertility. If this water is tapped and stored, it can be useful in two ways: First, it can be used for irrigating crops in the command areas of the storage tanks. Secondly, it

will help check the soil erosion. In view of this, development of minor irrigation projects tapping the water flow of springs and rivulets (locally known as *Kuhls*) flowing through out the year, was started by the Government of Himachal Pradesh with the help of central aid. Since then, large number of minor irrigation projects have been financed and implemented in the state. Table 1 shows the expenditure incurred and area benefitted from these projects in the state. From the year 1951 to the year 1988, about 63500 hectares of area have been brought under assured irrigation through the development of minor irrigation facilities.

Table 1: Plan-wise investment on and area benefitted from minor irrigation projects in Himachal Pradesh

Plan Period	Investment (Rs. in lakhs)	Area Benefitted (hectares)	Cumulative Total (hectares)
First Plan (1951-1956)	33.57	2570	–
Second Plant (1956-1961)	65.56	3687	6257
Third Plan (1961-1966)	44.21	2805	9062
Three Annual Plans (1966-67 to 1968-69)	111.61	7201	16263
Fourth Plan (1969-1974)	268.58	6175	22438
Fifth Plan (1974-1978)	652.84	9893	32331
Annual Plans (1978-79 and 1979-80)	971.33	4690	37021
Sixth Plan (1980-85)	2953.49	20045	57066
Seventh Plan (1985-1990)		6393*	63459

*Figure for the year 1985-88

These minor irrigation projects have made considerable impact on the farm economy of the state. The analysis that follows, examines the impact of these projects on the production patterns, cropping intensity, input use level, level of productivity and income and employment levels of the farmers, with a view to estimating their role and contribution towards the development of agriculture in particular and of rural areas in general. The analysis is based on the data collected from Shimla and Solan districts of Himachal Pradesh in view of the intensity of these projects in these areas. The data were gathered from 10 per cent of the beneficiaries of the projects in the selected districts as well as matching non-beneficiaries with fairly similar conditions to that of beneficiaries except for the facility of irrigation for the agricultural year 1989-90. For estimating incremental benefits accrued to the farmers due to these projects, 'with and without' project analysis technique was adopted, where beneficiaries were compared with non-beneficiaries. The differences in various estimates of beneficiary and non-beneficiary farmers were regarded as the net additional benefit (or change) of the minor irrigation works.

Production Pattern

Crop patterns followed by the farmers are the most important reflector of their profitability subject to the agro-climatic conditions of the region, type of the soil and availability of irrigation facilities. Therefore, assured irrigation facility considerably affects the choice of crops to be grown and number of acres to be planted under each crop. The cropping pattern undergoes perceptible change when assured irrigation becomes available, *cetris paribus*, traditional less profitable crops, giving way to more profitable commercial crops. The same scenario was witnessed in the state of Himachal Pradesh when minor (tank) irrigation scheme was operationalized at the beneficiary farms. It is evident from table 2 that the area under maize, which was the traditional crop, under rainfed conditions, declined from 47.14 per cent of the gross cropped area on the non-beneficiary farms to only 17.23 per cent on the beneficiary farms and that under wheat from 41.4 per cent to 18 per cent respectively. In place of these crops, beneficiaries put large area under vegetables like tomato, peas, ginger, radish, capsicum, turnip, garlic, onion, etc. The cultivation of green peas was the most favorite among the farmers due to its attractive price in the off-season[1]. The climate of Himachal Pradesh is very conducive for growing off-season vegetables, the cultivation of which gives higher income per unit area. The only limiting factor is the lack of irrigation facilities in the state. Therefore, to the extent constraint of water scarcity was relaxed in the selected areas with the implementation of tank irrigation scheme, the farmers responded to cash upon the higher prices of on season as well as off-season vegetables and their easy market clearance due to terminal vegetable markets of Simla and Solan. The shift in cropping patterns in favour of vegetables which require greater labour input, was supported by abundantly available family labour due to the small size of the operational holdings. Thus the area under vegetables was 62.92 per cent of the gross cropped area on the beneficiary farms. However, the tank

1. By off-season we mean the season which is different from what is followed in the plains

irrigation scheme did not help increase the cropping intensity on beneficiary farms as compared to non-beneficiary farms. After introduction of vegetable crops, the availability of irrigation water, labour and fertilizers started acting as constraints on the area under other crops due to which the gross cropped area on some of the beneficiary farms declined.

Table 2: Area under different crops as percentage of the gross cropped area

Crops	Beneficiary Farms	Non-beneficiary Farms
Kharif		
Maize	17.23	47.14
Bean	0.39	–
Radish, Turnip, Garlic & Onion	3.92	–
Carrot	0.52	–
Palk	0.39	–
Pea	19.97	–
Legumes	1.04	–
Potato	–	5.72
Arbi	–	1.07
Rabi		
Wheat	18.02	41.43
Barley	1.83	2.86
Tomato	24.67	–
Ginger	3.92	1.78
Cauliflower & cabbage	2.35	–
Brinjal	0.65	–
Capsicum	5.10	–
Gross Cropped Area	100.00	100.00
Benefitted/unbenefitted area	56.2	42.6
Cropping Intensity (%)	136.30	131.46

Assured irrigation facility considerably affects the choice of crops to be grown and number of acres to be planted under each crop.

Inputs Use

Besides labour, seed, irrigation and fertilizers are the significant inputs used in the production process. Irrigation plays the pivotal role in deciding the use of other inputs. Once the availability/supply of irrigation factor changes at the farm level, the matrix of other factors of production simultaneously undergoes changes because of complementarity between water and other inputs. Therefore, the availability of assured irrigation directly and/or indirectly influenced the resource use pattern on the selected beneficiary farms. Table 3 gives the per acre use of N, P, and K on the beneficiary and non-beneficiary farms. For traditional crops like maize and wheat the difference in the use of nutrients between these two categories of farms was only marginal. Maize is grown in kharif season and hardly requires any irrigation in this area due to adequate monsoon rains. Further, maximum attention of the farmers was focussed on the vegetables and scarcely any irrigation was provided to wheat and maize crops as their profitability was low vis-a-vis vegetable crops. Out of the total sample, only about 12 per cent beneficiaries provided irrigation of wheat crop and that too only once.

Irrigation plays the pivotal role in deciding the use of other inputs.

In case of vegetables, the three nutrients i.e. N, P and K were applied through farm yard manure as well as chemical fertilizers, whereas for maize and wheat only farm yard manure was the source of nutrient application. The use of N + P + K was 101.4 kilogram per acre in capsicum, 86.8 kg in cauliflower and cabbage, 79.6 kg in brinjal, 144.8 kg in ginger, 81.4 kg in tomato, 47 kg in peas, 63.7 kg in carrot, and 75 kg in beans. For the farm as a whole the use of nutrients was higher as 77.7 kg per acre on beneficiary farms as compared to only 29.2 kg per acre on non-beneficiary farms. Consequently, the expenditure on fertilizers went up by 227 per cent on beneficiary farms.

Human Labour and Bullock Labour Employment

Use of human labour on per acre basis on beneficiary and non-beneficiary farms is given in table 4. The use of family labour was high for all the crops on both the farm situations due to its adequate availability and lack of employment opportunities in other sectors of the economy. Hired labour utilization was less and it was being used only in case of wheat, maize, peas, barley, tomato, ginger and cauliflower crops to supplement family labour for harvesting/earthing/picking operations while rest of the farm operations were being performed by family labour alone. For the farm as a whole, per acre use of human labour increased from 423 man hours on non-beneficiary farms to 543 hours on beneficiary farms due to introduction of labour intensive vegetable crops in the

Table 3: Per acre use of fertilizers and manures on beneficiary (B) and non-beneficiary (NB) farms

Crops	N (kg)	P (kg)	K (kg)	N+P+K (kg)	N+P+K (Rs.)
Maize					
B	13.49	4.73	5.16	23.38	76.18
NB	10.90	2.62	5.24	18.76	44.75
Diff	2.59	2.11	–0.08	4.62	31.43
Radish, Turnip, Garlic & Onion					
B	22.76	7.11	1.88	31.75	14.20
Beans					
B	30.00	15.00	30.00	75.00	90.00
Carrot					
B	31.60	13.90	18.20	63.70	170.00
Palk					
B	25.56	5.23	8.86	39.65	133.83
Legumes					
B	24.93	17.81	16.62	59.36	117.00
Peas					
B	21.15	10.44	15.40	46.99	99.42
Potato					
NB	9.37	4.68	9.37	23.42	28.12
Arbi					
NB	16.66	8.33	16.66	41.65	50.00
Wheat					
B	16.83	2.45	4.36	23.64	79.59
NB	14.85	3.19	6.38	24.42	62.43
Diff	1.98	–0.74	–2.02	–0.78	17.16
Barley					
B	14.46	2.32	3.03	19.81	75.33
NB	14.00	1.25	2.50	17.75	68.20
Diff	0.46	1.07	0.53	2.06	7.13
Tomato					
B	50.67	11.71	19.06	81.44	231.41
Ginger					
B	61.73	29.70	53.36	144.79	276.92
NB	20.00	10.00	20.00	50.00	60.00
Diff	41.73	19.70	33.36	94.79	216.92
Cauliflcwer & Cabbage					
B	44.02	22.25	20.50	86.77	286.70
Brinjal					
B	42.93	18.63	18.06	79.62	266.66
Capsicum					
B	54.34	22.95	24.09	101.41	325.59
Farm as a whole					
B	44.19	14.30	19.23	77.72	214.85
NB	16.39	4.28	8.57	29.24	65.74
Diff	27.80	10.02	10.66	48.48	149.11

Table 4: Human labour and bullock labour use on beneficiary (B) and non-beneficiary (NB) farms

(Hours per acre)

Crops	Family labour	Hired labour	Total labour	Bullock labour
Maize				
B	285.34	39.58	324.92	31.09
NB	228.48	33.33	261.81	22.65
Diff	56.86	6.25	63.11	8.44
Bean				
B	418.00	–	418.00	23.75
Radish, Turnip, Garlic & Onion				
B	434.48	–	434.38	16.38
Carrot				
B	419.05	–	419.05	16.67
Palk				
B	475.00	–	475.40	25.52
Peas				
B	373.73	10.19	383.92	15.95
Legumes				
B	760.00	–	760.00	20.00
Potato				
NB	351.50	–	351.50	35.62
Arbi				
NB	418.00	–	418.00	38.00
Wheat				
B	366.52	28.96	395.48	33.60
NB	220.68	24.14	244.82	32.75
Diff	145.84	4.82	150.86	0.85
Barley				
B	210.00	20.00	230.00	27.50
NB	150.00	–	150.00	23.75
Diff	60.00	20.00	80.00	3.75
Tomato				
B	355.35	35.26	390.61	17.69
Ginger				
B	427.63	40.72	468.35	17.82
NB	407.54	30.19	437.73	11.32
Diff	20.09	10.53	30.62	6.50
Cauliflower & Cabbage				
B	480.00	53.33	533.33	16.97
Brinjal				
B	569.23	–	569.23	21.15
Capsicum				
B	550.44	13.99	564.63	22.45
Farm as a whole				
B	506.73	36.39	543.12	31.13
NB	388.69	34.51	423.20	36.24
Diff	118.04	1.88	119.92	–4.93

cropping pattern. This increase was of the order of about 28.3 per cent. The use of bullock labour was lower by about 4.93 pair bullock hours per acre on beneficiary farms against non-beneficiary farms. It declined from 36.24 pair hours on non-beneficiary farms to 31.13 pair hours per acre on beneficiary farms because on the beneficiary farms, larger proportion of the gross cropped areas was under the vegetables, where more emphasis was placed on manual labour for field preparation and other operations to ensure precision for better yields.

Cost of Cultivation, Gross & Net Returns

Due to changes in the crop-mix and level of inputs used, considerable increase in the per acre cost of cultivation of important crops and for the farm as a whole was observed on the beneficiary farms (table 5). In case of maize and wheat crops, there was some increase in per acre variable costs on beneficiary farms as compared to non-beneficiary farms. These costs including imputed value of family labour increased by about 27 per cent and 41 per cent respectively. Excluding family labour expenses, the increase was to the tune of 30.8 and 10.9 per cent correspondingly. Apart from this increase, vegetables were introduced in the cropping pattern, the cost of cultivation of which was very high as compared to the traditional crops like maize and wheat. The per acre cost of cultivation including family labour was Rs 4141 for capsicum, Rs 4105 for ginger, Rs 3618 for brinjal, Rs 2774 for tomato, Rs 2007 for carrot, Rs 1908 for peas and Rs 1661 for radish, turnip, onion and garlic taken together. If the family labour expenses were not taken into account, the corresponding figures for these vegetables w ere Rs 2723, 3004, 2152, 1859, 928, 946 and Rs 542 per acre only indicating that vegetable farming was family labour intensive and was therefore well suited to the resource position of the poor small farmers of the state. The use of pestcides and chemical fertilizers also got prevalent on beneficiary farms in order to protect the crops from diseases, insect-pests and under-nourishment. This means that both the resources i.e. capital (cash inputs) and labour were being used depending upon their availability and there was no uncalled for use of cash inputs in the agriculture production process.

Vegetable farming was family labour intensive and was therefore well suited to the resource position of the poor small farmers of the state.

For the farm as a whole, there was a sharp increase in the cost of cultivation. Inclusive of family labour costs, it increased from Rs 1543 per acre on non-beneficiary farms to Rs 2927.4 per acre on beneficiary farms registering a rise of about 90 per cent. If the family labour costs were not considered this increase was of 117.3 per cent. The increase in costs demonstrated the awareness among the farmers to use improved techniques of production and introduce favorable shifts in cropping pattern in order to derive the benefit of the integrated national market and favourable agro-climatic conditions, as the most crucial and complementary input of irrigation water became available to them.

The gross returns per acre for maize and wheat crops increased slightly on beneficiary farms as compared to non-beneficiary farms due to small increase in their yields from 5.47 quintals to 5.78 quintals per acre in case of maize and from 5.54 to 5.89 quintals per acre in case of wheat. The maize crop is grown in monsoon season when irrigation requirements are the minimal. The yield of wheat on both the farms also did not differ much because the rain in the agricultural year 1989-90 was regular, even and widely distributed in the region. Therefore, even the unirrigated wheat yielded well. The gross returns for vegetables grown on beneficiary farms were very high because of their off-seasonal production when in the national markets prices rule high. The gross returns were as high as Rs 18269 per acre for tomato, Rs 12203 for capsicum, Rs 12350 for cabbage and cauliflower, Rs 6614 for peas, Rs 13110 for brinjal and Rs 5257 per acre in case of radish, turnip, onion and garlic taken together. Water requirements of the off-season vegetables are very heavy; consequently, it is extremely difficult to grow these crops on unirrigated (non-beneficiary) lands. However, minor irrigation facilities helped beneficiaries to grow vegetables and increase gross returns substantially. The gross returns for the farm as a whole, were Rs 11524.9 per acre for beneficiaries and Rs 3071.2 only for non-beneficiaries. This increase in gross returns of Rs 8453.7 per acre could be attributed to assured irrigation made available through the development of irrigation facility on the farmers' fields, which in turn increased the use of complementary inputs and consequently raised the productivity and helped bringing about more remunerative shifts in the cropping pattern. Higher use of traditional as well as modern inputs like human labour, pesticides and fertilizers, etc. increased the costs on beneficiary farms of Rs 1384.3 per acre when family labour was included and Rs 875.8 per acre when family labour was not considered as a part of variable costs. Yet the absolute as well as proportionate increase in the gross

Table 5: Gross returns, cost of cultivation and net returns for different crops on beneficiary (B) and non-beneficiary (NB) farms

(Rs. per acre)

Crop	Category	Gross returns	Cost of cultivation-I*	Cost of cultivation-II**	Returns to fixed factors-I*	Returns to fixed factors-II**
Maize	B	1445.00	1187.85	453.10	257.15	991.90
	NB	1367.50	934.71	346.38	432.79	1021.12
	DIFF	77.50	253.14	106.72	–175.64	–29.22
Beans	B	4749.00	1544.21	467.86	3204.79	4281.14
Radish, Turnip, Garlic & Onino	B	5257.75	1660.66	541.87	3597.09	4733.88
Carrot	B	7837.50	2006.71	927.66	5830.79	6909.84
Palk	B	5145.83	1736.78	512.63	3409.05	4633.20
Peas	B	6614.84	1907.88	945.52	4706.96	5669.32
Legumes	B	12468.75	2627.31	670.31	9841.44	11798.44
Potato	NB	11576.25	2932.41	2027.03	8643.48	9549.22
Arbi	NB	13456.25	5250.77	4174.43	8313.48	9281.82
Wheat	B	1472.50	1456.73	512.94	15.77	959.56
	NB	1385.00	1030.82	462.57	354.18	922.43
	DIFF	87.50	425.91	50.37	–338.41	37.13
Barley	B	1085.71	971.38	418.09	114.33	667.62
	NB	712.50	704.71	309.18	7.79	403.32
	DIFF	373.21	266.67	108.91	106.54	264.30
Tomato	B	18269.03	2773.93	1858.90	15495.10	16410.13
Ginger	B	17353.33	4105.09	3003.95	13248.24	14349.38
	NB	16340.00	3484.61	2435.20	12891.39	13904.80
	DIFF	1013.33	656.48	568.75	456.85	444.58
Cauliflower & Cabbage	B	12350.00	3675.59	2439.60	8674.41	9910.40
Brinjal	B	13110.00	3618.17	2152.41	9491.83	10957.59
Capsicum	B	12203.65	41.41	2723.27	8099.00	9480.38
Farm as a whole	B	11524.86	2927.39	1622.57	8597.47	9902.29
	NB	3071.17	1543.10	746.75	1528.07	2324.42
	DIFF	8453.69	1384.29	875.82	7069.40	7577.87

*Including imputed value of family labour
**Excluding imputed value of family labour

returns was much higher than the increase in costs. Consequently, returns to fixed farm resources on beneficiary farms was substantially higher than that of non-beneficiary farms. These (RFF) were Rs 8597.5 per acre in case of beneficiaries and only Rs 1528.1 per acre in case of non-beneficiaries. This difference (or increase) of Rs 7069.4 per acre in these returns net of variable costs can be regarded as the net additional benefit of the minor irrigation projects taken up at the beneficiary farms. If the family labour is excluded from the costs assuming it to be a fixed factor of production, the net addition to the income of the farmers due to minor irrigation projects was estimated to be Rs 7578 per acre. The net present value of the stream of additional benefits accruing from these projects at a discount rate of 12 percent, over their per acre capital costs of Rs 10397, was estimated to be Rs 45027 if the economic life of these projects was taken as 25 years (as standardized by the Department of Agriculture) and therefore minor irrigation projects in Himachal Pradesh were found to be economically viable. The micro level field studies conducted in different regions of the country have also exhibited significant impact of irrigation on crop patterns, crop intensity, yield levels of different crops and farm income levels. But this impact varies between projects and across regions depending upon climatic factors and nature of irrigation source (Dhawan, 1985; Moorti, 1976; Nadkarni, et al., 1979; Rao, 1971; Vaidyanathan, 1987).

The foregoing analysis indicates that these projects help increasing the income of the farmers and are com-

mercially viable from costs point of view. Thus, maximum attention needs to be given for developing these works in the state and tapping every perennial source of water, springs or rivulets, if technically feasible, for improving the profitability as well as viability of the farming business in the state thus putting her on the path of growth and sustenance.

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Your market is changing. If students are the product, then industry is the market. Industry is changing because of globalization and restructuring in most businesses. Hierarchical structures are breaking down — MBAs are going into a world with less structure.

— *Anonymous Executive*, 1990

Feature

Resource-Use Efficiency in Hill Farms: A Study from Himachal Pradesh

R.K. Sharma, A.K. Sharma & Dayanand Singh

A study was conducted in two blocks of Kangra district to assess resource-use efficiency. The results reveal that the area under high yielding varieties of maize and paddy was low and could be increased. The factors affecting the gross value of maize, paddy and wheat were human labour, manure and fertilizers, capital and bullock labour which explained more than 85 per cent of the total variations in these crops.

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The population explosion in India has created new and fast rising demand for agricultural products. To feed the additional population and to improve the per capita food availability land needs to be intensively cultivated. The introduction of new agricultural strategies such as HYV seeds, fertilizers, irrigation etc., has increased the productivity of Indian agriculture appreciably. But the heterogeneous geographic and topographic conditions and varying socio-economic factors have led to selective applicability and acceptability of modern agricultural technology. In Himachal Pradesh for instance, the primitive method of cultivation is still in operation, the labour is underutilized and thus, the productivity per unit of any factor of production remains low.

In Himachal Pradesh, the primitive method of cultivation is still in operation, the labour is underutilized and thus, the productivity per unit of any factor of production remains low.

Methodology

A study was undertaken to assess the existing resource use and resource efficiency of different categories of farms in Himachal Pradesh. Two blocks viz., Nagrota and Nurpur of Kangra district of Himachal Pradesh were selected. Five villages in each block were selected by simple random technique. The farms in selected villages were categorised into small farms (upto 2 ha of land) and large farms (more than 2 ha of land). In all 40 small and 20 large farmers comprised the sample for the study. The average size of holding was estimated to be 0.97 ha, 2.32 ha and 1.40 ha., for small, large and

all-farms situation. The data pertain to the agricultural year 1990-91.

To work out the resource-use efficiency, the Cobb-Douglas production function was used:

$$Y = b_0 X_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} e^u$$

where,

Y = Total value of i^{th} crop in Rupees.

X_1 = Human labour in man-days. Includes both casual and family labour.

X_2 = Manures and fertilizers in Rupees. This includes the owned as well as purchased, evaluated at market rates.

X_3 = Working capital. Includes expenses on seed, irrigation, and plant protection.

X_4 = Bullock labour in Rupees. It includes owned, hired or exchanged bullock labour.

Analysis was undertaken on a per hectare basis.

The adjusted coefficient of multiple determination ($\bar{R}^2$) was calculated and tested for its significance with F-test.

The resource productivities were compared using the following formula:

$$\frac{b_{ij}\,\bar{Y}_j}{\bar{X}_{ij}} = \frac{b_{ik}\cdot\bar{Y}_k}{\bar{X}_{ik}}$$

$$b'_{ij} = b_{ik}\,\frac{\bar{Y}_k\cdot\bar{X}_{ij}}{\bar{Y}_j\,\bar{X}_{ik}}$$

The positive difference between the actual elasticity of resource X_i in situation j(b_{ij}) and the estimated elasticity (b'_{ij}) required to equate its marginal productivity of resource X_i, would be higher in situation-I against which the test was made.

The value of Y was computed as follows:

$$t = \frac{b_{ij} - b'_{ij}}{\text{Var. } b_{ij} + \frac{\bar{Y}_k\cdot\bar{X}_{ij}}{\bar{Y}_j\cdot\bar{X}_{ij}}\text{ Var. } b_{ik}}$$

where,

$\bar{Y}_j$ = mean of output in j^{th} situation.

$\bar{X}_k$ = mean of input in k^{th} situation.

$\bar{X}_{ij}$ = mean of X_i in j^{th} situation.

$\bar{X}_{ik}$ = mean of X_i in k^{th} situation.

$V(b_{ij})$ = variance of b_i in j^{th} situation.

$V(b_{ik})$ = variance of b_i in k^{th} situation.

Maize, paddy and wheat are the important crops in the study area covering more than 90 per cent of the cropped area. Hence analysis has been undertaken for these crops only.

Results and Discussion

Existing Pattern of Input Use

The input use at farm level reflects the adoption of technology and ultimately affects the resource-productivities of the inputs in hilly areas. High yielding varieties and fertilizer a are the important input factors since irrigation is limited the irrigation source being *kuhl*. Moreover, because of small holdings in hilly areas, the use of modern assets in terms of machinery and equipment is also meagre. Hence input use was considered for HYVs and fertilizer. The results obtained are presented in table 1.

Table 1: Area under HYVs and Fertilizer use on Sample Farms

Crops	Small	Large	All farms
Area under HYVs (Per cent)			
Paddy	66	69	67
Maize	28	32	29
Wheat	100	100	100
Fertilizer Use (Kg/Hectare)			
Paddy	43	37	41
Maize	18	23	20
Wheat	35	29	33
Potato	10	14	12
Mustard	8	12	10

It is obvious from the table that in *Kharif* season on small farms HYV paddy accounted for 66 per cent of total area under paddy. The corresponding figure for maize was 28 per cent. In *rabi* season the entire area was under HYVs in case of wheat. This includes S-308 also. On large farms HYV paddy covered 69 per cent of total paddy. The allocation of area under wheat was cent per cent. The use of chemical fertilizers was higher on small farms for paddy and wheat as compared to large farms. This may be because the subsidy for scheduled caste families was to the extent of 50 per cent. The large farmers used more fertilizer per hectare in maize.

Resource-Use Efficiency

The elasticity of production and related parameters are presented in table 2. The explanatory variables in-

Table 2: Resource-Use Efficiency on Sample Farms for Important Crops

Regression Coefficient	Maize			Paddy			Wheat		
	Small	Large	All Farms	Small	Large	All Farms	Small	Large	All Farms
Constant	0.77	1.17	0.25	–0.23	–5.15	–0.72	–3.74	–3.64	–3.06
Human labour	0.31 (0.22)	0.38 (0.21)	0.81** (0.08)	0.94** (0.14)	1.90** (0.50)	1.11** (0.16)	1.58** (0.42)	1.18* (0.49)	1.37** (0.10)
Manures and fertilizers	0.14 (0.07)	0.37** (0.12)	0.05 (0.04)	0.27** (0.06)	0.11 (0.10)	0.34** (0.06)	0.15* (0.07)	0.17 (0.09)	0.26** (0.05)
Working capital	0.25* (0.12)	0.03 (0.05)	0.15* (0.07)	0.11* (0.05)	0.29* (0.13)	0.39 (0.09)	–0.23 (0.16)	0.94* (0.46)	–0.30* (0.13)
Bullock labour	0.42** (0.14)	0.13* (0.05)	0.18** (0.06)	–0.05 (0.15)	0.99 (0.50)	–0.08 (0.15)	0.98* (0.42)	0.24 (0.32)	0.95** (0.10)
Returns to scale $\left(\sum_{i=1}^{n} b_i\right)$	0.67**	0.50**	1.14**	1.31**	2.19**	1.45	2.71**	2.12**	2.28**
$\bar{R}^2$	0.84**	0.93**	0.82**	0.97**	0.85**	0.85**	0.98**	0.94**	0.95**

*Significant at 5 per cent level.
**Significant at 1 per cent level.

Table 3: Comparison of Resource Productivities between Small and Large Farms

Factors	Maize			Paddy			Wheat		
	b_{ij}	b_{ij}	$b_{ij}-b_{ij}$	b_{ij}	b_{ij}'	$b_{ij} - b_{ij}'$	b_{ij}	b_{ij}'	$b_{ij} - b_{ij}'$
Human Labour	0.31	0.38	–0.07*	0.94	1.89	–0.95**	1.58	1.14	0.44**
Manures and fertilizers	0.14	0.33	–1.19**	0.27	0.11	0.16*	0.15	0.17	–0.02*
Working capital	0.25	0.02	0.23**	0.11	0.28	–0.16**	–0.23	0.98	–2.21**
Bullock labour	0.42	0.13	0.29**	–0.05	0.96	–1.01	0.98	0.26	0.72**

*Significant at 5 per cent level.
**Significant at 1 per cent level.

cluded in the function explained 84 per cent, 93 per cent and 82 per cent of total variations in maize. Bullock labour influenced the yield of maize under all size groups. This may be because bullock labour was important to plough the fields after the first shower of pre-monsoon rains. Any delay in sowing thus affecting the yield levels adversely. The working capital was found to be significant on small farms whereas, manures and fertilizers were significant on large farms. Human labour was found to be important on large farms. In paddy, human labour and working capital were important for both the categories of farms. Paddy being a labour intensive crop right from its sowing, irrigation, interculture, harvesting, threshing etc, human labour had the highest elasticity. The returns to scale were decreasing in maize while in paddy and wheat they were increasing. This reveals that there was sufficient. scope for increasing the input use in both the crops. In case of wheat, the elasticity coefficients were 1.58, 1.18 and 1.37 for small, large and all-farms, respectively. Manures and fertilizers were important on small farms, whereas, working capital had high elasticity (0.94) on large farms. The table further indicates that the coefficient of multiple determination significantly explained more than 80 per cent of the total variations for all the three crops under both the categories of farms.

Comparison of Resource Productivities

Table 3 shows the comparison of resource productivities between small and large farms for all the three crops under consideration. The positive difference between marginal productivities of working capital and bullock labour was significantly high on small farms for maize. This suggests that if additional funds are available the small farmers should utilize them for bullock labour whereas, it would be more remunerative if used for manures and fertilizers for large farms. MVPs of human labour, working capital and bullock labour for paddy were higher on large farms as indicated by negative signs. Signifying more efficient utilization of these resources by large farmers. In case of wheat, human labour and bullock labour were used more efficiently by small farmers.

The large farmers were found to be more efficient in the use of manures and fertilizers and working capital.

The large farmers were found to be more efficient in the use of manures and fertilizers and working capital.

The study shows that there is sufficient scope for increasing fertilizer consumption. Returns to scale indicated that farmers were still operating in the first zone of production function except for maize and thus there is sufficient scope for increasing input use. Comparison of resource productivities shows that bullock labour was more efficiently used by small farmers in maize and wheat. The use of manures and fertilizers was more efficient on large farms for both these crops. In paddy, small farmers used manures and fertilizers more efficiently while the large farmers used the other three resources better. □

If there's anything we've learned it's to give equal time to both the program's project and the globalization experience. If you walk away from this with an excellent project completion, but don't know how a Frenchman lives, don't know why a Japanese businessman gets promoted, haven't tasted sushi, haven't ridden in the British subway, you've blown it.

Quote from *A Senior Executive Participating in a Global Development Program*

Feature

Improved Cart for Rural Transport

S.D. Deshpande

An improved punctureless rubber tyred ox-cart has been developed as alternative to the existing pneumatic tyred cart in order to overcome the problems faced by pneumatic carts apart from high initial cost. The new cart uses old truck tyres filled with coconut coirs and steel/wooden spokes radiating from the metallic hub. The cart also has an improved frame, a steel axle, proper balance and provision for carrying loose and low density material. The performance evaluation studies revealed the carrying capacity of this cart as 1200 kg on field terrain.

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Animal drawn carts have a significant role to play in the transportation system of India. There are about 15 million animal drawn carts in India handling and transporting over 75% of the agricultural produce, which involve an investment of about 300 crores of rupees, and provide livelihood for 20 million people (Rup Mitter, 1985). Motorized vehicles can not replace these carts for the reason that the later provide one of the most important means of short haul transport in the rural areas, the tonnage carried through this means being no less than the tonnage carried by road and rail together.

Motorized vehicles can not replace these carts for the reason that the later provide one of the most important means of short haul transport.

Most of the existing 15 million carts (about 87%) are traditional. Pneumatic tyre carts are better alternatives to the traditional carts, but due to high initial investment and frequent repair and maintenance, this cart has not become popular amongst farmers (Deshpande and Ojha, 1984). However, if old, used truck or bus tyres without air tubing are filled with low cost coconut coir, the above mentioned problem can be solved. In India, total number of trucks and buses are about 5 lakhs. Each vehicle has an average of six tyres i.e. 30 lakhs tyres on road. The average life of a tyre has been estimated as 10 years. Therefore, 3 lakh bus and truck tyres become unsuitable for automative use each year. If it is assumed half of these are available and suitable for these types of wheels, then about 75000 bullock carts could be made each year using old tyres at reduced cost (Deshpande, 1985).

Punctureless Tyre Cart

A punctureless rubber tyre ox-cart has a body/frame developed out of light metallic sheets and closed from all

sides so as to carry loose or low density material like straw and husk (Fig. 1). The cart body is also equipped

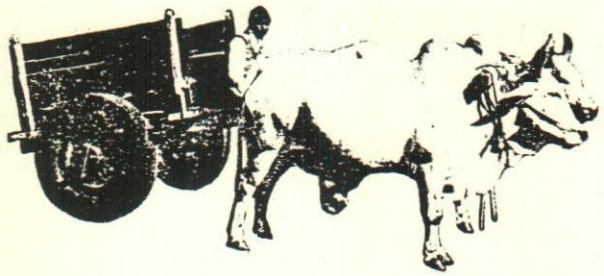


Fig. 1.

with a folding and detachable seating arrangement for the transport of passengers. A simple type of braking arrangement operated either by hand lever and or pedal is used. The cart operator presses the hand lever so that the brake shoes are actuated through a brake wire and fit on the wheel hub's inner side, causing slowing down of the speed. Bright mild steel rods of 10 and 6 mm diameters having length equal to the hub length, are placed alternately along the periphery of the axle. This arrangement helps to rotate these rods with the rotation of the wheel and allows the circulation of lubricant easily amongst these rods. This way, these rods act as antifriction bearings. A through hole is drilled from the wheel hub upto the bearings and a grease cup is mounted on the hub. During the cart operation, grease starts dropping on the bearing rods automatically. The position of the wheel and axle is arranged in such a way that the centre of gravity of the cart passes through the two wheels to the ground under loaded condition, thereby assuring proper cart balancing. This is helpful in reducing the transfer of neck load on the oxen. The dimensional details for the punctureless tyre cart are shown in Fig. 2. The major specifications of the improved punctureless tyre cart are given in Appendix I.

Punctureless Rubber Tyres Wheel

The cart wheels are made of used truck tyres of 9 in x 20 in (230 mm x 510mm) size. Instead of rubber tubes, tyres are pressure filled completely with coconut coirs which are available in plenty at a low price. The coir is filled in the tyre manually and compacted with the help of a metallic rod. Then the tyres are assembled on to the cart and run on the farm road in order to settle the coir in the tyre. The tyres are then separated again from the cart

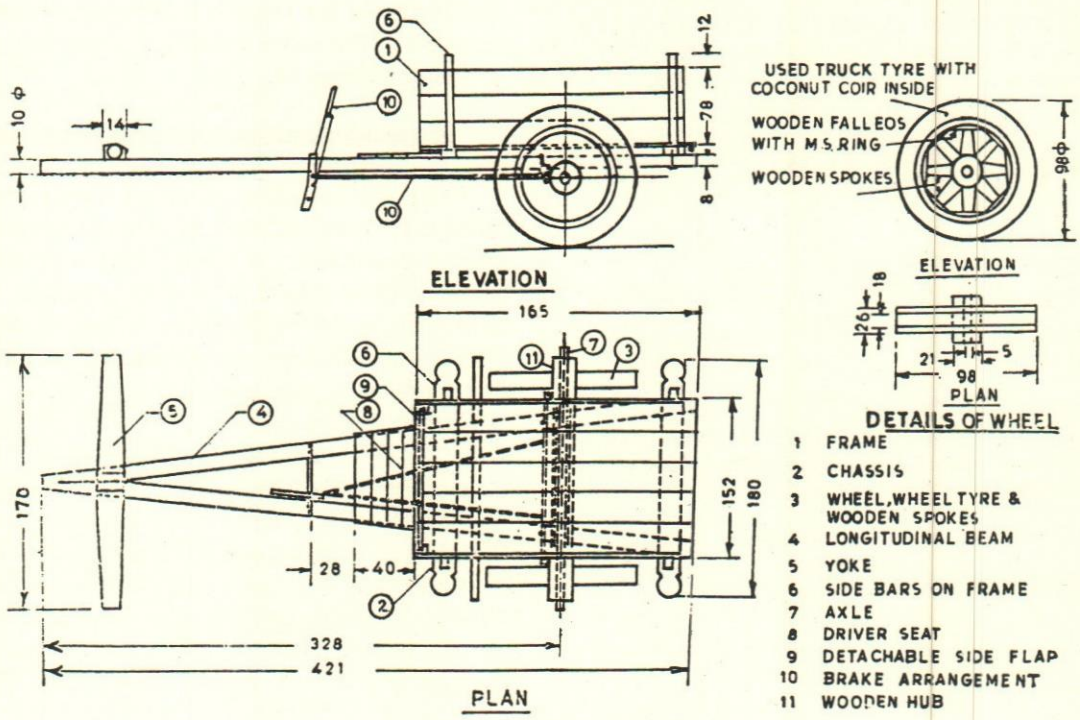


Fig. 2.

and the coir is filled in the tyre by compacting with a pointed metallic rod. This helps to fill the tyre with coir to the maximum extent. Wheel sinkages in field terrain are similar for empty carts equipped with coir filled tyres and pneumatic tyres, indicating similar tyre stiffnesses.

Eight wooden spokes emerge from the periphery of the wooden hub located at the centre of the tyre. These spokes penetrate into the wooden falleoes tightly fixed along the inside periphery of the tyre. Two circular mild steel rings of 10 cm width are fitted on both sides all along the falleoes and are tightened with nuts and bolts, thereby giving firm support to the falleoes and making tyre falleoes and ring as one single unit.

Results

The tare weight of the developed cart was found to be 350 kg. This value is about 100 kg more than the average size conventional carts. The maximum carrying capacity of the cart was noted to be 1200 kg on off-the-road land terrain and also on tar and moorum roads. At this payload, the cart body did not show any sign of damage. The local 'Malvi' bullocks were able to negotiate the load comfortably.

The draft for pulling the cart by a pair of local oxen varied from 69 N to 255 N at no-load and 372 N to 1.07 KN at full loading of the cart, depending upon the terrain, the lowest being on tar road and highest on loose field terrain (Table 1). The curves plotted between draft and payload indicate the increase in draft with payload (Fig. 3) which is an expected trend. The increase in draft was apparently due to the increase in rolling resistance contributed by soil-wheel interaction, wheel sinkage and axle bearing friction.

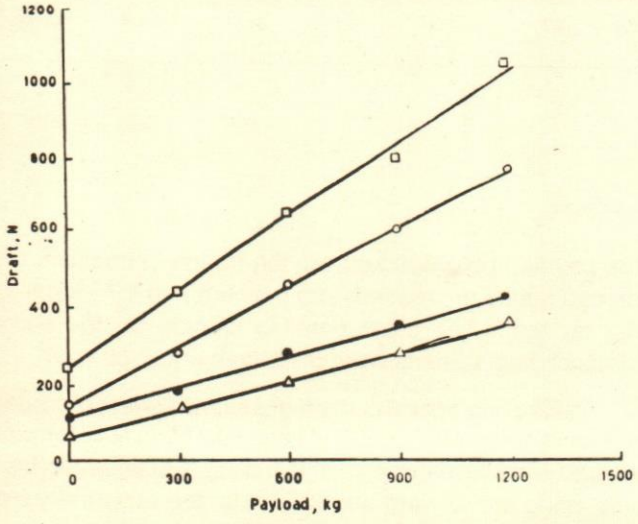


Fig. 3.

Working speed of the cart was determined by operating the vehicle on various terrains and at different payloads. By changing the payload to 1200 kg from the no-load condition on the tar road, the ox-cart speed was decreased from 5.60 km/h to 5.04 km/h. The corresponding speeds for the same loads on field terrains were 5.28 km/h and 4.43 km/h respectively (Fig. 4).

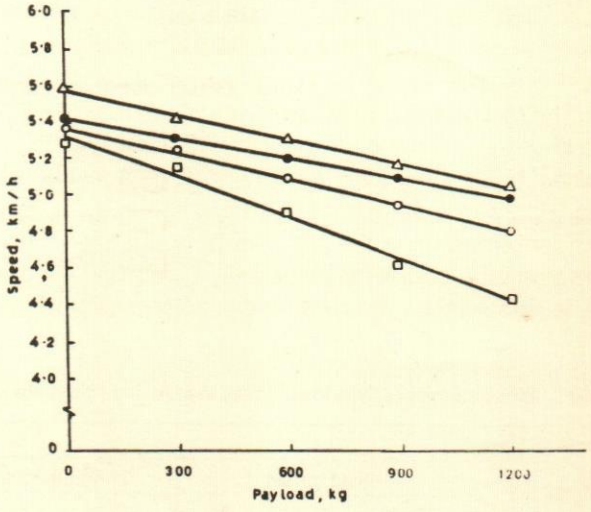
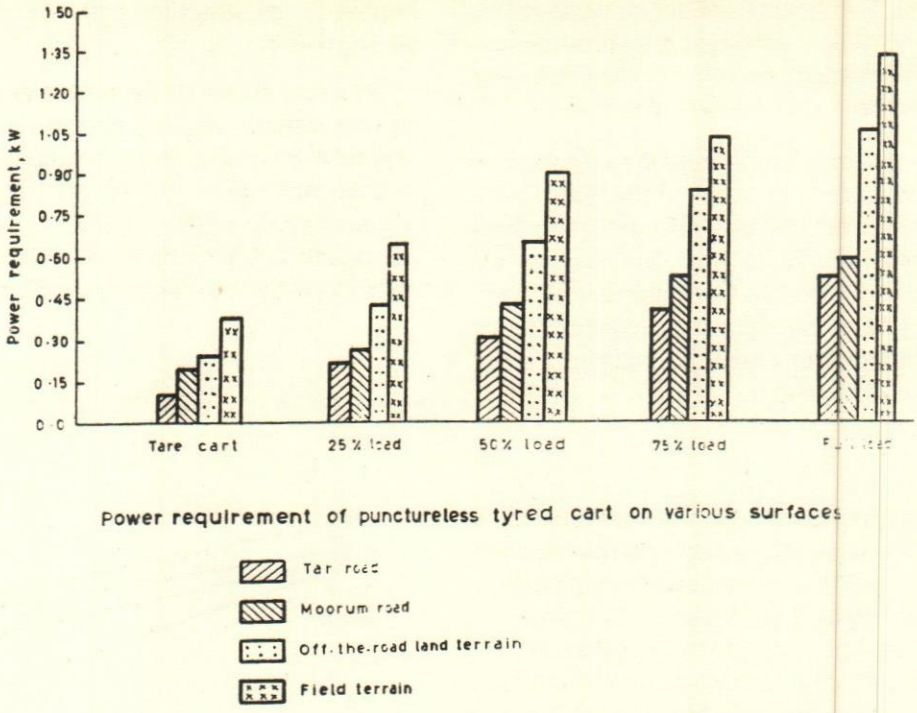


Fig. 4.

Taking into account the highest and lowest recorded values of the draft i.e. 1.068 kN and 372. N on the two surfaces while pulling 1200 kg of payload, and using the forward speed values from table 1, power requirements were computed as 1.3 kW and 0.53 kW respectively.

The values for power requirement were calculated from the values of draft and speed (table 1), and are shown in Fig. 5. It is clear that the power requirement for the fully loaded cart on tar road and moorum road was well within the limit of 1.0 kW and slightly higher i.e. 1.06 kW for off-the-road land terrain, which a pair of large sized oxen can develop. The carrying capacity was limited to 550 kg and 300 kg on field terrain for a pair of medium (0.8 kW) and small sized (0.6 kW) bullocks respectively. The lower power values developed on such surfaces was due to the sinkage of the animal feet in soil causing resistance to their forward speed and utilising the power for body movement.



Power requirement of punctureless tyred cart on various surfaces

Fig. 5.

Table 1: Measurement of Draft in N, Speed in kh/h and Power Requirement in kw on Different Surfaces at Various Payloads

Stages of loading	Type of terrain											
	Field terrain			Off-the-road land terrain			Moorum surface			Tar road		
	D	S	P	D	S	P	D	S	P	D	S	P
Tare cart	255	5.28	0.38	157	5.37	0.24	127	5.42	0.19	69	5.60	0.11
25% load	441	5.17	0.64	284	5.29	0.43	176	5.30	0.26	137	5.41	0.21
50% load	657	4.90	0.90	451	5.10	0.65	294	5.20	0.43	206	5.30	0.31
75% load	794	4.61	1.04	598	4.95	0.84	372	5.09	0.53	284	5.18	0.41
Full load (1200 kg)	1068	4.43	1.33	784	4.81	1.06	421	4.97	0.59	372	5.04	0.53

Note: 'D' indicates draft in N

'S' indicates speed in km/h

'P' indicates power requirement in kW

Values of draft, speed and power requirement are average of 10 replications.

The axle of the conventional ox-cart is made of wood and the load carrying capacity is to a maximum of 800 kg. The conventional cart was also tested with the same pair of local 'Malvi' oxen and under similar ground conditions. The tare weight of the conventional cart was 240 kg. The draft values varied from 98 to 314 N at no-load, depending upon the terrain, the lowest being on tar road and the highest on field terrain. The speed of the conventional cart was measured at various payloads and by changing the payload upto 800 kg from the no-load condition, the ox-cart speed decreased from 5.50 km/h to 4.73 km/h on the tar road. The corresponding speeds for the same loads on field terrains were 5.10 km/h and 3.80 km/h.

Taking into account, the highest and lowest recorded values of the draft i.e. 1.37 kN and 510 N on field terrains and tar road respectively while pulling 800 kg of payload and using the forward speed values, the power require-

ments were computed as 1.47 kW and 0.68 kW respectively.

Comparing the results stated above in respect of draft, speed and power requirement, it is clear that the punctureless tyre ox-cart is superior to the conventional cart and should be pupularised in rural India.

The estimated cost of the improved punctureless tyre ox-cart is about Rs. 6000.00 (US $ 200.00) as compared to Rs. 4000.00 (US $ 133.00) for conventional cart and Rs. 10,000.00 (US $ 333.00) for pneumatic tyre cart. The economics of operation of the improved punctureless tyre cart are also favourable. The costs of transport work out as Rs. 0.15/km-100 kg for punctureless tyre cart, Re. 0.17/km-100 kg for a traditional cart and Re. 0.20/km-100 for the cart using pneumatic wheels.

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APPENDIX-1

MAJOR SPECIFICATIONS OF IMPROVED OX-CART

Name	:	Punctureless rubber tyre ox-cart or Central India
Type of cart	:	Double animal drawn two wheeled multipurpose ox-cart
Function	:	Transport of farm produce, building materials in bags or bulk and passengers
Detailed specifications	:	
Overall length including beam	:	4210 mm
Cart width	:	1800 mm
Frame height	:	780 mm
Chassis size	:	1650 x 1520 mm
Wheel type	:	Old/used truck tyre 9.00 x 20" 10PR filled with coconut coirs
Hub type	:	Wooden hub
Hub diameter	:	210 mm
Hub length	:	280 mm
Type of bearing	:	Bush bearing fitted with cut M.S. rods (acting as a taper roller bearing)
No of spokes	:	08
Axle material	:	M.S. pipe
Axle diameter	:	50 mm (Outside)
Axle length	:	17 60 mm
Yoke length	:	1800 mm
Whether braking system provided	:	Yes

Test results:

a) Draft at full load on:

i) Field terrain	:	1.07 kN (109 kgf)
ii) Tar road	:	372 N (38 kgf)

b) Power requirement at full load on :

i) Field terrain	:	1.33 kW (1.78 hp)
ii) Tar road	:	0.53 kW (0.71 hp)
Tare weight	:	350 kg
Carrying capacity	:	1200 kg on field terrain
Approximate cost	:	Rs 6000.00 or US $ 200.00
Useful life	:	10 years.

□

Feature

Power Tiller — A Potential Source for Rural Employment

P.S. Tiwari & A.C. Varshney

Power tiller is a machine usually fitted with two wheels, in which the direction of motion and control for field operations are performed by an operator walking behind it. It is also known as hand tractor, walking tractor or garden tractor. Attachment for riding may be provided with the power tiller. Power tillers are especially designed and developed for use on small and medium farms and under farming conditions where large conventional four wheel tractors are either difficult or uneconomical to be used. They are the best suited machines for paddy based

f power tillers for paddy cultivation is well
outhern and Eastern parts of India. They
al for custom hiring and at prevailing
an repay the loan/capital for-

Finally on the basis of net income, pay back period of power tillers has been found out.

Power tillers may be considered as a potential source for rural employment and an alternative source of income generation for unemployed rural youth.

Role of Mechanization in Agricultural Development

The experience of various developed and developing countries has shown that there is a definite and positive relationship between farm power availability and farm productivity. The yield of crops increases with increase in farm power input. By 2000 AD, India will require 240 million tonnes of food grains to feed her people. Production of this huge quantity of food grains is a challenge for the country. The challenge becomes more formidable in view of the fact that the land and water resources in the country have been already exploited to a considerable

concentration of power. In many parts of the country the use of land preparation and harvesting machines has made it possible for farmers to have two or three crops, whereas earlier only one crop could be sown in a year.

Mechanization contributes to agricultural development in several ways, but primarily through enchancing the power, expanding the processes and increasing precision in farming operations.

Power Tillers for Agricultural Mechanization

Utility of power tiller in paddy cultivation in wet
areas is well proven. They are perhaps the b
machines for preparing seedbed for paddy
conditions. Research work conducted
ganizations has proved the super
ddling
ther operatic

The utility of [illegible] established in So[illegible] offer a good potentia[illegible] rates an entrepreneur ca[illegible] rowed within 2.5 years. The power tillers also offer a good opportunity for mechanizing small and marginal holdings and are a viable source for rural employment conclude the authors.

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farming and [illegible] was introduced in Indian Agriculture in China, Japan, [illegible]2, keeping its commercial success in

Power tille[illegible]areas in mind. Indigenous manufac-
the year 1961-62[illegible] started during 1965-66. It was
wetland cultivation a[illegible]g seedbed for paddy under
turing of power tillers [illegible]t one decade extensive
primarily meant for prepari[illegible]as been carried out in
wet land conditions. In the las[illegible] Equipment for per-
research and development work h[illegible]ions in crops like
the field of power tiller technology.
forming most of the agricultural operatio[illegible]m pigeon-
paddy, wheat, maize, sorghum, pearlmillet, gra[illegible]
pea, soybean and groundnut have been developed. With
these developments power tillers have become a ver-
satile power source for small and medium farmers and
their adoption is increasing day by day, their number
exceeding a lakh, at present.

Power tillers may be considered as a potential source for rural employment and an alternative source of income generation for unemployed rural youth. An estimate has been made for employment potential in rural areas of the country where paddy-paddy or paddy-wheat crop rotations are being practised. Based on the annual use and hiring rates prevailing in some states of the country, annual income by owning power tillers either for use on own farms or for use on hiring basis has been calculated.

deavour as increase in land and wate e resources is use of agricul- economically feasible through the use o wards this en- r resources is machines.

Mechanization contributes t ment in several ways, but pri to agricultural develop- the power, expanding t marily through enchancing precision in farming op the processes and increasing involved in agricul perations. It reduces the drudgery mechanization als tural operations. The process of changes in so acts as an enabling factor for other technology. For example, fertilizer spreaders, pesticide applyers and irrigation pumps all permit the effective use of new production inputs. Mechanization enables farmers to increase control over their production, especially by improving the timeliness of operations such as seeding, interculture, harvesting and threshing. Machines allow the farmer to cover more areas in shorter time. The timeliness of sowing and harvesting alone can increase yields by over 15% due to better crop stand and reduced losses, respectively. Mechanization also facilitates structural changes in agriculture. For instance, it may augment the land available by permitting land that is difficult to prepare, to be brought into production or by permitting multiple cropping. Operations like land development and chisel ploughing to conserve moisture can only be performed through machines because of high

is carried out by bullocks or tractors in terms of quality of work and saving in labour cost. Table 1 presents the results of a study conducted to compare the power tiller and bullock farming systems under soil conditions of Bhubaneswar region. (Annual Report, 1991) It is evident from these results that power tiller farming system is economical and generates more income as compared to bullock farming system primarily because of higher crop yield due to better quality of seedbed and lesser competition of weeds with the crop. Comparative studies conducted at Narendra Deva University of Agriculture and Technology, Faizabad (Annual Report, 1990) have also indicated less water infiltration rate, higher crop yield and net benefits in paddy fields prepared by power tiller rotavator than from the seedbed prepared by tractor or bullock systems.

Being a small and compact unit the power tiller has good potential to be used for interculture in orchards, forestry, widely spaced row crops like soybean, groundnut, pigeonpea, cotton etc. and for mechanizing hill agriculture. Power tiller operated rotavators are not only suitable for preparing land under wetland condition, they are also suitable for preparing land for almost all the cereals, pulses, oilseeds and tuber crops. The capability of rotavator to pulverise the soil and shred and mix the weeds under most of soil conditions makes it suitable for land preparation for most of the crops grown under upland cultivation also.

Table 1: Performance of Power Tiller and Bullock Farming Systems in Raising Paddy Crop, Variety Lalat, 1991 (OUAT, Bhubaneswar)

Performance Indicator	Value		
	PT_1	PT_2	BT_1
Type of soil	Sandy loam	Sandy loam	Sandy loam
Field capacity, ha/h	0.11	0.115	0.031*
			0.205**
Puddling index	0.84	0.86	0.66
Crop yield, q/ha	32.55	39.30	23.92
Cost of cultivation, Rs/ha	3820	4101	4594
Income from produce,Rs/ha	6998	8450	5143
Net benefit, Rs/ha	3178	4349	549
Benefit cost ratio	1.83	2.06	1.12

Treatments:
PT_1 = Rotapuddling once by Mitsubishi Power Tiller
PT_2 = Rotapuddling twice by Mitsubishi Power Tiller
BT_1 = Ploughing twice by mould board plough plus puddling by zig zag puddler once with bullocks.
* Field capacity of bullock drawn mouldboard plough.
** Field capacity of bullock drawn zigzag puddler.

Power tillers may be considered as the most suitable power source for mechanizing small and medium size farms. The special problem of mechanizing small farms is generally associated with the low investment capacity of this category of farmers and lack of equipment compatible with the technical and economic requirement of small holdings. In the seventies small farmers owning tractors had managed to pay their loans by operating tractors on hire either for agricultural uses or for transportation of goods in towns and cities. Their major income during off seasons had been through transport work. Due to introduction of mini trucks, use of tractors for transport of goods in cities and towns has been hampered. In many cases farmers purchased tractors on loan from bank and found themselves unable to repay the loan by the income generated from the tractor alone. Due to low investment cost, power tillers offer an alternative for mechanizing small and medium holdings. The versatility of power tillers in being capable of operating small stationary machines provides sufficient number of operating hours to cover the investment and operation charges without any undue financial loan on the owners.

Power tillers may be considered as the most suitable power source for mechanizing small and medium size farms.

Apart from its utility in cereal, pulse and oilseed crops, orchards and forestry, the power tiller with 1.2 tonne trailor is an ideal power source for transporting farm produce and farm inputs. The trailor has the provision of seat for the operator to operate the trailor at higher speeds on farm road and highways. They may be a good alternative to bullock carts in rural areas.

Power Tiller Custom Hiring

Problem of unemployment has displaced rural youth from villages to metropolitan cities where they are being exploited. Power tillers offer a good potential for custom hiring in paddy growing areas of the country and therefore, may be considered as.a source of earning for rural youth. The practice of custom hiring is very popular in Tamil Nadu, Kerala, Andhra Pradesh, Karnataka and West Bengal. A survey conducted in two talukas of Tamil Nadu State indicated that farmers use power tillers for about 1000 hours in a year out of which the power tiller is given on custom hiring for about 650 to 700 hours. The main utility of power tillers is for tillage operations followed by transport (Table 2). A similar utilization pattern is being followed in Kerala, Andhra Pradesh, Karnataka and West Bengal also. The farmers without any land holding or with very small land holding, owning even 2-3 power tillers just forcustom hiring. During peak season they operate the power tiller seven upto 20 hours a day. During off seasons power tillers are being used for transporting goods in towns and cities. The popularity of custom hiring is getting extended to other states like Orissa, Bihar and Maharashtra.

Table 2: Trend of Custom Hiring in Tamil Nadu

Operation	Utilization of Power Tiller, hours/year					
	Sukkinnanur Taluka			Thookanaickan Palayam Taluka		
	Own farm	Custom hiring	Total	Own farm use	Custom hiring	Total
Tillage	175.50	425.50	601.00	168.51	417.60	586.11
	(53.65)	(62.47)	(59.61)	(54.75)	(62.67)	(60.19)
Transport	120.50	95.90	216.00	111.21	98.00	209.21
	(36.83)	(14.02)	(21.42)	(36.14)	(14.71)	(21.48)
Threshing	6.15	20.15	26.30	4.00	19.40	23.40
	(1.88)	(2.96)	(2.61)	(1.30)	(2.91)	(2.40)
Stubble removal	9.50	85.50	95.0	8.46	81.30	89.76
	(2.90)	(12.55)	(9.42)	(2.75)	(12.20)	(9.22)
Non-agricultural	15.50	54.50	70.00	15.58	50.00	65.58
	(4.74)	(8.00)	(6.94)	(5.06)	(7.51)	(6.71)
Total	327.15	681.15	1008.30	307.76	666.30	974.09
	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00

Power tillers offer a good potentially for custom hiring in paddy growing areas and may be considered as a source of earning for rural youths.

Economics of Power Tiller Custom Hiring

The incremental monetary benefits due to the investment in powr tiller depend on the operational use of the machine on the owner's own farm and for custom hire. The income from the use of power tiller on own farm is realised from the crop activity it promotes and that from custom service obtained by way of the hiring charges received. Costs of operation of various power tiller matching equipment such as rotavator, seed cum fertilizer drill, cultivator, reaper, thresher and trailor are given in Table 3 and 4. These costs have been calculated on the basis of prevailing prices and rates during the year 1994-95. As evident from table 2 the maximum utilization of power tiller is for tillage operations (about 60%). An expost evaluation study conducted by National Bank for Agricultural and Rural Development (NABARD 1985, 1987) in the States of Tamil Nadu and West Bengal found the operational use of power tiller for preparatory tillage alone as 84% of the total annual operational use, whereas, the use on transport activities was limited to only 16%. Net benefits gained and pay back period have been worked out for power tiller rotavator on the basis of prevailing rates of custom hire. The data for different states have been presented in Table 5. It is obvious that an entrepreneur can earn Rs. 27,000 to Rs. 34,000 per year by putting power tiller on custom hire and can repay the loan/capital borrowed within 2.5 years. The benefits earned are net and do not include the operator's wages since the operator's wages are already included in the cost of operation. Thus these earnings are only through the management of the power tiller by an entrepreneur. The income can be further argumented if the owner of the power tiller owns other matching equipment besides rotavator and number of operating hours is increased.

The income from the use of power tiller on own farm is realised from the crop activity it promotes and that from custom service obtained by way of the hiring charges received.

The study conducted by NABARD in Thanjavur and Periyar districts of Tamil Nadu for evaluating the farm mechanization schemes relating to financing of tractor and power tillers by commercial banks, finds the investments in both tractors and power tillers viable with the respective financial rates of return as 25% and above 50%. The sensitivity analysis showed that a 10% increase in the capital cost or a 10% decline in the benefits, does not significantly affect the financial viability of both investments. The values of financial rate of return worked out to 22% and 21% for tractor and above 50% and 49% for power tiller for a 10% increase in cost and 10% decline in the benefits, respectively. The higher financial rate of return of power tiller investment was due mainly to its low

Table 3: Fixed Costs of Various Power Tiller Matching Equipment

Equipment	Purchase price, Rs (P)	Salvage Value, Rs (S)	Service life, years (L)	Annual use, h	Depreciation, (Rs) P-S	Insurance, taxes, shelter, Rs $\frac{P+S}{2} \times 0.035$	Interest Rs $\frac{P+S}{2} \times 0.14$	Repair maintenance, Rs, 10% of P	Total fixed cost, Rs/ Annum
Power tiller with rotavator	6500	3250	10	800	6175	1194.38	4777.5	6500	18647
Withot rotavator	60000	3000	10	800	5700	1102.50	4410.0	6000	17213
Seed-cum-fertilizer drill	5000	250	8	100	598.75	91.88	367.5	500	1553
Cultivator	2000	100	10	100	190	36.75	147.00	200	574
Vertical conveyor reaper	15000	750	7	200	2035.71	275.63	1102.5	1500	4914
Platform reaper	14000	700	7	200	1900	257.25	1029	1400	4587
Thresher	12000	600	8	300	1425	220.50	882	1200	3728
Trailor	14000	700	12	150	1108.33	257.25	1029	1400	3795

Table 4: Costs of Operation for Various Power Tiller Matching Equipment

Equipment	Fixed cost, Rs/h	Variable cost				Total operating cost, Rs/h (Fixed cost + variable cost)
		Fuel cost, Rs/h (@ Rs 7.75/L)	Lubricant cost, Rs/h (@ Rs 52/L)	Labour charges, Rs/h (@ Rs 40/day)	Total variable cost, Rs/h	
Power tiller rotavator	23.31	1.3x75=10.08	1.3x0.0x52=2.03	5	17.11	40.42
Seed-cum-fertilizer drill	37.05	1x7.75=7.75	1x0,03x52=1.56	5	14.31	51.36
Cultivator	27.26	0.8x7.75=6.2	0.8x0.05x52=1.25	5	12.45	39.71
Vertical conveyor reaper	46.07	0.8x7.75=6.2	0.8x0.03x52=1.25	5+4*=9	16.45	62.52
Platform reaper	44.44	0.8x7.75=6.2	0.8x0.03x52-1.25	5+4*=9	16.45	60.89
Thresher	33.95	1.3x7.75=10.08	1.3x0.03x52=2.03	(1 operator + 3 labourers) 17**	29.11	63.06
Trailor	46.82	1x7.75=7.75	1x0.03x52.=1.56	5	14.31	61.13

*1 Additional Labour @ Rs 32/day
**3 Additional Labours @ Rs 32/day

Table 5: Break Even Point and Pay Back Period for Power Tiller Rotavator in Different States.

	Kerala	Tamil Nadu	Karnataka	W. Bengal
Cost of operation, Rs/h	40.50	40.50	40.50	40.50
Hiring rates, rs/h	76	75	72	80
Break even point, h	317	322	340	297
Hours of operation**	900	975	875	850
Income, Rs/yr	68400	73125	63000	68000
Net benefits, Rs/yr	31950	33637	27562	33675
Pay back period, years	2.03	1.93	2.36	1.94

*Includes wages of operator @ Rs. 40/day
**Based on survey data.

capital cost. The study further suggests that since power tiller allows for greater manoeuvrability within small sized paddy fields while completing the crucial farm operations and is less capital intensive, its suitability to areas where paddy cultivation is predominant is greater than that of a tractor.

The study further suggests that since power tiller allows for greater manoeuvrability within small sized paddy fields while completing the crucial farm operations and is less capital intensive, its suitability to areas where paddy cultivation is predominant is greater than that of a tractor.

Employment Potential

The study conducted by NABARD (1985) has also revealed that though there was a displacement of human labour from preparatory tillage operations, there was an increased absorption of human labour in sowing / transplanting, harvesting and threshing in case of mechanized farms. The overall result in regard to human labour employment and mechanization was positive. Thus contrary to popular belief power tillers have neither displaced human labour on the farm nor aggravated the problems of rural employment . In fact the share of hired labour in the total cost of cultivation not only continued to be largest but also increased marginally from 26% to 28% when power tillers were used. The employment of family labour among the sample beneficiaries has also increased due mainly to increase in gross cropped area.

Though power tillers have the potential to be used in several farming situations for different crops, the present estimates for employment potential have been made for paddy based farming because here the power tillers have been found to be most suitable and custom hiring is also popular in these areas. In India the paddy crop is cultivated in about 42.60 million hectares. Out of this area small and medium farms account for about 66.5% or 28.33 million hectares. Considering a possibility of introduction of power tillers only on 30% small and medium farms and commend area of a 8-10 hp power tiller about 6 hectares, the requirement of power tillers comes to about 1.42 millions for paddy based farming only. Thereby the number of power tiller operators will also be around 1.42 millions. Considering that a single workshop with 5 mechanics will be sufficient for repair and maintenance of 100 power tillers, the total number of mechanics required to look after the work of repair and maintenance will be about 71,000. In view of the above discussions it be concluded that power tillers have very good potential for the employment of rural youth particularly those in paddy growing areas of the country. They offer a good opportunity for mechanizing marginal and small holdings.

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Energy Intensity Ratios in India

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An attempt is made here to arrive at energy intensity ratios for the Agriculture sector, Industry, Transport and the Economy as a whole for the years 1985 to 1994. The energy consumption data are gathered from the Tata Energy Research Institute (TERI) Energy Data Directory & Year book 1995-96, which provides the commercial energy balances in million tonnes of oil equivalent (mtoe). It is assumed that net availability and consumption are equal. The Gross Domestic Product (GDP) at 1980-81 prices are collected from the National Accounts Statistics (NAS), for various years of the Central Stastical Organisation (CSO).

Energy Intensity Ratios in India

Consumption of Energy in Agricultural Sector						Energy Intensity Ratios in Agriculture			
Year	GDP* Rs.crores	Coal (mtoe)	Petroleum (mtoe)	Power (mtoe)	Total (mtoe)	Coal	Petroleum	Power	Total
						(000 mtoe/Rs. crores)			
1985	49136	—	0.30	1.80	2.10	0.000	0.006	0.037	0.043
1986	49445	—	0.30	2.00	2.40	0.000	0.006	0.040	0.049
1987	48995	—	0.40	2.50	2.90	0.000	0.008	0.051	0.059
1988	49258	—	0.40	3.00	3.50	0.000	0.008	0.061	0.071
1989	57940	—	0.40	3.30	3.70	0.000	0.007	0.057	0.064
1990	58568	—	0.50	3.70	4.30	0.000	0.009	0.063	0.073
1991	60991	—	0.60	4.20	4.90	0.000	0.010	0.069	0.080
1992	59322	—	0.60	4.90	5.60	0.000	0.010	0.083	0.094
1993	62440	—	0.70	5.30	6.10	0.000	0.011	0.085	0.098
1994	64456	—	0.80	6.00	6.80	0.000	0.012	0.093	0.105

Consumption of Energy in Industry Sector						Energy Intensity Ratios in Industry			
1985	30092	32.80	7.40	5.30	45.70	1.090	0.246	0.176	1.519
1986	32817	35.80	7.60	5.60	49.20	1.091	0.232	0.171	1.499
1987	32445	38.40	7.70	5.90	52.20	1.184	0.237	0.182	1.609
1988	34818	41.30	8.00	5.80	55.40	1.186	0.230	0.167	1.591
1989	37865	42.80	8.30	6.40	57.80	1.130	0.219	0.169	1.526
1990	42285	44.30	8.80	6.80	60.50	1.048	0.208	0.161	1.431
1991	44919	46.20	9.00	7.10	62.90	1.029	0.200	0.158	1.400
1992	43470	48.60	9.40	7.40	65.90	1.118	0.216	0.170	1.516
1993	44357	50.30	9.50	7.60	68.50	1.134	0.214	0.171	1.544
1994	46421	51.90	9.70	8.00	71.00	1.118	0.209	0.172	1.529

Consumption of Energy in Transport Sector						Energy Intensity Ratios in Transport Sector *			
1985	6727	3.70	16.40	0.20	20.30	0.576	2.552	0.031	3.159
1986	7008	3.80	17.70	0.30	21.70	0.542	2.526	0.043	3.096
1987	7165	3.20	19.30	0.30	22.80	0.447	2.694	0.042	3.182
1988	7837	3.00	21.20	0.30	24.40	0.383	2.705	0.038	3.113
1989	8352	2.60	23.10	0.30	26.00	0.311	2.766	0.036	3.113
1990	9124	2.30	25.20	0.30	27.80	0.252	2.762	0.033	3.047
1991	9540	2.10	25.60	0.30	28.00	0.220	2.683	0.031	2.935
1992	10184	2.00	26.90	0.40	29.30	0.196	2.641	0.039	2.877
1993	10764	1.70	28.40	0.40	30.60	0.158	2.638	0.037	2.843
1994	11116	0.80	30.30	0.50	31.60	0.072	2.726	0.045	2.843

Consumption of Energy in the Economy						Energy Intensity Ratios in Indian Economy			
1985	144617	36.50	37.10	9.60	85.80	0.252	0.257	0.066	0.593
1986	149349	39.60	39.40	10.40	92.70	0.265	0.264	0.070	0.621
1987	163271	41.60	42.30	11.50	99.40	0.255	0.259	0.070	0.609
1988	170322	44.30	45.20	12.30	105.80	0.260	0.265	0.072	0.621
1989	188462	45.40	49.10	13.50	113.70	0.241	0.261	0.072	0.603
1990	201453	46.60	53.10	14.80	121.20	0.231	0.264	0.073	0.602
1991	211260	48.20	54.10	16.00	124.90	0.228	0.256	0.076	0.591
1992	213590	50.60	56.20	17.50	130.70	0.237	0.263	0.082	0.612
1993	222089	52.00	58.20	18.60	136.40	0.234	0.262	0.084	0.614
1994	233042	52.70	60.40	20.10	140.80	0.226	0.259	0.086	0.604

* = in 1980-81 prices
Note: million tonnes oil equivalent(mote) figures may not add up to totals due to rouding off
Consumption + Net availability and consumption are equal
Commercial energy balance Source: TERI Energy Data Directory & Year Book 1995-96.
Gross Domestic Product(GDP) Source: National Accounts Statistics, CSO, 1994, 1988.

Compiled by
Anil Kumar

American business and industry are beginning to understand that poor quality costs companies as much as 20 percent of sales revenues nationally, and that improved quality of goods and services goes hand in hand with improved productivity, lower costs and increased profitability.

— The Malcolm Baldrige National Quality Improvement Act of 1987

Air Pollution From Cupola Furnaces

Environment Division

There are over 6000 Cupolas operating in the country which together contribute to a production of 1 million tonne of ferrous and non-ferrous castings annually. The conventional cupolas still exist, being the low cost equipment in small foundaries in producing Cast Iron materials. The Cupola furnaces differ widely interms of blast used, construction, operating mechanisms etc. Coke is the dominant fuel used for melting the scrap, lime is used for removal of slag. Natural gas is used instead of coke in the Cokeless type cupola furnaces. Table 1 shows selected cupola furnaces with different capacities.

Process Details

The basic equipment for a conventional cupola is essentially a refractory-lined cylinder open at the top and equipped with air ports (known as tuyeres) at the bottom. Air is supplied from a forced-draft blower. Alternate charges of metal, coke and limestone are placed on the top of the burning coke bed to fill the cupola. The heat generated melts the metal, which is drawn off through a tap hole. The two principal dimensions of the cupola are its diameter and operating height (charge door to tuyeres). The diameter determines the melting capacity, and the height affects the thermal efficiency.

The control of air at the tuyeres influences production rates, costs, metal losses, coke ratios, stack temperature, physical properties of the metal, and volume of stack emissions. Air is required, not only to furnish oxygen for the combustion of coke, which supplies the heat required for melting the iron, but also to aid in the potential combustion of the carbon, silicon and managanese in the metal. The latter function greatly influences the resultant chemical and physical properties of the metal when it is poured into the mould.

The lower part is full of coke. The so-called coke bed is one of the most important featues of the cupola. Air from the blower is blown through the windbelt and water-cooled tuyeres in the cokebed in order to burn coke and to develop the necessary heat to reach gas and coke temperatures of 1500°C to 1600°C and to superheat and carburise the liquid metal in the coke bed. The hot gas leaving the coke bed provides the heat to melt the metallic charge and to preheat the charged materials in counterflow. The coke is combusted to a mixture of CO and CO_2. Hot metal and slag are collected in the cupola hearth. Slag and metal are separated by gravity and continuously flow out of separate siphons.

Air Pollution

The main pollutants emitted from Cupola Furnaces are:

(1) Gases/Fumes (CO, SO_2, NOx, Oil & Vapour, Hydro-Carbons)

(2) Particulate Matter

Dust in the discharge gases arises from dirt on the metal charge and from fines in the coke and limestone charge. Smoke and oil vapour arise primarily from the partial combustion of oil from greasy scrap charged to the Furnace.

Solid and Liquid Waste

Two types of solid wates are generated, first is slag and the second is Dust. Dust mostly arises as a result of action to control air pollution in the form of pollution control devices. Solid wastes occur in the form of slag left after every batch. Dust is collected in the outlet of air pollution control system. These wastes are disposed of for land fillings etc. Liquid wastes/Slurry are generated in wet type pollution control systems like Scrubber.

Factors influencing Emissions

The factors influencing emissions are:

— Non-uniform charge and Blast distribution

— Improper combustion

— Non-uniform sizes of scrap/limestone

— Oily/dusty scrap

— Excess air

Table 1. Types of Cupola Furnaces

Sl. No.	Type	Description	Design Details	Flue Gas Data
1	Hot Blast Cupola	Hot air at 500-600°C blown through the wind belt and water cooled tuyeres in the coke bed.	Capacity:70T/Hr, Shell Dia:3.8M, Inner Dia:3.2M, Total Height:15M	CO:0.02% SO_2:300mg/N_m^3 Nox:200mg/NM^3 (After control system)
2	Cokeless Cupola	Energy source is Natural Gas (or heating fuel) instead of Coke	Capacity:5 T/Hr, Shell Dia:1.3M, Inner Dia:0.8M	CO,SO_2,NOx, traces far below the standards
3	Divided Blast Cupola	Air is divided into two compartments for burning CO to CO_2	Capacity:4T/Hr, Shell Dia:1.4M, Inner Dia:1.06M, Height:15M	CO_2:6 - 8% CO :0.3-0.9% O_2 :12 - 14%
4	Standard Grey Iron Melting Cupola	Air is supplied by positive - type Blower at atmospheric pressure	Capacity:5T/Hr, Shell Dia:1.7M, Inner Dia:1.2M, Height:17M	CO_2:4 - 6% CO: 1 - 2% O_2 : 10 - 12%

Pollution Control

For employing any type of the gas-cleaning or pollutant removing device, the first essential need shall be to collect and transmit the emissions through a proper formal duct. Such collection and conveyance of the emitted gases through the duct and the pollution-control device should not result in any back-pressure in the furnace or otherwise adversely affect the feed-charging sstem or the flow of gases through the furnace. The end of the pipe gas-cleaning alternatives available can be classified as follows:

1. Wet-Scrubber systems: Venturi-Scrubbers, Cyclone-Scrubbers, Counter Scrubbing Towers etc.
2. Dry Dust-Cleaning Devices: Cyclones, Multi-Clones and Bag Filters Systems etc.

Cupola Furnace Characteristics:

The Conventional type Cupola furnaces use limestone as flux for removing slag. The emission characteristics carry considerably over different parts of the Batch. Emission of particulates depends on a number of factors includes particles of lime, soot, coke-dust ash, rust etc. besides metal fumes, the concentration and proportion of each being different in a batch. The range of cycles arranged emissions in the Cupola furnaces is given in Table 2

Table 2: Range of Cupola Emission characteristics:

Stack Temperature	: 200 — 600°C
Dust Concentration	: 400 — 2500 mg/N_m^3
SO_2 Concentration	: 30 — 45 ppm
NO_x Concentration	: 60 — 100 ppm
CO Concentration	: 1 — 2%

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Book Review

Work Motivation Models For Developing Countries: Edited By Rabindra Kanungo and Manuel Mendonca. Sage Publication India, New Delhi - 110 048, 1994, 288 pp, Rs. 275/- (cloth), Rs. 150/- (paper).

Productivity at work is an issue confronting organisations all over the world. Improving the quality of worklife and increasing productivity through motivation is the need of the hour. More so in view of the problem of low productivity on the part of India and other developing countries in the face of growing globalisation and international competition. The potentials of work motivation techniques have however, not been fully realised in these countries even though the know-how and techniques developed in the West have been transferred to them.

This collection of original essays on the subject of motivation is unique in that it brings together several renowned academicians researchers and practioners who have worked on one common theme of critical importance in both the West and Third World Countries, including India. The chapters in this volume include literature reviews, conceptual models, case studies, empirical work, compensation/reward management and participative management that seek to explain which human resource management practices would or would not be effective in motivating employees to high performance levels in organisations in the developing and cross-cultural societies. The contributors and editors are fully competent to deal with the subject of middle management motivation and management education having been on the management faculty of McGill University of Montreal (Canada), University of Regena, Saskatchewan and Calcutta, A.N. Sinha Institute of Social Studies, India, some of them also have work experience in industries and development projects and consultancy work in developing countries. Their efforts serve to:

- Question the relevance of work motivation models and practices developed in the West in a different cultural context for orgnaisations in developing countries;
- Identify the characteristics of the socio-cultural environment and of the internal work cultures in developing countries;
- Propose modifications in the conceptual models and related motivational practices that are consistent with the cultural features of developing countries and provide a firm basis for managerial action that are both practical and effective.

This interesting volume combines a strong practical bias with a conceptual thrust. It is a sort of "Motivation Bible" for management teachers and students, trainers, managers, academicians and researchers, policy makers and implementors and all those who are interested in organisational behaviour, organisational development, international business and cross-cultural management.

MAYA refers to a mere illusion, lack of substance. MOKSHA refers to a grasp of real road to enlightenment. In a poetic vein the book concludes OD can only be MAYA as long as we insist that it is a universal model. On the other hand, OD can lead to MOKSHA if we are able to develop indigenous rationale, strategies and techniques suited to the specific socio-economic cultural environment.

The contributions in the book are primarily based on studies on practices in India. Inclusion of more studies in prevailing situations in other developing countries would have enhanced the value of the book and been in conformity with the title.

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Cases on Labour Law: Minimum Conditions of Employment (Ed.) Debi S. Saini. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 1995, 386 pp, Rs. 495/-

Compelled by the obligation to maintain social order in a given society, it becomes almost inevitable that the State intervenes directly or indirectly in controlling industrial relations between the employers and employees. The instruments and modalities used by the State vary widely in their extent and coverage. The role of the State stems from the fact that it has the dual concern and responsibility to safeguard the interests of employers and employees while at the same time ensuring that the society at large has access to the products and services of industry and business at reasonable price and quality.

The extent of the State's involvement in the process of regulating the relationship among the employers and employees and the society as a whole appears to vary depending on the level of socio-economic development, and the nature of such intervention seems to depend on the kind of political system prevalent in the country.

Historically, State intervention in industrial relations in India had assumed a more direct form to protect the commercial interests of the British. Later with the specific objective of achieving a socialistic pattern of development, independent India followed a pattern of direct state intervention in controlling employer-employee relations. Moreover, the focus of the 'Welfare State' also reinforced the need of direct state intervention. All this resulted in a labour policy largely guided by a plethora of labour laws.

The book under review is a compilation of abridged versions of some of the important judgements delivered by the Indian judiciary while interpreting some of the important central labour laws. While the labour laws cover a wide range of work related areas the case book compiled by Dr. Saini has chosen to confine itself to laws relating to working conditions in factories, mines, docks, bidi workers, newspapers and other establishments. Labour in these contexts also became subject to various malpractices associated with contract labour, interstate migrant labour, bonded labour and child labour.

The case book contains an interesting collection of judgements covering important legislations including The Factories Act, 1948, The Mines Act, 1952, The Dock Workers' (Regulation of Employment) Act, 1948, The Bidi and Cigar Workers' (Regulation of Employment) Act, 1966, The Working Journalists and Other Newspapers (Conditions of Service and Miscellaneous Provisions) Act, 1955, The Motor Transport Workers Act, 1961, The Child Labour (Prohibition and Regulation) Act, 1970, The Inter-State Migrant Workmen (Regulation of Employment and Conditions of Service) Act, 1976, and The Bonded Labour System (Abolition) Act, 1976.

The judgements compiled in the volume cover the various facets of these acts and thus throw light on their interpretations in different contexts. It is also interesting to note that the case book contains judgments relating to a long span of more than thirty years including judgments dating back to 1961 to as recent as those delivered in 1993. While appreciating the tremendous effort employed by the author in choosing, compiling and systematically presenting such variety of judgments, it would have been a worthwhile value addition if he had also attempted to provide some comments on the shift, if any, in the pattern of judgements delivered over such a long period of time, particularly in the post-liberalised context.

There is no doubt that the book should be of immense value to employers, union leaders, policy makers, teachers and practitioners of law and management.

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Indian Public Administration — Institutions and Issues: by Ramesh K. Arora & Rajni Goyal, Wishwa Prakashan, New Delhi-110 002, 1995, 611 pp, Rs. 135/-

The Indian Constitution, enforced on 26 November, 1950, provides a framework of ideals and values for the Indian Public Administration. It evolved from the rich experience of many centuries from the Arthashastra of Kautilya through the Moghal "Ain-i-Akbari" to the legacy of the British rule in India dating back to 31 December, 1600. The Vedic influence as seen through the state administration in the days of the Ramayana and the Mahabharata — the predominant sense of fair play in "Ram Rajya" — is also inherent in the Indian Constitution. The authors, however, prefer to discuss the evolutionary perspective only from Kautilya's Administrative State. The framers of the constitution anticipated numerous tension-areas in the democratic administration of a vast country like India characterized by heterogeneity of ideals, goals, structures, and roles in a continuously changing and demanding environment. These led to as many as 86 amendments to the Constitution in just 45 years to meet the aspirations of the people for an interactive public administration. And yet the administration has not lived upto the expectations of the masses!

The present volume has successfully brought out this evolutionary perspective leading to the actual working of

the Constitution, various problems faced and the resultant administrative reforms. The responsibility of enforcing the Constitution rests with the Government, hence the Public Administrative System, through the executive branch of the government, has to facilitate the application of the ideals of liberty, equality, justice, socialism, and secularism in the governance of India. These aspects have been clearly brought out in this volume.

The book consists of nine interactive parts arranged in sequence very well. The authors have traced the evolutionary perspectives, leading to the constitutional setting of parliamentary democracy. Part three explains the constitutional roles and responsibilities of the top Union Executives — the President, the Prime Minister, the Council of Ministers and the Cabinet Secretariat. It also deals with the Ministries and various Departments. The authors have explained the State Administration in a similar manner, the office of the Governor, the Chief Minister and the State Council of Ministers alongwith the functioning of the State Secretariat. The volume gives details of Area Administration — from the District Collector down to the village level "Panchayati Raj" in good detail. The Indian Administrative Services, from recruitment to training, is next dealt with. The book elaborates on "Developmental Administration" from the Central Planning Commission and administration of the Public Sector to State and District planning including Rural Development Programmes. Part eight deals with the Accountability System — the roles of parliamentary control over public expenditure including the Comptroller and Auditor General of India. In part nine, current conflicts of Generalists and Specialists are discussed alongwith administrative reforms. It has been amply highlighted that despite pressures in 1992, the Satish Chandra Committee did not favour exclusion of Doctors & Engineers, the cream of our brilliant young men and women from competing for higher civil services as they have been performing with distinction, in many cases. Even the very early Second Pay Commission had observed that when the work content of a department is mainly technical, it is desirable that its Secretary should be a technocrat. The authors have also rightly pointed out that the massive corruption in the public administration is astounding and immediate remedial actions are needed.

Prof. Ramesh K. Arora and Dr. Rajni Goyal, both in teaching profession with long years of rich experience, have designed this volume to serve as a standard text-cum-reference book for the students of Indian Universities and for serious candidates appearing in natlional and state level competitive examinations. They have explained the salient features in simple language and lucid style such that the students will feel at ease with the topics. The authors have also quoted comparisons with other countries and expert opinions, wherever possible, with their comments. This has made the volume more interesting for the students, particularly for the civil services examinations. The book will surely be a good reference even for general students and the public alike.

It is, however, observed that the authors have not dealt with the very critical topics of the election process, which became nightmares with rigging and violence, in the biggest democracy of the World. Another glaring lacuna is the total exclusion of the judiciary in India. The judiciary, in recent times, has become all important and the last hope for the people of India, often even against the public administration! The offices of the Chief Justice and the Chief Election Commissioner (CEC) are top Constitutional Authorities and these widely affect day to day public administration. Hence their roles, responsibilities and functioning should have been an integral part of the book. These glaring omissions should be made good in the next edition. The "Contents" page of the book is also rather sketchy — to be of utility, these should be expanded to give more details of the topics covered in the book for easy reference.

Finally, the authors have expressed their anxieties rightly in that the public administration has to inculcate right values, new knowledge for effective management and right attitudes to meet the emerging socio-economic and cultural change for the 21st century.

The civil servants can imbibe these only when a supportive culture promotes and nurtures the values. The Indian leadership is on test now at this critical juncture of life of the Nation and the future will be for us to see if the public administration can become people-friendly and ensure peace and prosperity.

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The Working of Stock Exchange In India: BY Dr. H.R. Machiraju, Wiley Eastern Ltd., New Delhi, 1995, 227 pp, Rs. 350

The working of the stock exchanges in the capital market in India has under gone a sea-change affecting the transfer of savings from the household sector to companies, government public sector bodies etc. The activities of the secondary market has adversely affected the spectacular growth of the primary market. The stock

market has become highly sensitive after the firm steps taken by its Chairman Mr. D.R. Mehta to safeguard the interest of the investors. Many workers have contributed on these related aspects. The present work of Professor Machiraju under review has a unique feature with reference to the comparative analysis of the provisions for monitoring the operations of stock exchanges in India vis-a-vis USA.

The entire work has been systematically presented in twelve chapters in a sequence to understand the subject comfortably. Each chapter is followed by references and supported with appendix wherever needed. The first chapter, introduces the subject of stock exchange in India by highlighting its growth, and activities of BSE. Chapter II presents the views of Patel Committee (1984) and Pherwani Committee (1991) on the functions of Stock Exchanges in India. This is followed by the details of regulations, relating to SE and brokers under Securities Contract Regulation Act of 1956, and rules of 1957, Govt. of India's SEBI Rules and regulations of 1992 for Brokers and sub-brokers. The book also covers the listing requirements of OTCI and SEBI's powers. The author highlights the mechanism of trading and its related issues, besides clearing and settlement in stock exchanges. The interesting features are the critical analysis of Badla System, the information about the regulations of U.S. Securities and Exchange Act and Regulations of New York Stock Exchange besides the explanation of a typical Settlement Programme. The functioning of OTC has been covered next alongwith National Stock Market system. Here also, the author has covered the relevant aspects of Pherwani Study Group (1991) and its evaluation besides briefly stating the National Market System of U.K. and U.S.A.

Another outstanding and useful feature of this book is an exclusive chapter (VIII) on selected stock exchanges abroad. Professor Machiraju deserves appreciation for exploiting his vast experience and knowledge in sharing useful information about Amsterdam Stock Exchange (Netherland), U.K.'s stock exchange known as the International Stock Exchange in London and stock exchange alternative trading system, the London International Financial Futures and Options Exchanges, New York Stock Exchange of USA (NYSE) American Stock Exchange (AMEX) of USA, Tokyo Stock Exchange, Japan. Besides, the author has also given an account of emerging markets in Asia covering Honk Kong Stock Exchange, Taipei Stock Exchange, Korea Stock Exchange and Stock Exchange of Singapore. This information is bound to be useful and act as a guide to those who desire to tap the international market as a source of funds.

The problem of Insider Trading has been discussed along with an Indian case study. While mentioning the provisions of prosecution of insiders in USA, the author explains the inadequacy of provisions in India with regard to monitoring the holdings of insiders (P. 115). Chapter X presents the various indicators of market performance highlighting price movements, Indexes, weighted series, S & P 500 series, BSE sensex etc.

The technique of Financial Engineering is applied by using Derivatives to reduce the financial risk. The author, knowing this fact, has added to the utility of the book by elaborating in detail the various Derivatives — options, put and call option, straddle, strip, spread, strap, futures etc. He also presents the option trading in UK, USA and India with reference to its viability. The author feels that trading in derivatives would provide hedging against risk and promote a healthy capital market. The last Chapter analyses the regulations of the stock market, particularly with reference to self regulation by SE and supervision by SEBI. The analysis emphasises that more efficient, transparent and responsive steps are required. Many countries like Japan, UK and USA have prohibited forward trading (Badla System) but option and future tradings are allowed. The chapter also comments on securitisation of PSU equity, development of debenture market, asset backed debenture etc.

Although Prof. Machiraju has covered international Stock Exchanges and their operations alongwith Indian stock exchanges at appropriate places in the book, a little more effort could have been taken to summarise the salient features in a chart form with comments on those characteristics with can be applied in Indian situation, to facilitate the readers. A short description and analysis of or few glaring cases like SCAM, M.S. Shoe and others could have been incorporated highlighting the feeble areas of the control mechanism and possible recommendations as an annexure. These would have been certainly additional feathers in the cap. However, this does not dilute the importance of the useful and excellent contribution made by the author. This book will be extremely useful to those who are interested in finance particularly in Indian capital market, International capital market and operations of stock exchanges. The volume is a good ready reference for merchants bankers, managers and registrar of issues, Company Secretaries and finance executives, students and teachers teaching the subject in professional courses like CFA, CA, CS, MBA (finance).

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The Theory of International Values by Rajas Parchure, Wiley Eastern Ltd., New Age International Ltd., New Delhi, 1994, 246 pp, Rs. 300/-

Rajas Parchure in his book 'Theory of International Value' tries to integrate the pure theory of trade with monetary and other real institutional aspects of the economy. Rajas deviates from the classical model of two countries, two commodities and two currencies (2×2×2) and tries to build up a multi-product, multi-country and multi-currency model. He introduces tariffs, transfers and customs in the model to approximate reality. Using matrix algebra, to prove the hypothesised view, he makes a multi-equation model. His work is mainly based on Graham's theory of international value and Sraffa's work on production of commodities by commodities. He uses the Leontief system to analyse the trade pattern and exchange rate determination in the world economy.

In the first chapter the author builds up 2×2×2 balance of payment multi-equation system for the determination of exchange rate and shows the under-determination of the system of equations. To determine the system, he makes the assumption that the balance of payment equation of the model not only balances in terms of domestic currency but also in terms of one other currency as well. Thus, tacitly, he introduces the assumption of bilateral foreign exchange market and money market equilibrium in the system.

The author next discusses the gains from trade and develops commodity arbitrage condition and analyses the emerging pattern of trade as the number of countries increase. This chapter analyses which countries import which commodities and from whom. Parchure shows that the two decisions are interdependent.

The author asserts that it is the relative price structure of the countries which determine the comparative advantage/disadvantage leading to a particular import, production and export structure. He further asserts that inter-country trade pattern is not independent of the internal structure of economic systems, the factor endowments and the techniques of production of the countries, because these factors ultimately result in a particular level of relative prices.

The author introduces Leontief-Sraffa System and using the Engel's demand equation, brings about demand and supply equilibrium. He asserts that equilibrium is achieved only when there are right price signals from both the supply and demand side. He does not explain what are the right price signals and how these are going to come about. He then subjects the model to changes in propernsities and terms these as random disturbances, although these are not random in nature at the aggregate level.

Then the author starts analysing the pattern of trade with the help of the 2×2×2 system. Subsequently he increases the number of commodities and countries and discusses the emerging scenario in the framework of Walrasian system and develops the algorithm to determine the trade pattern. In the course of developing algorithm, the author tries to establish Graham's ideas. He criticises the Absolute Purchasing Power Parity (PPP) and says that if it holds, there will not be any gains from trade and so no trade. He rightly says that PPP assumes that money is not demanded for its own sake but for the goods it can buy. This is not true of one currency but for all the currencies, therefore he asserts that it hardly follows from this that the exchange rate must be determined exclusively by the quantities of goods that various moneys can buy. He argues that it amounts to calling the consequence the cause. He further says that in PPP what is blatantly neglected is the total expenditure on goods by all the countries. He asserts that it is the total expenditure that determines the inter country demand and supplies of various currencies. One is unable to understand why such an inference should not be there, because he is considering multi-country and multi-commodity model whereas the PPP determines bilateral exchange rates, so in this case the expenditure of the country against whose currency the exchange rate is being determined is reflected in the price levels. The price levels reflect the demand and supply conditions in an economy.

He criticises the BOP theory of classical economists for the determination of exchange rate, who excluded capital from the theories of international values as contrast to their domestic theories of values in which the capital occupied the central position and contends that the basic reason for such a difference was the simplicity required for the treatment. Though simplicity of treatment may be one of the reasons for making an assumption, the usual reason for making any assumption is to bring out the objective features of the problem in the model and find out the policy variables with the help of which the objective of making the model is achieved.

In the end of the chapter Parchure criticises Heckascher Ohlin theorem and asserts that the proposition is based on choice of technique whereas now a days that technique is chosen which maximises profit without considering the factor endowment.

Next, Parchure relaxes the assumption of international immobility of labour and considers the effects of the international economic policy such as tariffs and quotas

and the economics of fixed exchange rate system. He tries to show that there is no need to divide the international economics into micro and macro economics.

He shows that the growth in one country has the effect of deteriorating her terms of trade with smaller countries with decreasing degree of her dependence on smaller countries. However, the share of the growing country in the world exports tends to increase over time as they tend to produce more and more commodities. He further proves that the growing countries have positive propensities to import.

In his model, labour is the only factor input, therefore the technical progress is considered as labour-reducing per unit of output. This, he says, would effect a pattern of inter-country comparative advantage and that the labour would be released from the sector enjoying technical progress. The released labour can be used in other sectors of the economy. If technical progress takes place in the exporting sector, it increases the overall advantage in trade, which leads to the deterioration of the terms of trade but the levels of consumption in the economy increases. On the other hand, if technical progress takes place in the import-substituting industry, after some time the terms of trade tend to improve but no country's welfare reduces. The author does not define the welfare he is talking about. He also discusses the effects of trade on the migration of labour. The chapter then deals with policy issues such as transport and distribution costs, tariffs, retaliatory tariffs, custom-unions, inter-country transfers, effect of fixed exchange rate and budgetary policies. This chapter deserves a thorough reading.

Next the author builds a Walrasian General Equilibrium model of Leontief-Sraffa type. He starts with two commodity and no saving model and thereafter introduces savings and growth in the model. He discusses the difficulties involved in generalising the model to more than two commodities situation. He discusses the procedure to find out equilibrium and in the next sections he discusses how in the face of disequilibrium the adjustment takes place.

The eighth chapter deals with the complications that arise when international trade in capital goods is introduced in the model. He starts with one consumption good and one capital good and goes on increasing consumption and capital goods in the model. From autarky, he introduces trade and develops a general algorithm to solve the system.

Next, Parchure generalises the model developed in the last chapter. He introduces transfers, tariffs and discusses the political economy of tariffs. In the last section rough idea of how the forward exchange rate is determined in the frame work of the model is discussed.

In the last chapter the author tries to link the theory developed in the work with the process of reforms. The author rightly remarks that the international economic relations are only surface manifestations of international allocation of economic activities. He further says that the policy measure to reform international economic relations alone, without reforming the inter-country pattern of productive activities, will not be able to achieve durable international economic stability. It is very much necessary to address to the question of international division of labour and capital. The principal aim of international economic policy is maintaining full employment conditions, ensuring rising standards of living and utilising the full potential of world resources. The fulfillment of these aims is of global concern. To attain these aims, global institutions have now become active and even domestic institutions have started looking globally. Parchure remarks that the classical theory dominates the thought on international matters. Until its strength and weaknesses are not exposed, the new ideas will not receive appraisal. It is not clear, whether the international community is concerned with the fulfillment of objectives of international economic policy or the abandoning the classical economic thought. Whatever theory can fulfill the objectives of the international economic policy should be welcomed. The new ideas will be accepted in their own right. Keynesian revolution was accepted when classical thought could not solve the economic problems facing nations.

Parchure shows the weaknesses of classical economic thought to attain the objectives of the international economic policy. He rightly points out that classical theorists believe that national welfare is national concern and that national govenrments have all necessary equipment to promote welfare and ensure domestic stability and that multi-country cooperation is necessary only in matters of genuine multi-country concern. Parchure objects and says that classical theorists give residual importance to trade relations. He asserts that quantitatively, trade relations may appear to be a small part of nation's economic activity, however, it is usually a vital part and cites examples of Japan without oil imports etc. He says that due to this vital parts (imports), the world is rigidly linked. Therefore the world is to be looked as one entity. In the same spirit, he criticises the classical division of economic thought in pure and monetary components and brings out the inconsistencies in the two components and refers to the assumption of immobility of labour and capital as the greatest faults.

In the last part of the chapter he discusses what lies beyond classical solutions. He also discusses current problems of surpulses and deficits in balance of payment in Keynesian perspective and suggests short term strategies. In the last section he discusses the new perspective needed to achieve world economic welfare. The chapter is thoughtfully written.

For scholars in international economics, particularly in the field of international trade exchange rate and world economic order, the book will be valuable reading.

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Towards Employment Guarantee in India: Indian and International Experiences in Public Works Programmes: by Indira Hirway and Piet Terhal, Sage Publications, New Delhi, 1994, 283 pp, Rs. 285.

In this volume, seven case studies on Rural Public Works Programmes (RPWPS) are assessed by the authors. One each from China, East Pakistan and Netherlands and four from India (Maharashtra, West Bengal, Karnataka and Gujarat) form the core of the work of the authors upon which they have drawn an insight on the Public Works Programmes for the poor and perpetuated policy implications for India. The book is divided into three parts. Following the framework of rural publc works, economic development and employment guarantee schemes are thoroughly discussed in the first chapter. Three chapters (2 to 4) on studies outside India comprise part I, followed by four chapters (5 to 8) on case studies from India in Part II and a primary case study on RPWPs from Gujarat in six chapters (9 to 14) constitutes Part III. It is evident from the distribution that the main focus of the book is on India.

The framework chapter discusses the origin of RPWPs as a 'relief work' to victims of disasters such as droughts and floods which have threatened the survival of the poor since time immemorial and presents the various roles attributed to them: minimum income, food security to the most needy, generation of employment even during normal periods and developmental rural works in recent times. Besides its contribution to the promotion of the general level of development of the economy by creating capital assets and protection of the environment, the authors have presented RPWPs as a regular instrument of poverty alleviation in an economy where the lack of remunerative employment is the single most important reason for poverty.

Part I of the book traces RPWPs in the economically advanced Netherland, the poor semi-feudal economy of former East Pakistan (now Bangladesh), and China. The Dutch Public Works experience in the 1930s is briefly presented, it is based on the study by M. Oosterbean (1988). The authors clearly indicate the possibility of public authorities intervention in the labour market in times of chronic unemployment through technically experienced autonomous orgnaizations like the Dutch Waste Land Development Corporation (DWLDC).

The experience in former East Pakistan drawn on the constrasting studies of Thomas (1968) and Sobhan (1968) provides an account of how RPWPs initiated as Flood Relief and channelled through local governments contributes to useful infrastructural investment (roads, drainage, flood embarkment and community buildings). It also portrays the role of local participation in the planning and implementation of rural development works and the vulnerability of such programmes to political interests and manipulations.

The Chinese experience in mobilizing surplus labour for rural capital construction provides invaluable lessons on the technical feasibility of self-reliance RPWPs, the motivation of people to use their labour power and the pivotal importance of institutional changes as the key to development. Besides the brief description of the 'human cost' involved, the authors have also presented the relevance of Chinese experience to India taking into account some of their common features. This analysis would have been more revealing, if it has been supported by cross-sectional data from the two countries.

The second part of the book (Chapters 5-8) traces National Rural Employment Programme (NREP) and Rural Landless Employment Guarantee Scheme (RLEGS) at all India levels and presents case studies from Maharashtra, Karnataka and West Bengal using secondary sources. The Maharashtra Employment Guarantee Scheme (MEGS) which has dual objectives of employment guarantee to the rural landless adult and improvement of rural infrastructure has been extensively discussed. A comprehensive account has been given to its planning, organisation, implementation and consequential impacts that could be learnt from such a type of RPWPs which requires political commitment, more than anything. A brief account of the Karnatka Land Army Corporation (KLAC) which is somewhat different from contracts presented in the book provides a good methodology to link wages with productivity. However,

this part suffers from lack of exhaustive discussions and absence of dependable research studies. Despite the several weaknesses noted from the NREP in West Bengal, the authors have indicated the important roles that could be played by the socio political and economic structures of the society in determining the level of success of Public Works Programme.

From their primary studies which comprises the third and major part of the book, the authors have vividly brought up the failure of NREP/RLEGP in Gujarat in taking up labour intensive works such as afforestation and land development which would create more and lasting employment for the unemployed.

The last chapter from which the book derives its title presents a comparative assessment of the seven case studies discussed with some of the important lessons and proposes an all India Employment Guarantee Scheme. Based on the programme's contribution towards poverty alleviation, development and protection of the environment, the Chinese case has been rated at the top followed by the Netherlands case and Maharashtra, East Pakistan and West Bengal, respectively, in that order. Karnataka and Gujarat cases have been rated at the bottom owing to their poor performance. However, this rating is subjective and might be quite inconclusive given the different socio-economic and political settings under which they were formulated and implemented.

Provided that there is political commitment of the leaders, radical reform in administrative capabilities and cost effectiveness, an All-India Employment Guarantee Scheme may be the right path. However, given the prevailing variations in all aspects among the states in the country, its realization may take a distant future.

Overall, the book provides useful references and framework for studies on RPWPs and is a welcome addition to literature in the field of rural development.

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Directory of ISO-9000 Certified Companies: TQM Centre, The Associated Chambers of Commerce & Industry of India, New Delhi, 1995, Rs. 400/-.

Indian industry's quest to achieve the goals of quality through Total Quality Management, presupposses that a quality system be implemented in the organisation. Towards achieving these goals. ISO-9000 is playing an important and significant role in harmonising quality standards at international level. These standards have been adopted by nearly seventy countries as their national standards.

Indian corporate sector has taken up the implementation of ISO-9000 quality standards in real earnest and on top priority and it has responded quite well within a short span. This may be evident from the fact that the number of ISO-9000 certified companies has crossed four digit figure by September, 95.

The TQM Centre of the Associated Chamber of Commerce and Industry has taken the initiative in bringing out the first ever Directory of ISO-9000 certified companies in the country. The directory provides the list of ISO-9000 certification agencies in the country alongwith their complete address. It contains, the list of 1031 companies in alphabatical order, who got the certification from the competent bodies in the country. Listing of entry includes complete name and the address of the unit; quality standard, scope of the supply, certification body and date of certification.

The process of adopting ISO-9000 standards was initiated by the industry in 1988. By the end of September 95 more than 1000 units obtained ISO-9000 registration. This indicates the overwhelming response of Indian industry to become competitive in domestic as well as international markets. The companies have obtained ISO-9000 certification among various industrial sectors are: Engineering 31.5%, Electronics 15.5%, Electrical 11.8%, Chemical 11.5%, Textiles 9.9%, Auto components 5.2%, Service 2.4%, Software 2.2%, Cement 2.1% and others 7.9%.

Indian industry has adopted mainly ISO-9001 and ISO-9002 standards and no unit has so far got registration in ISO-9003. 33% of units have obtained ISO-9001 and the remaining 67% opted for ISO-9002.

This Directory is likely to bridge the long felt information gap by the practising professionals and concerned people in TQM and ISO-9000. With hard bound cover, and excellent printing, its over-all get up is soothening to the eyes of the reader. This volume is a must for Professionals, Materials and Marketing Managers and Consultants engaged in the field of TQM and ISO-9000 Certification process.

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What should a school of business teach? The answer is, I believe, that a school of business ought to teach profound knowledge. A school of business has the obligation to prepare students for the future, not for the past. As constituted, most schools of business teach students how business is conducted, and how to perpetuate the present system of management — exactly what we don't need. Most of the time that students spend in a school of business today is to learn skills, not knowledge.

—W. Edwards Deming
"Foundation for Management of Quality"
in the Western World"
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